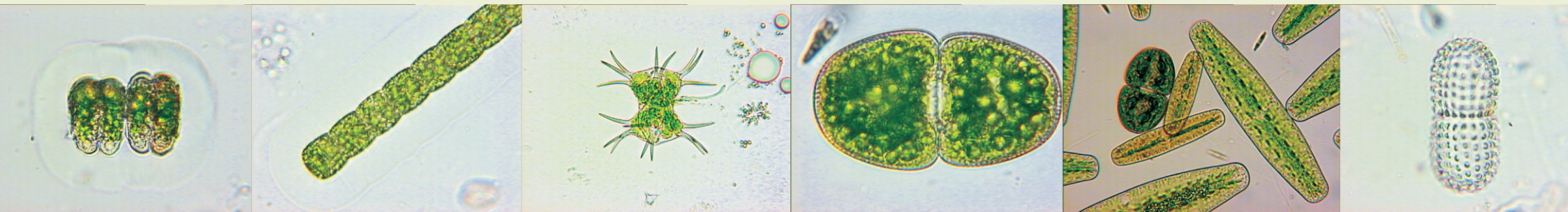


DESMIDS OF SOUTHERN AFRICA. AN ANNOTATED AND ILLUSTRATED LIST

Anatoliy LEVANETS
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This book dedicated to the memory of the Professor Nadiya Massjuk – teacher, guide, tutor, scientist, fighter, person, example. You live and will live in us.

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INTRODUCTION

Desmids are very interesting, numerous and morphologically unique group of algae which attracted attention of phycologists for the long time. Here we want to cite only main books and monographs which dedicated to desmids studies on different territories as well as some comments.

Europe (Hassal 1845; Ralfs 1848; Delponte 1873; Cooke 1887; Nordstedt 1896, 1908; Comère 1901; West, West 1904, 1905, 1908, 1912; Migula 1911; West and al. 1923; Krieger 1933, 1937; Růžička 1977, 1981; Lind, Brook 1980; Brook 1981; Förster 1982; Lenzenweger 1996, 1997, 1999, 2003; Kouwets 1999; Brook, Williamson 1991, 2010; Compère 2001; Vrhovšek and al. 2006; Coesel, Meesters 2007; John, Williamson 2009 etc.).

Countries of former USSR (Kossinskaja 1952, 1960; Shtina and al. 1981; Palamar-Mordvintseva 1982, 1984, 1986, 2003, 2005; Topachevskiy, Massjuk 1984; Algae. Reference book 1989; Diversity of algae of Ukraine 2000 etc.). Unfortunately all identification books/guides, floras, check-lists and most important articles on desmids of this part of the world published in local languages (Russian, Ukrainian etc.) and not accessible for international scientific community. This is a big problem which leaves colleagues from countries of former USSR (except of scientists from Estonia, Latvia and Lithuania) out of desmidiology boat in general.

North America (Wolle 1884, 1987a,b; Stokes 1893; Prescott 1970; Prescott and al. 1975, 1977, 1981, 1982; Greeson 1982; Dillard 1990, 1991a,b, 1993; Wehr, Sheath 2003; Johansen and al. 2007; Fučíková and al. 2008 etc.).

South America (Bicudo, Bicudo 1970; Bicudo, Azevedo 1977; Bicudo, Sormus 1982; Bicudo, Samanez 1984; Thérézien 1989, 1991; Bicudo, de Casrto 1994; Tell and al. 1994; Biodiversidade... 2001; Géneros... 2006; Donato 2010 etc.).

Asia (Turner 1892; Hirano 1956, 1957, 1959a,b; Vyverman 1991; Biodiversity... 2000; Dogadina and al. 2007; Wang and al. 2008 etc.).

Australia and New Zealand (Ling, Taylor 1986; Croasdale, Flint 1981, 1988; Croasdale and al. 1994 etc.).

Africa (Bourrelly, Couté 1991 etc., see also bibliography in Levanets, van Rensburg 2010).

Only a few works dedicated/have information about desmids living in the soils of different regions mostly European: Aleksahina, Shtina 1984; Ettl, Gärtner 1995; Shtina 1997; Kostikov and al. 2001; Vrhovšek and al. 2006).

This book is the first step in generalization of all existing knowledge on diversity of Southern African desmids (published from 1855 until 2009). This work include also all annotations about morphology, taxonomy, ecology, distribution as well as all known imaged of desmids recorded in Southern Africa (on additional DVD to the book).

Our general original data about distribution of desmids also included in following annotated list. Because of big number of discovered taxa which are new for science and which must be described according to the International Code of Botanical Nomenclature, we decided to publish those descriptions separately.

GENERAL DATA

REPUBLIC OF SOUTH AFRICA situated at the extreme southern part of Africa. Its shores are washed by two oceans - the Indian and Atlantic. Area is about 1.2 million km². The prevailing type of relief of inland territory - the flat plateau heights 1000-2000 m a.s.l (in the western and south-western parts of the country Little, Great and Upper Karroo, in the eastern - High-, Low-, Grass- and Bushveld). Along the Indian and Atlantic oceans stretching band of the coastal plains. Inland plateau and coastal plains are separated by Great Escarpment, which is a steep edge of the inland areas. In the south-east and east, it forms a high scenic Drakensberg Mountains, where situated the highest point of country-Mount Cathkin Peak (3,660 m). In the south-west of the country are Cape Mountains with an average height of approx. 1700 m. The extreme north-west part of South Africa occupied by the Namib Desert, while on the north is the plains of Kalahari Desert. Territory of South Africa lies in the subtropical and tropical climate zones. Average annual temperature never drops below +12-15°C. Only in areas of the highest mountains are freezing, but snow never lies more than a few days. On the inland plains average temperatures vary from +7-10° C in July to +18-27°C in January. On the subtropical coast during the summer months the temperature is approx. +21°C, at winter time about +13°C.

The eastern and south-eastern coastal areas receive up to 1000 mm of rainfalls per year, but slopes of Great Escarpment even up to 2000 mm: it is the wettest areas of South Africa, where there is a hot, humid tropical climate. Precipitation decreases from the east to the west: in the centre of the country rainfalls are 250-500 mm, on the west coast - only 30-50 mm per year. About 70% of South African area suffers from a lack of moisture, and approximately 50% suffer from frequent droughts.

Most of the permanent rivers belong to the Indian Ocean basin, biggest of them is Limpopo River. The largest river in the country - Orange River (approx. 2000 km long) - belongs to the Atlantic Ocean basin. Its major tributaries - Vaal, Caledon, Brak etc.

The flora of South Africa is so special and unique, that the southern part of the country separated as a special Cape Floral Kingdom - one of six on Earth. The country's territory is covered mostly by veld: from relatively moist broadleaf with palm trees and baobabs (the east) to the deserted (to the north and west) (for more detailed description of the veld see fundamental work Acocks 1988; for description of vegetation in general - Low, Rebelo 1996). Fauna of the country has suffered since the beginning of European colonization. In most safety fauna found in national parks (for more detailed description see Atlas of National Parks and Reserves of South Africa 2006).

Drakensberg Mountains (Africa's highest mountain range south of Kilimanjaro) extend from the north of Hoedspruit in RSA Northern Province 1,000 kilometers south to the mountain Kingdom of Lesotho, where a series of spectacular peaks, some 240 kilometers long, creates the western border of KwaZulu-Natal. On this border they are known as uKhahlamba (or "barrier of spears") to the Zulus. Later they were renamed "Dragon Mountains" by the Trekkers seeking to cross them. A massive basaltic cap set on a broad base of sedimentary rocks belonging to the Stormberg series of 150 million years age. The highest peak is Thabana Ntlenyana (3,482 meters). Drakensberg Mountains are home for the world's second-highest waterfall, the Tugela Falls, with a total drop

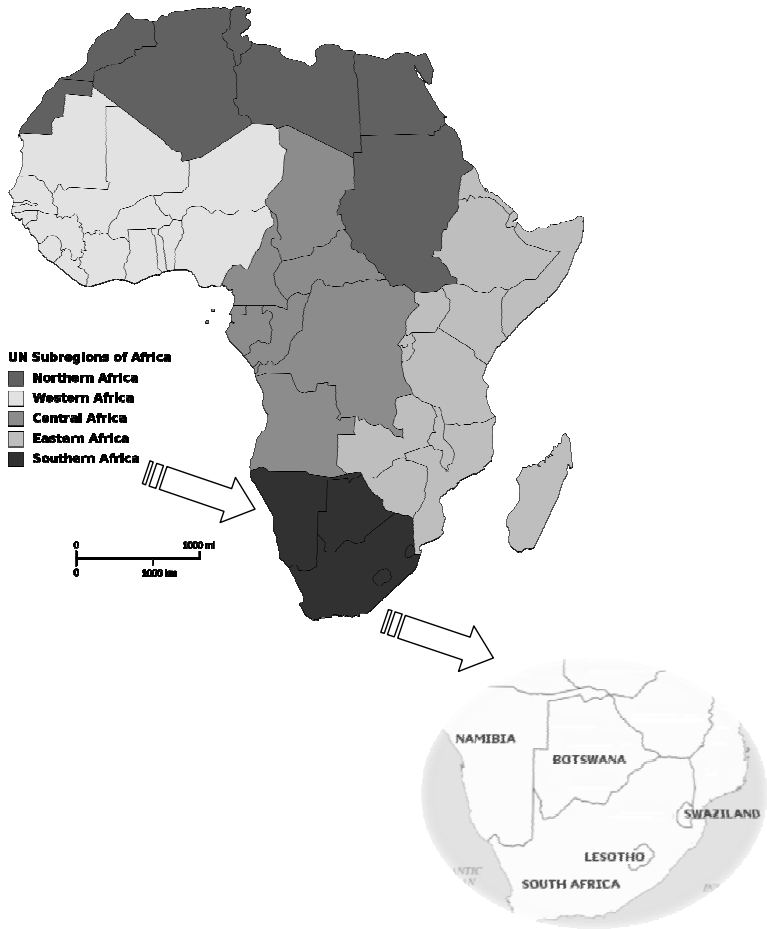


Fig.1. Location of Southern Africa (Republic of South Africa, Republic of Namibia, Republic of Botswana, Kingdoms of Lesotho and Swaziland) on African continent.

(Images from http://en.wikipedia.org/wiki/Outline_of_Africa;
http://www.roamingafrica.com/main_hunting_safari.htm)

of 947 m. Part of the chain forms the watershed between the rivers flowing west to the Atlantic and those flowing east and south to the Indian Ocean. The Orange and Tugela rivers rise in the Mont-aux-Sources. Van Reenen's and Laingsnek are the main passes. Drakensberg Mountains are home to aquatic, forest, scrub, fynbos, savannah, mountain grassland and heath plant families, including a large number of species listed in the Red Data Book of threatened plants, with 119 species listed as globally endangered (Golding 2002).

Inscribed in 2000, the Drakensberg-uKhahlamba National Park is located in the west of KwaZulu Natal province on the Kingdom of Lesotho border (S 29°23', E029°32'). It is 243.000 hectares in size, stretching 150 kilometers from Royal Natal National Park in the north to Cobham Forest Station in the south. It is a mixed cultural and natural heritage site and the fourth site in South Africa to be granted as World Heritage status. Africa's highest mountain range south of Kilimanjaro is situated there, as well as the largest and most concentrated series of rock art paintings in Africa, made by the San people over a period of 4000 years. Both the Zulu name, *uKhahlamba* (barrier of spears) and the Afrikaans name *Drakensberg* (dragon mountain) fit the formidable horizon created by the range. A massive basaltic cap set on a broad base of sedimentary rocks belonging to the Stormberg series of 150 million years ago, the mountains are South Africa's main watershed.

The site's diversity of habitats protects a high level of endemic and globally threatened species, especially birds and plants. 98 of the 2153 plant species in the park are endemic or near-endemic (Golding 2002). These include the extremely rare, *Protea nubigena* Rourke, a plant found on a high ridge in the Royal Natal section of the park. Part of the reason for the Drakensberg's rich biodiversity is its extremes of altitude, from 1000 meters above sea level to 3500 meters.

Dominated by Hodgson's Peaks which enclose the Giants Cup, Cobham Nature Reserve is a 52.000 hectare section of the uKhahlamba Drakensberg Park in the southern berg adjacent to Himeville Village (situated approximately 150 km from Pietermaritzburg). Cobham is dominated by vast expanses of *Themeda triandra* Forsk. and *Festuca* spp. (*F. caprina* Nees, *F. costata* Nees) grasslands. The grasslands are interspersed with rocky outcrops/boulders, streams and rivers and indigenous forests.

The reserve was established in 1959 by the Department of Forestry, and has been administered by KZN Wildlife (formerly the Natal Parks Board) since 1988. Vergelegen is managed as part of Cobham. It is the closest hiking route (via Mkhomazi pass) to the highest peak in the Drakensberg, Thabana Ntlenyana (the beautiful little Mountain) which is situated in Lesotho. At 3482 m, Thabana Ntlenyana is the highest peak south of Kilimanjaro. The area has large numbers of small upland lakes or tarns – and there is an area in Cobham called the Lake District.

KINGDOM OF LESOTHO is a small country surrounded from all sides by the territory of South Africa and landlocked. Area – 30.355 km².

From three sides Lesotho is separated from South Africa by the Drakensberg Mountains. On the west of the Kingdom is a hilly plateau, and the central part of the country is occupied by medium-altitude mountains (2500 m). In the northern part of country stretches Thaba Putsoa and Maluti Mountains, where the highest point of Lesotho Mountains – Thabana Ntlenyana (3.482 m) is situated. The eastern part of the country is occupied by mountainous terrain, on the border with South Africa terminating down near-vertical basalt walls of Great

Escarpment. Lesotho - the only country in the world where there are no plains located below 1400 m.

Highland location has caused quite a harsh climate. This is the only African country where there is a season with average zero temperatures and almost the whole of area during the winter time is covered with snow. Seasonal changes in temperature in the mountainous north-east of the country is considerable: from +34°C in summer to 16°C in winter time. Average rainfalls is about 730 mm per year, mostly in the summer season.

On the territory of the Lesotho Mountains South Africa's major rivers has its origins, the Orange and Caledon. All the rivers are extremely rapids, there are many beautiful waterfalls: the largest is Maletsunyane (183 m). Highlands occupied by a relatively poor grass vegetation, in middle altitudes –by rich alpine meadows. The foothills are covered with grass steppes and small groups of acacias. Under arable land is located approx. 10% of land area, pasture use 2/3 of the territory, forests cover less than 2%.

REPUBLIC OF BOTSWANA is inland state in Southern Africa, which has no coastal line. Area – 600.370 km². About 85% of Botswana's Kalahari Desert is a monotonous terrain: a vast flat drainage basins with average altitude of 800-1000 m. On the east and west it is surrounded by desert plateau (highest point - Mount Tsodilo - 1489 m).

Most of the Kalahari territory is a desertifying deciduous savanna and only in the places where groundwaters reaches surface shrub savanna formed. Here distributed different acacias, and several species of aloe, one of whom - spiral aloe - is endemic to the Kalahari. Widespread variety of pumpkin that can accumulate water during the rainy season, among them the other endemic to the Kalahari - a wild watermelon – which is an excellent food for cattle and wildlife in the dry season. In the north part of country, due to the more humid climate are typical savannah with acacias and baobabs. For these places is also characteristic marula tree, whose fruit ripen once every 3-4 years and only in very hot weather. Ripe fruit begins to ferment, and they love to feast on elephants. Banks of northern rivers (different tributaries of Zambezi River) covered with tropical forests, and wetland areas of internal delta of Okavango River occupied by dense thickets of papyrus, reeds and shrubs. In general, forests cover approx. 25% of the country, arable land - just 0.7% and pastures - approx. 45%. Huge open spaces are savanna grassland herds of many wild animals: different antelopes, giraffes, rhinos, and others. To preserve them were organized national parks, reserves and sanctuaries, which occupies in total about 17% of the country area and protect attractive tourism objects. The most famous are: Chobe National Park, Nxai Pan National Park, Central Kalahari Game Reserve, Kgalagadi Transfrontier Park (Atlas of National Parks and Reserves of South Africa 2006)).

Botswana's climate varies significantly in the northern and southern parts of the country. In the north prevail tropical climate, in the south - the dry subtropical with distinct continentality features. The average January temperature is +25°C, July +16°C. The amplitude of diurnal temperatures reaches +22°C, while in the south in the winter there are night frosts. Precipitation in the north reaches 700 mm per year, and in the south - not exceeding 250 mm. Rivers in most of the Kalahari area are dry during the dry season which continuous about 9 months - from March to November, the lower reaches of many of them turn into a chain of salt lakes. The most significant river of Botswana - Okavango - has no runoff into the ocean, it forms a huge inland delta, which is a virtually unique wet boggy area in Botswana and covered up to 40.000 km². One of the

branches inside the delta empties into the lake Ngami, the other flowing through the deep canyon of the far east, nourishes a shallow lake-marsh Makgadikgadi which is constantly changing its shape. Okavango waters in many places, seeping through the loose rocks, flowing hundreds of miles under the earth, only to re-emerge on the surface as springs or seep into the depressions, pans. In the south-east of country flows waters of Limpopo tributaries.

REPUBLIC OF NAMIBIA located in the south-west of the African continent, on the Atlantic coast. Area is 825.418 km².

Most of the territory of Namibia is a plateau with an average altitude of 900-1500 m. To the east it falls to the Kalahari Desert, in the west ends of the coastal Namib Desert steep edge. Internal hilly plains and plateaus occupy approx. 1/2 of the total area of the country, it is here that the main economic activity is concentrated. In the western part of the plateau is the highest peak - Mount Königstein (2606 m). Relatively low lands of Kalahari and Namib are virtually unusable. Most of the Namib Desert occupy the world's highest sand dunes, often painted in bright red colour. Dunes are in continual motion, and because of that the terrain in Namibia is extremely volatile. In the central part of the desert area is rocky or covered with stones.

In Namibia dominate tropical and mostly very dry climate, despite the proximity of the ocean. Dryness due to the predominance of easterly winds which lose all the moisture during the crossing the high plateaus of Southern Africa and because the influence of cold Bengal currents. The average temperature of the warmest month (January) ranging from +18°C on the coast to +27°C in the Kalahari desert and the coldest in the same regions from +12 to +16°C. Precipitation is irregular and vary from 10-50 mm on the coast up to 500-700 mm in the extreme north-east.

Major rivers - the Kunene in the north and the Orange in the south - make natural borders of the country. The largest lake - Etosha - is located in the Namibian north and occupies an area of drainageless basins about 4.000 square km.

In the north of country dominate grass-shrub desert which changes into shrub desert to the south. In the more elevated central part of the country dominate desert savanna, in Namib desert – temporal ephemeral vegetation. Due to the almost complete absence of rainfall, some plants adapted to absorb moisture from the mist, for example, *Welwichia mirabilis*. The area of arable land covers approx. 1% of the territory. The rich fauna of the savanna is preserved only in Etosha National Park, home to black rhinos, zebras, aardwolves, honey badgers, and variety of the antelopes (hemsbock, springbock, dik-dik, eland, wildebeest), giraffes, elephants, lions etc. Here is one of the world's largest colonies of flamingos. In Namibia created a system of national parks and reserves, some of which relate to the world's largest (Namib, Etosha); all protected areas occupy 15% of the country.

KINGDOM OF SWAZILAND – the smallest of the African states – located in between South Africa and Mozambique. This inland country covers 17360 sq.km.

Despite its modest size, the natural conditions of the country is very diverse. The relief of the kingdom has a distinctive "step" structure: from west to east each other are replaced by High Veld (1000-1500 m, but here the highest point of the country - mountain Emlembe, 1862 m) and the Middle Veld (400-800 m), which ends in an almost a flat plain - Low Veld (150-300 m).

In the mountains of the High Veld dominated moderately warm climate, slightly below - subtropical, which changes into tropical climate in the eastern tropical plains. The highest rainfall - up to 1500 mm per year (on the windward slopes of high mountains up to 2500 mm) - falls in the west. The wet season is summer, winter in the mountains are dry and relatively cold, at night are freezing, and sometimes even snowy. The average temperature in July (winter) is +12°C, in February (summer) - +23°C. With moving to the east average temperatures gradually increase and rainfall decreases: in some areas of Low Veld temperatures in summer reaches +40°C and average annual rainfall is 500 mm. The most important river is the Great Usutu, crossing the country from west to east. On the Low Veld special systems are built for irrigation of large areas of fertile soils.

Swaziland vegetation is rich and varied: on relatively small area of the country growing 2.4 thousand plant species. Most of the High Veld is occupied by mountain meadows and forests, areas which are growing in recent years (artificial plantations). Natural vegetation consist from *Acacia* forests, which now mostly changed to the mountain pastures, or replaced by plantations of pine and eucalyptus. In the east of country forest vegetation is transformed into the Mediterranean type, which is changing into the dry savanna of the Lower Veld with an abundance of acacias and baobabs. The few reserves and national parks inhabited by antelopes, buffalos, zebras, hippos, lions etc. Approximately 10% of the country lands are plowed.

ANNOTATED LIST

We follows classification system which described by P.F.M. Coesel and K. (J.) Meesters (2007) in accordance with J. Růžička (1977) based on M. Mix (1972).

- Class: **CONJUGATOPHYCEAE**
Order: **ZYGNEMATALES**
Family: **ZYGNEMATACEAE** [not a subject of our study]
Family: **MESOTAENIACEAE** Oltmanns (saccoderm desmids)
- CYLINDROCYSTIS** MENEH. EX DE BARY
MESOTAENIUM NÄGELI
NETRIUM (NÄGELI) ITZIGSOHN & ROTHE EMEND. LÜTKEMÜLLER
ROYA WEST ET WEST
SPIROTAENIA BRÉB. EX RALFS
Order: **DESMIDIALES** Round (placoderm desmids)
Sub-order: **CLOSTERIINEAE**
Family: **GONATOZYGACEAE** (Lütkem.) G.S. West et E.F. Fritsch
- GONATOZYGON** DE BARY
Family: **PENIACEAE** Haeckel
PENIUM BRÉBISSON EX RALFS
Family: **CLOSTERIACEAE** A. Pritch.
CLOSTERIUM NITZSCH EX RALFS
Sub-order: **DESMIDIINEAE**
Family: **DESMIDIACEAE** Ralfs
- ACTINOTAENIUM** (NÄG.) TEILING
DOCIDIUM BRÉBISSON
PLEUROTAENIUM NÄGELI
TRIPLASTRUM IYENGAR ET RAMANATHAN
TETMEMORUS RALFS EX RALFS
EUASTRUM EHRENBERG EX RALFS
MICRASTERIAS C.A. AG. EX RALFS
COSMARIUM CORDA EX RALFS
COSMOCLADIUM BRÉBISSON
XANTHIDIUM EHRENBERG EX RALFS
STAURODESMUS TEILING
ARTHRODESMUS BRÉBISSON EX RALFS
STAURASTRUM MEYEN EX RALFS
SPHAEROZOSMA CORDA EX RALFS
ONYCHONEMA WALL.
SPONDYLOSIUM BRÉBISSON EX RALFS
HYALOTHECA EHRENBERG EX RALFS
DESMIDIUM C.A. AG. EX RALFS
PHYMATODOCIS NORDST.
GYMNOZYGA EHRENB.

All illustrations, distribution according to the list of samples and all notes about morphology, taxonomy, ecology are listed for each recorded in Southern Africa taxon. Some of the notes are in Latin (especially from early works and description of new taxa, those notes marked by *Italic*), notes of Bela Jenő Cholnoky (1955) sited in German. Some abbreviations used in the list, i.e. RSA – Republic of South Africa; NAM – Republic of Namibia; BOT – Republic of

Botswana; SWA – Kingdom of Swaziland; LES – Kingdom of Lesotho; crass. – thickness; isthm. – width of isthmus; lat. – width of cell; long. – length of cell; max. – maximum; min. – minimum; diam. – diameter.

SAMPLES DESCRIPTION AND ENUMERATION

1. RSA, Western Cape, Cape Flats, autumn 1874 (coll. A. Eaton) (Reinsch 1878).
2. RSA, Western Cape, Summit of Table Mountain, autumn 1874 (coll. A. Eaton) (Reinsch 1878).
3. RSA, Western Cape, Cape Town. From a fountain in the grounds of Government House, autumn 1874 (coll. A. Eaton) (Reinsch 1878).
4. RSA, Western Cape. In a rain-pool on the Cape Flats, near Claremont, autumn 1874 (coll. A. Eaton) (Reinsch 1878).
5. RSA, Little Namaqualand, in dam at Rozynbosch, 2800 feet above sea level, 9.01.1909 (West 1912).
6. RSA, Karroo, in sulphureous spring at Pappekuil, 950 feet above sea level, 2.12.1908 (coll. Prof. Pearson) (West 1912).
7. RSA, Upper (or Composite) Region, in dam at Karieboomfontein, 8.12.1908 (coll. Prof. Pearson) (West 1912).
8. RSA, Little Namaqualand, among *Chara* sp. in dam at Pella, 1500 feet above sea level, 8.01.1909 (coll. Prof. Pearson) (West 1912).
9. RSA, Little Namaqualand, in pool at Aggenys, 6000 feet above sea level, 6.01.1909 (coll. Prof. Pearson) (West 1912).
10. RSA, Karroo, in sulphureous spring, Gansfontein, 1200 feet above sea level, 2.12.1908 (coll. Prof. Pearson) (West 1912).
11. RSA, Little Namaqualand, among various algae, Dabainoris, 1500 feet above sea level, 11.01.1909 (coll. Prof. Pearson) (West 1912).
12. RSA, Karroo, among *Spirogyra* sp. in sulphureous spring at Gansfontein, 1200 feet above sea level, 2.12.1908 (coll. Prof. Pearson) (West 1912).
13. RSA, Cape Region between Ceres and Karooport, in sulphureous spring at Leeuwefontein, among *Spirogyra* sp., 2300 feet above sea level, 28.12.1908 (coll. Prof. Pearson) (West 1912).
14. RSA, Little Namaqualand, in dam at Pella, 1500 feet above sea level, 8.01.1909 (coll. Prof. Pearson) (West 1912).
15. RSA, Little Namaqualand, in dam at Kamiebies, 3000 feet above sea level, 24.12.1908 (coll. Prof. Pearson) (West 1912).
16. RSA, Great Namaqualand, in cattle-trough at Gründoorn, 3400 feet above sea level, 4.02.1909 (coll. Prof. Pearson) (West 1912).
17. RSA, Upper (or Composite) Region, Holle River, in drying mud in the river-bed, 2700 feet above sea level, 10.12.1908 (coll. Prof. Pearson) (West 1912).
18. RSA, on a sloping granite rock, over which water was trickling, quite exposed to the sun, Kasteel's Poort Stream, Twelve Apostles' Range, about 1000 ft. above sea level. January 1908 (coll. E.P. Phillips) (Fritsch 1918).
19. RSA, in a shallow mountain stream, well shaded by large trees, current very slow, below Long Kloof on the Twelve Apostle's Range, about 2000 ft. above sea level. February 1908 (coll. E.P. Phillips) (Fritsch 1918).
- 20, 21. RSA, small stream by roadside, shaded by overhanging bush, Camps Bay, about five miles from Cape Town. March 1st, 1908 (coll. E.P. Phillips) (Fritsch 1918).

22. RSA, stagnant pool, shaded by overhanging bush, Camps Bay. March 1st, 1908 (coll. E.P. Phillips) (Fritsch 1918).

23. RSA, green frothy scum on surface of water in a rather large hole in the bed of a small mountain stream, otherwise quite dry, well shaded by a large rock and surrounding bushes; in a deep valley on the Twelve Apostles, about 2000 ft. alt. March 8th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

24. RSA, on sloping rock over which the water trickled rather swiftly (water from pool), a soft flocculent mass, position exposed to sun for greater part of day. Orange Kloof, below Tunnel Door, about 2000 ft. alt. (Table Mt.). March 8th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

25 and **26.** RSA, in running water, on a flat rock, in a place where the water widened out into a shallow pool. Orange Kloof, below Tunnel Door, about 2000 ft. alt. (Table Mt.). March 8th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

27. RSA, from a mountain spring in a hollow, forming a small pond, thickly overgrown with a water-weed, Orangezicht, above Cape Town (300 ft.). March 24th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

28. RSA, pond in Municipal Gardens, Cape Town, growing on stems and petioles of *Limnanthemum indicum* Thw. April 13th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

29. RSA, pond in Municipal Gardens, Cape Town, growing on the brick walls of the pond. April 13th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

30. RSA, small pool of water in the hollow of a rock, Table Mt.. 3000 ft. alt. April 12th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

31. RSA, small pond about 500 yards from the large "vlei" in Maitland, about three miles from Cape Town. July 11th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

32, 33. RSA, Valkenberg Vlei. June 28th, 1908 (coll. W.T. Saxton) (Fritsch 1918).

34. RSA, Modder River, Orange Free State. June 29th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

35. RSA, Orange River, Cape Province. June 25th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

36, 37, 38. RSA, Riet River, attached to *Myriophyllum*. July 28th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

39. RSA, Riet River, Orange Free State, attached to Willow leaves. July 28th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

40. RSA, Modder River, Orange Free State, with *Ranunculus*, etc. July 28th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

41. RSA, Riet River, Orange Free State. July 28th, 1908 (coll. H.H.W. Pearson) (Fritsch 1918).

42. RSA, in a small pond, which was drying up, adjoining the "vlei", Green Point Common; algae forming a frothy green mass. July 22nd, 1908 (coll. E.P. Phillips) (Fritsch 1918).

43. RSA, from another small pond, Green Point Common, where the water had completely dried up, leaving algae as a thick green carpet on top of the moist ground. July 22nd, 1908 (coll. E.P. Phillips) (Fritsch 1918).

44. RSA, in a little pool, formed by water flowing from a leaking water-pipe, Pipe Track, slopes of Table Mt., about 1000 ft. July 19th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

45. RSA, on a vertical rock, at side of an embankment, through which water was trickling, locality ? July 19th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

46. RSA, attached to *Crassula natans*, in a basin-shaped hollow on top of a high rock, which becomes filled with water during rains and heavy fogs, summit of Muizenberg Mts. August 3rd, 1908 (Fritsch 1918).

47. RSA, vlei at Lakeside. July, 1908 (coll. A.J. Ballatine) (Fritsch 1918).

48. RSA, vlei at Mowbray, near Cape Town. August 20th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

49. RSA, covering a rock, which was lying in a swampy piece of ground, with a thick greenish yellow slime, top of Kasteel's Poort, Table Mt., about 2500 ft. September 6th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

50. RSA, attached to roots of a plant, exposed in a small pool, top of Kasteel's Poort, Table Mt., about 2500 ft. September 6th, 1908 (coll. E.P. Phillips) (Fritsch 1918).

51, 52, 53. RSA, Muizenberg Vlei (in part growing on stem and leaf-sheath of *Typha*). (coll. Miss. E. Stephens) (Fritsch 1918).

54. RSA, in a spring on Table Mt., 3000-3500 ft. (coll. P. de Moll) (Fritsch 1918).

55. RSA, Cape, Cape Town, Table Mountain, on bare rock-surfaces and cliffs (Bews, 1916).

56, 57, 58 and **59.** RSA, in pools, partly sheltered by sedges, formed by a slow-running spring, Kentani, August 28, 1912 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

60. RSA, on rock in running stream, Kentani, September 20, 1912 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

61 and **62.** RSA, Kentani, November, 1912 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

63 and **64.** RSA, in half-stagnant, exposed pools, Kentani, August 6, 1912 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

65. RSA, pools of Buffalo River at King William's Town, December, 1912 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

66. RSA, in standing water, Malan, Willowvale District, February 11, 1913 (coll. Mr. M. Lundie) (Fritsch, Stephens 1921).

67. RSA, in slow-running water of marsh, Malan, Willowvale District, February 11, 1913 (coll. Mr. M. Lundie) (Fritsch, Stephens 1921).

68. RSA, in pools, Quingolo, Mqanduli District, December 23, 1913. Red deposit due to iron-bacteria (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

69. RSA, in pools, Quingolo, Mqanduli District, December 23, 1913 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

70. RSA, on decayed *Typha* in exposed stream, Quingolo, Mqanduli District, October 21, 1916 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

71 and **72.** RSA, exposed stream, Quingolo, Mqanduli District, October 21, 1916 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

73. RSA, floating dark slime, in exposed stream, Quingolo, Mqanduli District, October 21, 1916 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

74. RSA, slightly exposed stream at an altitude of 1200 ft., Kentani, March 24, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

75. RSA, on floating *Phragmites* stem, about a mile from the mouth of the Qolora, Kentani, April 18th, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

76. RSA, marshy ground, Kentani, 1200 ft., May 1, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).

77. RSA, sheltered marshy spot, Kentani, about 1200 ft., May 2, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
78. RSA, stagnant pool, near stream, Kentani, 1200 ft., May 24, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
79. RSA, open vlei near Godwana mouth, July, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
80. RSA, open vlei near Godwana mouth, epiphytes on *Nitella* and other water-plants, July, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
81. RSA, open vlei near Godwana mouth, July, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
82. RSA, slow-running stream, near Godwana mouth, July 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
83. RSA, scraping from side of tank, containing spring-water, N'quamakwe, 2500 ft., July 5, 1917 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
84. RSA, roadside puddle formed by drying surface spring, N'quamakwe, 2500 ft., July 5, 1917 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
85. RSA, on sheltered stones, in clear, running water, Kentani, about 1200 ft., April 19, 1915 (coll. Miss A. Pegler, A.L.S.) (Fritsch, Stephens 1921).
86. RSA, KwaZulu Natal Province, on bed of Umzindusi, Pietermaritzburg, March 28, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
87. RSA, KwaZulu Natal Province, in mountain-streamlet, Newcastle, April 6, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
88. RSA, KwaZulu Natal Province, mountain-stream, Newcastle, April 7, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
89. RSA, KwaZulu Natal Province, mountain-stream, Newcastle, April 7, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
90. RSA, KwaZulu Natal Province, on mud from bottom of pool in mountain-stream, Newcastle, April 7, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
91. RSA, KwaZulu Natal Province, on rocks in quiet pool in stream, Cedara, April 18, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
92. RSA, KwaZulu Natal Province, on rocks in stream, Edendale, May 25, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
93. RSA, KwaZulu Natal Province, on dead leaves of *Typha capensis* in old quarry, Victoria Bridge, Pietermaritzburg, moist, aerial, shaded, June 5, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
94. RSA, KwaZulu Natal Province, greyish-black ooze from mass of decaying *Typha* in old quarry, Victoria Bridge, Pietermaritzburg, June 5, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
95. RSA, KwaZulu Natal Province, in stagnant water in quarry at Victoria Bridge, Pietermaritzburg, June 5, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
96. RSA, KwaZulu Natal Province, free-floating in quiet pool in stream, Chase Valley, Pietermaritzburg, May 22, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
97. RSA, KwaZulu Natal Province, in running water, mostly attached, Chase Valley, Pietermaritzburg, May 22, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).
98. RSA, KwaZulu Natal Province, surface-scum on stagnant pool near Police Barracks, Pietermaritzburg, June 8, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

99. RSA, Natal, in running water, Star and Garter, near Pietermaritzburg, June 12, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

100. RSA, KwaZulu Natal Province, among mosses on rocks, Overwood, Polela, May 6, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

101. RSA, KwaZulu Natal Province, black patches, floating on the surface of an irrigation trench, Edendale, June 24, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

102. RSA, KwaZulu Natal Province, greyish-green scum on surface of irrigation ditch, mixed with leaves, Edendale, June 24 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

103. RSA, KwaZulu Natal Province, attached in running water, near Polo ground, Pietermaritzburg, July 8, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

104. RSA, KwaZulu Natal Province, in semi-stagnant water of pool in streamlet, branch of Dorp Spruit, Pietermaritzburg, July 12, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

105. RSA, KwaZulu Natal Province, on damp soil, Pietermaritzburg, September 5, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

106. RSA, KwaZulu Natal Province, in dripping water on cliffs, Drakensberg, Goodoo Pass, altitude 6500 ft., September 9, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

107. RSA, KwaZulu Natal Province, gelatinous clumps among hepatics, near Tugela, Drakensberg, altitude 4500 ft., September 19, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

108. RSA, KwaZulu Natal Province, in moist, sunny rock crevices, Tugela Gorge, altitude 6500 ft., September 19, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

109. RSA, KwaZulu Natal Province, attached in waterfall at side of Tugela Gorge, sunny, altitude 6500 ft., September 20, 1915 (coll. Prof. J.W. Bews) (Fritsch, Rich 1924).

110. RSA, KwaZulu Natal Province, in damp shady place on ground, Mountain View, Greytown, January 17, 1921 (coll. G.C. Nel) (Fritsch, Rich 1924).

111. RSA, KwaZulu Natal Province, in swift running water in shaded part of waterfall, Berwing, Greytown, January 19, 1921 (coll. G.C. Nel) (Fritsch, Rich 1924).

112. RSA, pool on flats, near Stellenbosch, May 11, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

113. RSA, pool on flats near Stellenbosch, May 11, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

114. RSA, on outside of water-cask over which water was dripping, Stellenbosch Flats, May 11, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

115. RSA, in slowly running water, Stellenbosch Flats, June 22, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

116. RSA, from pool, Stellenbosch Flats, June 22, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

117. RSA, from small pool in garden, Stellenbosch, August 3, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

118. Same locality as sample No. **117** (coll. Miss A.V. Duthie) (Hodgetts 1926).

119. RSA, in ditch on side of road, near Papegaaisberg, Stellenbosch, August 4, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

120. RSA, on surface of damp gravel, Stellenbosch Flats, August 6, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

121. RSA, in pool near old graveyard (color pale yellow-green), Stellenbosch Flats, August 6, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

122. RSA, in shallow swamp, near Stellenbosch, August 22, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

123. RSA, on damp earth amongst mosses, Stellenbosch, no date (coll. Miss A.V. Duthie) (Hodgetts 1926).

124. RSA, attached to dripping roots hanging over edge of stone fountain (color dark green), Stellenbosch, March 7, 1916 (coll. Miss A.V. Duthie) (Hodgetts 1926).

125. RSA, attached to submerged leaf-stalks of water-plant in stone fountain, Stellenbosch, March 7, 1916 (coll. Miss A.V. Duthie) (Hodgetts 1926).

126. RSA, attached to edges and under-surface of floating leaf (color pale green), Stellenbosch, March 7, 1916 (coll. Miss A.V. Duthie) (Hodgetts 1926).

127. Same locality as sample No. **126** (coll. Miss A.V. Duthie) (Hodgetts 1926).

128. RSA, bright green gelatinous layer on damp clayey soil, Stellenbosch, July 27, 1918 (coll. Miss A.V. Duthie) (Hodgetts 1926).

129. RSA, bright green gelatinous layer on surface of depressions, filled with fresh water, on clayey soil, Stellenbosch Flats after rain, July 27, 1918 (coll. Miss A.V. Duthie) (Hodgetts 1926).

130. RSA, pool on flats near Stellenbosch, August 6, 1915 (coll. Miss A.V. Duthie) (Hodgetts 1926).

131. RSA, Griqualand West, sage-green growth on margins of pools in mid-stream, Riet River, at Aswegen's Hoek, Kimberley Division (Fritsch, Rich 1930).

132. RSA, Griqualand West, on twigs in pool in mid-stream, bright-green color, Riet River, at Aswegen's Hoek, July 1921 (Fritsch, Rich 1930).

133, 134. RSA, Griqualand West, free-floating in sunny dam, Newlands, Barkly West, December 1921 (Fritsch, Rich 1930).

135. RSA, Griqualand West, on muddy bottom of dam, dark-green growth, Newlands, Barkly West, December 1921 (Fritsch, Rich 1930).

136. RSA, Griqualand West, free-floating, grass-green growth in sunny pool, Newlands, Barkly West, December 1921 (Fritsch, Rich 1930).

137. RSA, Griqualand West, dark-green growth on twig in sunny dam, Newlands, Barkly West, December 1921 (Fritsch, Rich 1930).

138, 139. RSA, Griqualand West, pale yellow-green growth on surface of water, Kenilworth dam, Kimberley, January 1922 (Fritsch, Rich 1930).

140. RSA, Griqualand West, from freshwater pool near the pan at Zout Pan, Honeynest Kloof, 1918 (Fritsch, Rich 1930).

141. RSA, Griqualand West, sediment at bottom of jar, near the pan at Zout Pan, Honeynest Kloof, 1918 (Fritsch, Rich 1930).

142. RSA, Griqualand West, at junction of Riet and Modder Rivers, 1918 (Fritsch, Rich 1930).

143. RSA, Griqualand West, Mine Dam, Kimberley, June 1919 (coll. J.C. Moran) (Fritsch, Rich 1930).

144. RSA, Griqualand West, dark-green, free-floating growth in pit on open veld filled with rain-water (usually dry), Kimberley, March 1917 (coll. J.C. Moran) (Fritsch, Rich 1930).

145, 146. RSA, Griqualand West, attached to stems of grass below water, in pit on open veld filled with rain-water, Kimberley, March 1917 (coll. J.C. Moran) (Fritsch, Rich 1930).

147. RSA, Griqualand West, bluish-green growth on stones, Du Toits Pan, Kimberley, November 1917, (coll. J.C. Moran) (Fritsch, Rich 1930).

148. RSA, Griqualand West, bright-green growth on living water-weeds, Du Toits Pan, Kimberley, November 1917 (coll. J.C. Moran) (Fritsch, Rich 1930).

149, 150. RSA, Griqualand West, blue-green growth among water-weeds, pool on veld, overflow from pond fed by spring-water, Alexandersfontein, Kimberley, June 1918 (coll. J.C. Moran) (Fritsch, Rich 1930).

151. RSA, Griqualand West, bright-green growth among water-weeds, pool on veld, overflow from pond fed by spring-water, Alexandersfontein, Kimberley, June 1918 (coll. J.C. Moran) (Fritsch, Rich 1930).

152. RSA, Griqualand West, floating in still water in sun, Top Dam, Newlands, Barkly West, September 1921 (coll. C. Elliott Young) (Fritsch, Rich 1930).

153. RSA, Griqualand West, floating in running water in sun, Harts River, Newland, Barkly West, August 1922 (coll. C. Elliott Young) (Fritsch, Rich 1930).

154. RSA, Griqualand West, attached to soil in still water in sun, Harts River, Newland, Barkly West, August 1922 (coll. C. Elliott Young) (Fritsch, Rich 1930).

155, 157. RSA, Griqualand West, in furrow in sun, Mazelsfontein, Herbert, March 1922 (coll. J.H. Power) (Fritsch, Rich 1930).

156. RSA, Griqualand West, in furrow, Mazelsfontein, Herbert, March, 1922 (coll. J.H. Power) (Fritsch, Rich 1930).

158. RSA, Griqualand West, on weeds in an irrigation furrow, in sun, Douglas, March 1922 (coll. J.H. Power) (Fritsch, Rich 1930).

159. RSA, Griqualand West, brownish-yellow floating mass above weeds in Koedoesberg drift, Kimberley Division, July 1922 (Fritsch, Rich 1930).

160. RSA, Griqualand West, sage-green to brown growth on weeds in river, Koedoesberg drift, Kimberley, July 1922 (Fritsch, Rich 1930).

161. RSA, Griqualand West, pool in river bed, on twigs in sun, Driekops Eiland, Riet River, Herbert, July 1922 (Fritsch, Rich 1930).

162. RSA, Griqualand West, yellowish-brown growth on surface of weeds in Riet River. Koedoesberg drift, Kimberley Division, July 1922 (Fritsch, Rich 1930).

163. RSA, Griqualand West, brown growth on weeds in running water, Koedoesberg drift, Riet River, July 1922 (Fritsch, Rich 1930).

164. RSA, Griqualand West, brownish-yellow growth on surface, over matted weeds, Koedoesberg drift, July 1922 (Fritsch, Rich 1930).

165. RSA, Griqualand West, green to brown growth on under surfaces of stones in pools, Riet River at Driekops Eiland, Herbert, July 1922 (Fritsch, Rich 1930).

166. RSA, Griqualand West, stagnant sunny pools, Driekops Eiland, Riet River, May 1922 (coll. Miss A. Parker) (Fritsch, Rich 1930).

167. RSA, Griqualand West, grass-green growth in sunny sluit, Sogo Location, Herbert, June 1922 (Fritsch, Rich 1930).

168. RSA, Griqualand West, from sides of evaporating tank in sun, Kenilworth Observatory, near Kimberley, January 1923 (Fritsch, Rich 1930).

169. RSA, Griqualand West, from bottom of evaporating tank, in sun, Kenilworth, Kimberley, January 1923 (Fritsch, Rich 1930).

170. RSA, Griqualand West, dark-green growth from shallow sunny furrow, Newlands, December 1922 (Fritsch, Rich 1930).

171. RSA, Griqualand West, on the Eureka dam, Hay, October 1922 (coll. H.E. Louw) (Fritsch, Rich 1930).

172. RSA, Griqualand West, floating in still water in sun, Harts River, Newlands, October 1922 (coll. C. Elliott Young) (Fritsch, Rich 1930).

173. RSA, Griqualand West, free-floating in sluit of running water in sun, Newlands, February 1923 (coll. C. Elliott Young) (Fritsch, Rich 1930).

174. RSA, Griqualand West, sides of cattle trough, The Glen, Hay, February 1923 (Fritsch, Rich 1930).

175. RSA, Griqualand West, surface of stream, Dunmurry Kloof, Langebergen, Hay, February 1923 (Fritsch, Rich 1930).

176. RSA, Brakpan, Witwatersrand, plankton, September 7, 1927 (coll. M.E. Blenkiron) (Nyygard 1932).

177. RSA, Barberspan, West Transvaal, plankton, April 6, 1928, $t=23.5^{\circ}\text{C}$, $\text{pH}=9.1$ (coll. M.E. Blenkiron) (Nyygard 1932).

178. RSA, Barberspan, West Transvaal, plankton from the mouth of channel, April 6, 1928, $t=23.5^{\circ}\text{C}$, $\text{pH}=9.1$ (coll. M.E. Blenkiron) (Nyygard 1932).

179. RSA, Florida Lake, Witwatersrand, plankton, August 28, 1927 (coll. M.E. Blenkiron) (Nyygard 1932).

180. RSA, Florida Lake, Witwatersrand, plankton, September 10, 1927 (coll. M.E. Blenkiron) (Nyygard 1932).

181. RSA, Vaal River, Vereeniging, $\frac{1}{4}$ -mile downstream from Pumping station, plankton, July 25, 1928, $t=17.5^{\circ}\text{C}$, $\text{pH}=8.1$, $\text{O}_2=3.12$ pts./mill. (coll. M.E. Blenkiron) (Nyygard 1932).

182. RSA, Vaal River, Vereeniging, plankton from opposite outlet, July 25, 1928, $t=20^{\circ}\text{C}$, $\text{pH}=8.2-8.3$, $\text{O}_2=3.92$ pts./mill. (coll. M.E. Blenkiron) (Nyygard 1932).

183. RSA, Mtakati River, Pondoland, plankton occluded with *Chara* and *Nitella*, December 24, 1927, (coll. M.E. Blenkiron) (Nyygard 1932).

184. RSA, Rietfontein, Witwatersrand, algae, free floating with *Utricularia* sp., March 31, 1928, (coll. G.E. H.) (Nyygard 1932).

185. RSA, Transvaal, Lake Chrissie, the largest natural body of water in South Africa. A permanent pan, about 3 miles long, 10 to 20 feet deep, with flat rock bottom (? the water grey and turbid with colloidal silica, very slightly brackish, pH about 9), 26.2.1928 and 19.5.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

186. RSA, Transvaal, Kuil II, small pool in a dry stream-bed quite near the lake, 19.5.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

187. RSA, Transvaal, Eliazer Pan (pond below spring). A seasonal "mud pan", 1 square mile or less in area, very shallow, water very turbid, very slightly brackish, $\text{pH}=8.3-9.2$, very little macrovegetation, zooplankton (Phyllopoes and Copepods), 27.5.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

188. RSA, Transvaal, Florida Lake. This is really a mine dam formed out of what was once a stream in a hollow. Relatively permanent, no colloidal silica, fresh water. A *Scirpus* pan. Six monthly samples from July 1927 to January 1928, April and May 1929 (coll. Miss J. Schuurman) (Rich 1932).

189. RSA, Transvaal, Frischgewaagd Dam (near Trichard Station), 27.2.1928 (coll. Miss J. Schuurman) (Rich 1932).

190. RSA, Transvaal, Potchefstroom Dam, 1.10.1927 (coll. Miss J. Schuurman) (Rich 1932).

191. RSA, Transvaal, Rietfontein, a "grass pan" near Johannesburg. A temporary neutral pan of low salinity, water yellowish, slightly turbid, $\text{pH}=6.7-7.2$, macrovegetation rich, zooplankton (*Conochilus* and Copepods), 12.1.1928 and 23.2.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

192. RSA, Weltevreden West Pan, in the Lake Chrissie area. About one quarter of a square mile in area, permanent, no colloidal silica, remarkable among these pieces of water in having pure, clear, fresh water, $\text{pH}=6.8$, macrovegetation rich,

zooplankton (Cyclopoid and Ostracods), 19.5.1928 (coll. M.E. Blenkiron) (Rich 1932).

193. RSA, neighborhood of Cape Town, Lakeside Vlei (= Sand Vlei, Muizenberg Vlei), Cape Flats. "Not permanent, approximately neutral, slightly brackish. *Cladophora glomerata* (?) covered with epiphytic Diatoms and young *Oedogonium* plants, the Diatoms present are decidedly marine (This vlei is divided by a railway embankment into two portions, the eastern of which is connected with the sea at one point and contains *Ruppia* and other brackish-water aquatics, while the western part has typical freshwater plants and Algae. This sample evidently must have been taken from the eastern portion), 27.11.1927 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

194. RSA, neighborhood of Cape Town, Ronde Vlei, Cape Flats. "Thick-looking water. Salinity about half that sea-water". 20.1.1928 and 5.2.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

195. RSA, neighborhood of Cape Town, Steenbras Reservoirs, Hottentot Holland Mts. A very small sample was submitted. 7.1.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

196. RSA, neighborhood of Cape Town, Victoria (Upper Wynberg) Reservoir, Table Mountain. 15.1.1928 (coll. Mrs. G.E. Hutchinson) (Rich 1932).

197. RSA, Transvaal, Brakpan I. Slightly turbid, yellowish water, fresh, pH above 7, macrovegetation rich, zooplankton (*Conochilus* and Copepods). February, March, April, May, June, and November, 1928 (coll. Mrs. G.E. Hutchinson and Miss J. Schuurman) (Rich 1932).

198. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, 6500 feet above sea-level (on the top of koppje), November 1909 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

199. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, 6500 feet above sea-level (on the top of koppje), November 1909 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

200. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, 6500 feet above sea-level (on the top of koppje), 9th October 1913 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

201. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, 6500 feet above sea-level (on the top of koppje), 9th October 1913 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

202. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, amongst *Utricularia* etc., 6500 feet above sea-level (on the top of koppje), 22nd January 1924 (Fritsch, Rich 1938).

203. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, gelatinous masses stripped from the stems of *Cyperaceae*, 6500 feet above sea-level (on the top of koppje), 22nd January 1924 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

204. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, gelatinous masses stripped from the stems of *Cyperaceae*, 6500 feet above sea-level (on the top of koppje), 22nd January 1924 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

205. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, gelatinous masses stripped from the stems of Cyperaceae, 6500 feet above sea-level (on the top of koppje), 22nd January 1924 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

206. RSA, Transvaal, Belfast Pan (at Belfast), about 100 yards in diameter (when full of water), water is exposed to direct sunlight, forming a dense slimy mass in the warm shallow waters near the edge of te Pan, 6500 feet above sea-level (on the top of koppje), 22nd January 1924 (coll. Dr. E.M. Doidge) (Fritsch, Rich 1938).

207. RSA, Transvaal, Johannesburg, Florida Lake. The lake lies on the Jeppestown series (shales with sandstone and quartzites) of the lower Witwatersrand beds. It is artificial lake, roughly triangular in shape, being approximately ½ mile long and ⅓ mile broad. The dept at the stone-faced wall (the deepest portion) is roughly 20 feet, when the lake is full, but has been started to fall as low as 5 feet. During the two years of investigation this depth varied roughly from 16 to 20 feet, according to the time of the year. The mean annual rainfall is approximately 20 inches (760 mm.o, more than three-quarters of which usually falls during the summer (November-March), and the level of the water varies accordingly. The banks of the lake are natural, excepting for stone-faced wall at the outlet; at the inlet side the shores are weedy, while the central portion of this area is occupied by *Phragmites*; the bottom of the lake is composed of black mud. 5700 feet above sea level, 28° long., 26° 5' lat. from June 1927 until June 1929 (Schuurman 1932).

208. RSA, Limpopo Province, environs of Tzaneen, Southpans Mountains, “de Hoek” Forest Reserve near Debegeni Waterfalls. “Dripping water on shadowy, vertical rock wall. Debegeni”. Typical sub-aerophytic material forming by gelatinous mass of *Cyanophyta*, in which rich diatom associations and some desmids present. pH=5.6. Collected by author and Prof. Dr. R. Kraeusel and Prof. Dr. H.G. Schweickerdt (Cholnoky 1954a).

209. RSA, Limpopo Province, environs of Tzaneen, Southpans Mountains, “de Hoek” Forest Reserve near Debegeni Waterfalls. “Moss cover on small island in between grass. Debegeni”. Material formed by *Jungermanniales*. pH=5.6. Collected by author and Prof. Dr. R. Kraeusel and Prof. Dr. H.G. Schweickerdt (Cholnoky 1954a).

210-218. RSA, Limpopo Province, near Lephalale (Ellisras), vicinity of the police and postal station, river Mogol (tributary of the Crocodile (Limpopo) river) perfused Waterberg, pH=6.0-6.5. Collected by Dr. J.J. Theron. **210** - in river, on the ground; **211** - side of the river, on the ground; **212** - floating in the river; **213** - floating masses in the river; **214** - floating in the water, near the ford; **215** - roots of aquatic plants, near the ford; **216** - roots of aquatic plants, other spring near the ford; **217** - roots of aquatic plans from the ground, near the ford; **218** - aquatic plants, near the ford (Cholnoky 1954b).

219. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Small source with completely stagnant water on the shore of the main source. Yellow, light detritus. The water surface is oily (Cholnoky 1955).

220. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. The second source that has been excavated and artificially deepened. The water is nearly stationary, because of infiltrates. 20-25 cm deep. (Cholnoky 1955).

221. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Small pond, in the footsteps of the. Sunny, standing, with burned grass (Cholnoky 1955).

222. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Vlei, very shallow, almost stagnant. Above the larger sources. Red-brown, lighter (Cholnoky 1955).

223. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Vlei, above the major sources. Very shallow, with mass vegetation of *Spirogyra* (Cholnoky 1955).

224. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Vlei, control material of the previous sample (Cholnoky 1955).

225. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Vlei, benthos on the steep, excavated embankment opposite the mouth of a source system (see samples 226-229). Slowly flowing. (Cholnoky 1955).

226. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Shallow water source, not very slow flowing, polluted (Cholnoky 1955).

227. RSA, Gauteng, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Side branch, flowing from the previous site (**226**) (Cholnoky 1955).

228. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Side branch. Outflow from source **226**, a little more to the bottom (Cholnoky 1955).

229. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. A small drainage ditch deepening of the site **226** (probably even a source) (Cholnoky 1955).

230. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. A small puddle on the banks of the vlei slightly below the previous location. Much of organic detritus, very shallow, slightly polluted (Cholnoky 1955).

231. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Is a small water source. The environment of the site is similar to **227-229**, but in shade of *Acacia* shrubs (Cholnoky 1955).

232. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Below the previous source. Sandy-loamy slope of the drain in the deep shadows where the runoff was artificially deepened. The water is nearly stagnant (Cholnoky 1955).

233. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Slightly below the previous location, but water is no longer shaded and is only 10 inches deep (Cholnoky 1955).

234. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. A deeper drainage ditch near the small spring (**231**), almost stagnant water, slightly below the previous (Cholnoky 1955).

235. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. Almost from the same place as **234**, but about 5 m away on the other side of the small, stagnant water source (Cholnoky 1955).

236. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. In between mosses in the splash zone of the embankment of the main water source (artificially deepened) (Cholnoky 1955).

237. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. In a water pool. Partially artificially excavated (Cholnoky 1955).

238. RSA, Gauteng, Rayton-vlei, nearly 30 km east of Pretoria. From the vlei (pH 6.3) (Cholnoky 1955).

239. RSA, Transvaal, about 13 miles N.-N.W. of Nylstroom, greyish-brown deposit covering submerged stones in the spruit near drift, about half of mile S.W. of Leeupoort Dam, in slow-running water, 16.04.1954, pH about 6.2 (Claassen 1961).

240. RSA, Transvaal, about 13 miles N.-N.W. of Nylstroom, greenish-brown ooze from side of road near drift, 16.04.1954 (Claassen 1961).

241. RSA, Transvaal, about 13 miles N.-N.W. of Nylstroom, reddish-brown ooze from side of the road halfway between drift and Leeupoort Dam, 16.04.1954 (Claassen 1961).

242. RSA, Transvaal, about 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, greenish-brown, stagnant water, 16.04.1954 (Claassen 1961).

243. RSA, Transvaal, about 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, reddish-brown deposit, stagnant water, 16.04.1954 (Claassen 1961).

244. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, attached to inner side of embankment of Leeupoort Dam, below surface of the water, 16.04.1954 (Claassen 1961).

245. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, decaying plants on moist part of embankment, 16.04.1954 (Claassen 1961).

246. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, in pool on rocks, yellowish-brown, 16.04.1954 (Claassen 1961).

247. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, dirty orange-brown scum, 16.04.1954 (Claassen 1961).

248. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, below overflow on the S.W. side of Leeupoort Dam, greyish-brown deposit on bottom of pool next to spruit, pH 6.15, 16.04.1954 (Claassen 1961).

249. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, Dornfontein Spruit about one mile N.E. of Leeupoort Dam (underneath bridge on asphalt road between Nylstroom and Vaalwater, orange-brown growth among stones, N.E. side of stream under bridge, pH 6.35, 16.04.1954 (Claassen 1961).

250. RSA, Transvaal, Transvaal, 13 miles N.-N.W. of Nylstroom, Dornfontein Spruit about one mile N.E. of Leeupoort Dam (underneath bridge on asphalt road between Nylstroom and Vaalwater, orange- to greenish-brown scum next to sample **249**, 16.04.1954 (Claassen 1961).

251. RSA, Transvaal, Transvaal, 13 miles N.-N.W. of Nylstroom, Dornfontein Spruit about one mile N.E. of Leeupoort Dam (underneath bridge on asphalt road between Nylstroom and Vaalwater, dirty orange-brown deposit, N.W. side under bridge, slow-running water, 16.04.1954 (Claassen 1961).

252. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, near school about three miles N.E. of Leeupoort Dam, from pond, dirty orange- to greenish-brown scum, pH 5.75, 16.04.1954 (Claassen 1961).

253. RSA, 13 miles N.-N.W. of Nylstroom, near school about three miles N.E. of Leeupoort Dam, in furrow near pond, greyish-brown deposit, 16.04.1954 (Claassen 1961).

354. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, Doornfontein Spruit about three miles N.E. of Leeupoort Dam, near school, from pool near stream, pH 6.1, 16.04.1954 (Claassen 1961).

255. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, Doornfontein Spruit about three miles N.E. of Leeupoort Dam, near school, another pool near the stream, 16.04.1954 (Claassen 1961).

256. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, Doornfontein Spruit about three miles N.E. of Leeupoort Dam, near school, orange-brown ooze from side of same pool as in sample **255**, 16.04.1954 (Claassen 1961).

257. RSA, Transvaal, 13 miles N.-N.W. of Nylstroom, Doornfontein Spruit about three miles N.E. of Leeupoort Dam, near school, greenish-brown deposit on stones at drift, in running water, pH 6.25, 16.04.1954 (Claassen 1961).

258. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, floodwater S.W. of spring A, 22.04.1954 (Claassen 1961).

259. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, bottom of small pond (S. side), almost black deposit, about 90 yards S. of spring A, pH 5.8, 22.04.1954 (Claassen 1961).

260. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, same as sample **259**, 19.11.1954 (Claassen 1961).

261. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.N.W. of Nylstroom, furrow between spring A and small pond, about 85 yards from spring A, 22.04.1954 (Claassen 1961).

262. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, on W. side of larger pond, about 145 yards S. of spring A, 2.04.1954 (Claassen 1961).

263. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, sides, surface and bottoms of furrows S. of the pond (see sample **262**), 22.04.1954 (Claassen 1961).

264 and **265.** RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, from a vlei about three-quarters of a mile S.E. of spring A, pH 6.31, 19.11.1954 (Claassen 1961).

266. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine-miles N.-N.W. of Nylstroom, near localities of samples **264** and **265**, pH 5.85, 2.04.1955 (Claassen 1961).

267. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, W. side of small pond, 2.04.1955 (Claassen 1961).

268. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, N. side of small pond, 2.04.1955 (Claassen 1961).

269. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, spring B, pH 5.45, 2.04.1955 (Claassen 1961).

270. RSA, Transvaal, Moddernek (farm belongs to Mr. P.W. Botes), about nine miles N.-N.W. of Nylstroom, furrow halfway between spring B and small pond, 2.04.1955 (Claassen 1961).

271. RSA, Transvaal, Rietfontein (farm belongs to Mr. J.E. Theron), about 28 miles N.-N.W. of Nylstroom, from spring, pH 5.7, 6.04.1955 (Claassen 1961).

272. RSA, Transvaal, Rietfontein (farm belongs to Mr. J.E. Theron), about 28 miles N.-N.W. of Nylstroom, water from spring flowing into pond N.W. of spring, 6.04.1955 (Claassen 1961).

273. RSA, Transvaal, Rietfontein (farm belongs to Mr. J.E. Theron), about 28 miles N.-N.W. of Nylstroom, from N.E. side of vlei, W. of pond, 6.04.1955 (Claassen 1961).

274. RSA, Transvaal, Glentig (farm belongs to Mr. L.J. Groenewald), situated about seven miles E. of Rietfontein (which situated 28 miles N.-N.W. Nylstroom), from furrow, about 30 yards N. of spring, 21.11.1954 (Claassen 1961).

275. RSA, Transvaal, between the old and new bridges over the Plat River, about 3-4 miles W. of Warmbaths, almost stagnant water in deep part of river, 30.05.1954 (leg. B.J. Cholnoky) (Claassen 1961).

276. RSA, Transvaal, between the old and new bridges over the Plat River, about 3-4 miles W. of Warmbaths, slightly lower down, deposits on a falt stone, slow-running water, 30.05.1954 (leg. B.J. Cholnoky) (Claassen 1961).

277. RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, side of waterfall W. of road, swift-running water over sandstone, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

278. RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, a small tributary, slow-running water, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

279. RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, on rocks, stagnant water, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

280. RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, shallow water from river above the waterfall, pH 6.35, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

281. RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, small pools further down the vlei, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

282 and **283.** RSA, Transvaal, near the road about halfway between Warmbaths and Nylstroom, tributary of the Nyl River, side two places in the vlei on *Gramineae* and *Cyperaceae*, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

284. RSA, Transvaal, Kranskop, situated about seven miles E. of Nylstroom, small pond with partly broken bank, about 100 yards in diameter, stagnant water with *Marsilea* and *Nymphaea*, pH 6.75, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

285. RSA, Transvaal, Kranskop, situated about seven miles E. of Nylstroom, overflow of pond, swift-running water, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

286. RSA, Transvaal, Kranskop, situated about seven miles E. of Nylstroom, a tributary of the Nyl River near Kranskop, shallow water near the bank, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

287 and **288.** RSA, Transvaal, Modderpoort (farm belonging to Mr. G. Moerdyk), between Warmbaths and Nylstroom, not far from locality where samples **277-283** were collected, further from the road to the west, two samples collected on stones in the river, pH 6.2, 6.06.1954 (leg. B.J. Cholnoky) (Claassen 1961).

289. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, from the portion of the farm called Masoga, in a swimming pool among *Myriophyllum*, pH 6.1-6.4, 12.07.1955 (leg. B.J. Cholnoky) (Claassen 1961).

290. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, from the shallow part of a vlei with a sandy bottom, from the portion of the farm called Masoga, pH 6.1-6.4, 12.07.1955 (leg. B.J. Cholnoky) (Claassen 1961).

291. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, same locality as sample **290** but in deep water among green algae, pH 6.1-6.4, 12.07.1955 (leg. B.J. Cholnoky) (Claassen 1961).

292. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, wall of Premier Dam, overflow, slow-running water among *Marsilea*, pH 6.1-6.4, 12.07.1955 (leg. B.J. Cholnoky) (Claassen 1961).

293. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, from a Premier Dam, the bottom of the dam was sampled at a place far from the bank, and where the water was one meter deep, pH 6.1-6.4, 12.07.1955 (leg. B.J Cholnoky) (Claassen 1961).

294. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, a vlei situated between Premier Dam and the Nyl River, in water about 10 cm deep, pH 6.1-6.4, 12.07.1955 (leg. B.J Cholnoky) (Claassen 1961).

295. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, near sample locality **294.** in a furrow near the Nyl-road, pH 6.1-6.4, 12.07.1955 (leg. B.J Cholnoky) (Claassen 1961).

296. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, from the Nyl River, in swift-running water, on marshy sand, clearly oligotrophic, pH 6.1-6.4, 12.07.1955 (leg. B.J Cholnoky) (Claassen 1961).

297. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, from the Nyl Dam near the Nyl River, large algal masses, pH 6.1-6.4, 12.07.1955 (leg. B.J Cholnoky) (Claassen 1961).

298. RSA, Transvaal, Mosdene (farm belonging to Mr. E.A. Galpin), near Naboomspruit, Premier Dam, living material (leg. Dr. S. Saubert) (Claassen 1961).

299. RSA, Transvaal, neighborhood of the Belfast Pan, about two miles away, from the stems of water plants (including *Nitella*) in running water in a vlei (i.e. an expanse of flat marshy ground with one or more streams running through it), near the Forestry Station, on lower ground. January 22, 1924 (coll. by Dr. E.M. Doidge) (Rich 1940).

300. RSA, Transvaal, neighborhood of the Belfast Pan, about three or four miles away (to the east), from small streams tickling into a little river (a tributary of the Elands River), near the Drift (ford), on the opposite side of a small range of hills. January 22, 1924 (coll. by Dr. E.M. Doidge) (Rich 1940).

301-306. NAM, Nkure-Nkuru region, the immediate vicinity of the Finnish missionary hospital, which is on the Namibian side of the border river Okavango, about 2 km downstream from Cuangar, the nearest Portuguese station on the Angola side of the river, from the shore of the Okavango River. May-September 1960 (dry season) (coll. by Dr. Hellberg) (Grönblad, Croasdale 1971).

307. NAM, Nkure-Nkuru region, the same locality as in samples **301-306.** May 1961. (Prof. Paavo Kallio) (Grönblad, Croasdale 1971).

308. RSA, south-western Transvaal, near Klerksdorp, 16 km east of Ottosdal (approximately S 26°48', E026°07'), small pan (originated from a pit from which gravel had been collected for road constructions several years previously), reddish-brown sediments in shallow stagnant water 5-75 mm deep. pH=7.7, t=24°C. 4th April 1972 (Claassen 1976).

309. RSA, south-western Transvaal, near Klerksdorp, 16 km east of Ottosdale (approximately S 26°48', E026°07'), small pan (originated from a pit from which gravel had been collected for road constructions several years previously), reddish-brown sediments in shallow stagnant water 5-75 mm deep. pH=7.5, t=27°C. 12th February 1975 (Claassen 1976).

309. RSA, south-west Transvaal, near Klerksdorp, 16 km from Ottosdale, small pan, pH=7.7, t=24°C. April 1972 (coll. M.I. Claassen) (Claassen 1977).

310. RSA, south-west Transvaal, near Klerksdorp, 16 km from Ottosdale, small pan, pH=7.5, t=27°C. February 1975 (coll. M.I. Claassen) (Claassen 1977).

311. RSA, central Transvaal, farm Mosdene near Naboomspruit, small pool on the banks of the Nyl River, pH=6.1, t=26°C. February 1974 (coll. Mr. G. Germishuizen) (Claassen 1977).

312. RSA, Limpopo Province, Transvaal, (Polokwane), in various rocky pools on the banks of the Great Letaba River in George's Valley near Tzaneen (Claassen, Eicker 1985).

313. RSA, Gauteng, Transvaal, (Pretoria), in Kaalfontein vlei about 34 km from Pretoria at the crossing of the Pretoria-Bronkhorstspuit and Cullinan-Bapsfontein roads (Claassen, Eicker 1985).

314. RSA, Mpumalanga, Transvaal, (Winbank), in Kloppersloop near Loskopdam (Claassen, Eicker 1985).

315. RSA, Mpumalanga, Transvaal, (Komatipoort), in small stream about 6.4 km south-west of Plaston (Claassen, Eicker 1985).

316. RSA, North-West Province, Transvaal, (Bloemhof), in a small pan about 8.4 km from Makwassie on the road to Wolmaransstad (Claassen, Eicker 1985).

317. RSA, Limpopo Province, Transvaal, (Modimolle, former Nylstroom), in the Nyl vlei on the farm Mosdene near Mookgophong (former Naboomspruit) (Claassen, Eicker 1985).

318. RSA, North-West Province, Transvaal, (Zeerust), in a vlei 11.5 km from Koster on the road to Lichtenburg (Claassen, Eicker 1985).

319. Republic of South Africa, North-West Province, Transvaal, (Klerksdorp), in an old quarry 16.4 km from Ottosdal on the road to Hartbeesfontein (Claassen, Eicker 1985).

320. RSA, Western Cape, pond at Caledon, 250 m a.s.l., September 26, 1926 (Huber-Pestalozzi 1929).

321. RSA, KwaZulu Natal, reservoir at Gillits near Durban, 650 m a.s.l. November 2, 1926 (Huber-Pestalozzi 1929).

322. RSA, Orange Free State, pond at Marseilles, 1760 m a.s.l., October 25, 1926 (Huber-Pestalozzi 1929).

323. RSA, Mpumalanga, vlei at Davel, 1878 m a.s.l., November 9, 1926 (Huber-Pestalozzi 1929).

324. RSA, Mpumalanga, vlei at Breyten, 1950 m a.s.l., November 6, 1926 (Huber-Pestalozzi 1929).

325. RSA, Gauteng, Hartbeesport Dam, 1490 m a.s.l., November 13, 1926 (Huber-Pestalozzi 1929).

326. RSA, Gauteng, Waterkloof Dam, 1500 m a.s.l., November 16, 1926 (Huber-Pestalozzi 1929).

327. RSA, Western Cape, Knysna Forest, pool with *Sphagnum* at the Groote River Drift, close to Plettenbergbai, October 7, 1926 (Huber-Pestalozzi 1930).

328. RSA, Western Cape, Knysna Forest, swamp near Harkerville, October 7, 1926 (Huber-Pestalozzi 1930).

329. RSA, Western Cape, Knysna Forest, swamp in Deep Walls (Forest Research Station) (Huber-Pestalozzi 1930).

330. RSA, Western Cape, Knysna Forest, Concordia Pool, October 8, 1926 (Huber-Pestalozzi 1930).

331. RSA, Western Cape, Knysna Forest, Lemna-Pond in Groote Forest Reserve (Huber-Pestalozzi 1930).

332. RSA, KwaZulu Natal, Krantzkloof Nature Reserve, wet rocks and small pools near cascade falls (Williamson 1994).

333. RSA, KwaZulu Natal, wet rocks near Drummond, Valley of Thousand Hills (Williamson 1994).

- 334.** RSA, KwaZulu Natal, New Germany Nature Reserve, small pool (Williamson 1994).
- 335.** RSA, KwaZulu Natal, Umbilo River at Pinetown, shallow pools (Williamson 1994).
- 336.** RSA, KwaZulu Natal, wet dripping rocks on northbound side of N3 near Inchanga (Williamson 1994).
- 337.** RSA, KwaZulu Natal, Hazelmere Dam near Verulam (Williamson 1994).
- 338.** RSA, KwaZulu Natal, dam, Kenneth Stainbank Nature Reserve (Williamson 1994).
- 339.** RSA, KwaZulu Natal, Tongaat, pond in park (Williamson 1994).
- 340.** RSA, KwaZulu Natal, Midmar Dam, south-east margin (Williamson 1994).
- 341.** RSA, KwaZulu Natal, Umgeni Valley Nature Reserve near Howick, pool and wet rocks where road crosses the Nkonbongo river (Williamson 1994).
- 342.** RSA, KwaZulu Natal, Umgeni Valley Nature Reserve, roadside pool near perimeter fence (Williamson 1994).
- 343.** RSA, KwaZulu Natal, Kamberg Nature Reserve, small dam near Hatchery (Williamson 1994).
- 344.** RSA, KwaZulu Natal, lake at Rawdon's Hotel, Nottingham Road (Williamson 1994).
- 345.** RSA, KwaZulu Natal, roadside stream near Rosetta (Williamson 1994).
- 346.** RSA, KwaZulu Natal, wet rocks at waterfall near Rosetta (Williamson 1994).
- 347.** RSA, KwaZulu Natal, Springvale River near Rosetta (Williamson 1994).
- 348.** RSA, KwaZulu Natal, Albert Falls Dam, pond on south-east side (Williamson 1994).
- 349.** RSA, KwaZulu Natal, Ladysmith area, pools in dried river at Flagstone Spruit (Williamson 1994).
- 350.** RSA, KwaZulu Natal, roadside pond near Colenso (Williamson 1994).
- 351.** RSA, KwaZulu Natal, Umtoti Vlei, near Severnoaks (Williamson 1994).
- 352.** RSA, KwaZulu Natal, roadside pond near Bergville (Williamson 1994).
- 353.** RSA, KwaZulu Natal, Royal Natal National Park, wet rocks at Queen's Causeway (Williamson 1994).
- 354.** RSA, KwaZulu Natal, Cavern Berg resort, pool near Putteril's Weir (Williamson 1994).
- 355.** RSA, KwaZulu Natal, Cavern Berg resort, dam (Williamson 1994).
- 356.** 25. RSA, KwaZulu Natal, Himeville Nature Reserve, top dam (Williamson 1994).
- 357.** RSA, KwaZulu Natal, Himeville Nature Reserve, swampy ground adjacent to top dam (Williamson 1994).
- 358.** RSA, KwaZulu Natal, Hluhluwe Game Reserve, pond near Maqanda (Williamson 1994).
- 359.** RSA, KwaZulu Natal, Hluhluwe Game Reserve, pond near Nombali (Williamson 1994).
- 360.** RSA, KwaZulu Natal, Mkuzi Game Reserve, waterhole at Kumasinga hide (Williamson 1994).
- 361.** RSA, KwaZulu Natal, Oribi Gorge, dripping rocks (Williamson 1994).
- 362.** RSA, KwaZulu Natal, Oribi Gorge, shallow pools beside Umzimkulwana River (Williamson 1994).
- 363.** RSA, Cape Province, Table Mountain plateau, shallow pools (Williamson 1994).

364. RSA, Cape Province, Paarl Mountain Nature Reserve, roadside streamlet (Williamson 1994).

365. RSA, Cape Province, Paarl Mountain Nature Reserve, scraping from dam wall near visitor centre (Williamson 1994).

366. RSA, Cape Province, Paarl Mountain Nature Reserve, Bethel Dam (Williamson 1994).

367. RSA, Cape Province, Cape of Good Hope Nature Reserve, small pond and drainage ditches (Williamson 1994).

368. RSA, Cape Province, Bain's Kloof near Worcester, wet rocks (Williamson 1994).

369. 38. RSA, Cape Province, Bain's Kloof near Worcester, roadside streamlet (Williamson 1994).

370. RSA, Cape Province, Little Karoo Desert, roadside pool (Williamson 1994).

371. RSA, Cape Province, roadside pond near Grahamstown (Williamson 1994).

372. RSA, Transvaal, Brakpan, lake near Dalpark (Williamson 1994).

373. RSA, Transvaal, roadside pond and bog near Warburton (Williamson 1994).

374. RSA, Transvaal, Kruger National Park, pool in Sand River near Skukuza (Williamson 1994).

375. RSA, Transvaal, lake near Lochiel (Williamson 1994).

376. RSA, Ciskei, roadside pond midway between Bisho and the Keiskammer River (Williamson 1994).

377. SWA, Mbabane, stream near Parliament buildings (Williamson 1994).

378. SWA, Usuto River, pools near margin (Williamson 1994).

379. RSA, Orange Free State, Golden Gate Highlands National Park, Clarens north facing sandstone cliff (S 28°31', E028°37'), 2050 m above sea level, Moses-cave, on rock surface in seepage zone, May 1991 (Wessels, Büdel, 1995).

380. RSA, Western Cape, Little Karoo, shallow pool some 2-3 meters long, 1-2 meters wide and about 5cms deep alongside the road (R62) between Barrydale and Oudtshoorn (exact location cannot be given). The pool had the appearance of being a long-standing watery depression so was probably semi-permanent and fed by a spring. Sample was taken using a bulb pipette trailed across the mud surface was patchily covered with green algal growths (Williamson 1995, 1996).

381. RSA, Mpumalanga, Eastern Transvaal, roadside pond near Warburton, 14.09.1989. Sample was obtained by using a hand-held collecting net with a mesh size of 100 μm (Williamson 1996).

382-385. RSA, KwaZulu Natal, Krantzkloof Nature Reserve, wet rocks near waterfall. Sample **382** collected 1.03.1987, sample **383** - 14.08.1988, sample **384** - 29.01.1989, sample **385** - 4.09.1991 (Williamson 2000).

386-388. RSA, KwaZulu Natal, dripping rock face beside N3 freeway near Hammersdale. Sample **386** collected 4.09.1987, sample **387** - 26.03.1989, sample **388** - 4.09.1991 (Williamson 2000).

389. RSA, KwaZulu Natal, Queen's Causeway, Royal Natal National Park, 29.10.1988 (Williamson 2000).

390-394. RSA, KwaZulu Natal, Umgeni Valley Nature Reserve, Howick. Sample **390** collected 27.11.1987, sample **391** - 20.03.1988, sample **392** - 2.09.1991, sample **393** - 29.09.1991, sample **394** - 5.05.1988 (Williamson 2000).

395. RSA, KwaZulu Natal, Rosetta, wet rocks at waterfall, 2.08.1988 (Williamson 2000).

396. RSA, KwaZulu Natal, Oribi Gorge, dripping rock face, 7.09.1991 (Williamson 2000).

397. RSA, KwaZulu Natal, near Drummond, dripping rock face, 4.09.1991 (Williamson 2000).

398. RSA, Western Cape, near Ceres, Bain's Kloof, wet rocks, 12.01.1988 (Williamson 2000).

399. RSA, Western Cape, Paarl Mountain Nature Reserve, scrapings from wall of dam weir, 11.11.1987 (Williamson 2000).

400-411. BOT, Okavango Delta, Chief's Island, sampled from a mokoro by squeezing submerged plants, preferably those with finally dissected leaves, such as *Utricularia* species. Specification of samples: **400** – S 19°30'20", E 23°08'46", conductivity 107 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 03, 2006; **401** – S 19°30'18", E 23°08'31", conductivity 102 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 03, 2006; **402** – S 19°30'15", E 23°08'25", conductivity 110 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 03, 2006; **403** – S 19°30'13", E 23°08'20", conductivity 126 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 03, 2006; **404** – S 19°30'12", E 23°08'19", conductivity 170 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 04, 2006; **405** – S 19°30'09", E 23°07'33", conductivity 99 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 04, 2006; **406** – S 19°30'08", E 23°07'27", conductivity 98 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 04, 2006; **407** – S 19°30'27", E 23°08'50", conductivity 102 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 05, 2006; **408** – S 19°30'34", E 23°09'08", conductivity 153 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 05, 2006; **409** – S 19°30'33", E 23°09'13", conductivity 118 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 05, 2006; **410** – S 19°30'44", E 23°08'47", conductivity 117 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 06, 2006; **411** – S 19°30'36", E 23°08'59", conductivity 107 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 06, 2006 (Coesel, van Geest 2008, 2009).

412-418. BOT, Okavango Delta, Moremi Wildlife Reserve, sampled from the firm shore by squeezing submerged plants, preferably those with finally dissected leaves, such as *Utricularia* species. Specification of samples: **412** – S 19°14'12", E 23°21'13", conductivity 301 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 08, 2006; **413** – S 19°14'17", E 23°21'17", conductivity 65 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 08, 2006; **414** – S 19°15'07", E 23°24'09", conductivity 201 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 09, 2006; **415** – S 19°14'11", E 23°21'12", conductivity 62 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 09, 2006; **416** – S 19°16'58", E 23°22'32", conductivity 96 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 09, 2006; **417** – S 19°11'40", E 23°16'15", conductivity 50 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 10, 2006; **418** – S 19°11'41", E 23°16'15", conductivity 55 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 10, 2006 (Coesel, van Geest 2008, 2009).

419, 420. NAM, Caprivi Strip, Mohango Game Reserve, sampled from the firm shore by squeezing submerged plants, preferably those with finally dissected leaves, such as *Utricularia* species. Specification of samples: **419** – S 18°13'20", E 21°45'10", conductivity 44 $\mu\text{S}\cdot\text{cm}^{-1}$; sample **420** – S 18°13'19", E 21°45'10", conductivity 61 $\mu\text{S}\cdot\text{cm}^{-1}$ (Coesel, van Geest 2008, 2009).

421-424. NAM, Caprivi Strip, Caprivi Game Park, sampled from the firm shore by squeezing submerged plants, preferably those with finally dissected leaves, such as *Utricularia* species. Specification of samples: **421** – S 17°46'15", E 23°20'21", conductivity 135 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 13, 2006; **422** – S 17°52'33", E 23°19'06", conductivity 720 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 13, 2006; **423** – S 17°52'58", E 23°19'06", conductivity 132 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 13, 2006; **424** – S 17°52'37", E 23°18'19", conductivity 147 $\mu\text{S}\cdot\text{cm}^{-1}$, coll. October 14, 2006 (Coesel, van Geest 2008, 2009).

425. RSA, Western Cape Province, De Klip, Cape Flats, a few miles from Cape Town, from dry floors of the pools that still form in the wet season, December 24 1960 (Pocock, 1962).

426. Kingdom of Lesotho, Mohale Dam, samples collected in 2003 and 2006 in following points: Jordane (where the Jordane River enters Mohale Dam), Senbok (at the confluence of the Bokong and Senqunyane Rivers), Intake (at the intake tower) and Dam Wall (a position close to the dam wall) (Janse van Vuuren and al. 2007).

427. RSA, KwaZulu Natal Province, Midmar (29°30'S, 30°12'E) and Albert Falls (29°26'S, 30°26'E) Dams on the upper uMngeni River, sampled between 1989 and 1997 (Hart 2006).

428. RSA, KwaZulu Natal Province, Lake Sibaya, limnetic zone (Allanson and al. 1974).

429. RSA, KwaZulu Natal Province, Lake Sibaya (Hart, Hart 1977).

430. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone I, the source region on the southern flanks of the Witwatersrand, sampling sites chosen were originating springs at over 1707 meters a.s.l. and on Witwatersrand quartzites (Hancock 1973).

431. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone II is the region so drastically altered by pollution from mine-dumps. It commences on the high Witwatersrand quartzites, continues over basic lavas and terminates at the commencement of the dolomite beds. Sub-Zone IIa was comprised of the head waters which were subject to sand dump pollution, sites were found to be suitable, on streamlets which ultimately lead into the Klipspruit and both near sand dumps. Mine roads crossed just below the sites, and so dammed up the water sufficiently for swamp vegetation to develop; in the summer months light was considerably reduced by the heavy growth of *Phragmites* and of *Typha* (Hancock 1973).

432. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone II is the region so drastically altered by pollution from mine-dumps. It commences on the high Witwatersrand quartzites, continues over basic lavas and terminates at the commencement of the dolomite beds. Sub-Zone IIb consisted of the upper reaches which were subject to maximum mineral and acid pollution from the slimes-dams. Sampling sites were selected to cover the Klip river, the Klipspruit and their smaller tributaries. After ten months of sampling no living microscopic organisms had been found in this sub-zone, so sampling and water analyses were discontinued. The lifeless condition was obviously aggravated by the constantly moving bed of sand. The only living thing able to resist these conditions at all was *Phragmites communis* which developed along the stream margins and on the spits of sand in the stream beds (Hancock 1973).

433. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone III was termed the recovery zone for here living algae were again obtained in the samples, the verges now carried vegetation and the stream beds were stable enough for pioneer aquatics to develop. Sub-Zone IIIa was that part of the Klip river flowing over dolomite limestone and of the Klipspruit flowing over basic lavas and before these two streams merged in Olifantsvlei (Hancock 1973).

434. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone III was termed the recovery zone for here living algae were again obtained in the samples, the verges now carried vegetation and the stream beds were stable enough for pioneer aquatics to develop. Sub-Zone IIIb was a stony run at the outlet of Olifantsvlei where a fairly deep channel had been cut down and over which a road

bridge had been built. Quarrying for the bridge had left a pool of approximately 3 meters deep in the middle of the stony run. This sub-zone contained one main stream formed by the combination of the Klipspruit and Klip river and the bed was of dolomite limestone (Hancock 1973).

435. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone IV consisted of the alkaline middle reaches over dolomite limestone. For the first 18 kilometers the water table was very high so that the whole course had become wide and densely covered by reeds and other hydrophytes through which the water moved slowly and in which recovery from mine-dump pollution was completed. Two sites were selected for sampling, site 7 at the end of the reed swamp stretch and below a pulp and paper mill where the Klip river formed a small pool about a meter deep, and site B some eight kilometers further downstream and just below the entrance of the Natal-Rietspruit. Here the augmented water flowed briskly and had cut down the bed to form a channel about 3 meters deep and 15 to 20 meters wide. The banks and verges were quite devoid of vegetation as they were dry and the soil was friable and unstable (Hancock 1973).

436. RSA, Gauteng Province, Klip River (tributary of Vaal River). Zone V was the Vaal river area of Eccca Shales which make the water so turbid. The Klip river is wide, deep and slow moving here because of the damming-up effect of the Vaal river; the water is right up to the verges which are fringed with *Phragmites* and *Typha* (Hancock 1973).

Notes. See map of Griqualand West showing the principal localities (samples **131-175**) from which collections have been made, on p.2 (Fritsch, Rich 1930).

See map of sampling localities for samples **239-298** on Figs.1 and 2 (Claassen 1961).

Samples **332-378** were collected during the period January 1987 to June 1989 and during short visit in September 1991 (Williamson 1994).

Sample **370** which is present in list of samples in (Williamson 1994) did not used in characterization of distribution of desmid taxons (but several taxons in article mistakenly have no information about samples in which they were recorded).

CLASS: CONJUGATOPHYCEAE
ORDER: ZYGNEATALES
FAMILY: MESOTAENIACEAE
(Saccoderm Desmids)

CYLINDROCYSTIS MENEGH. EX DE BARY

1. CYLINDROCYSTIS BARBARICA CLAASSEN

Illustrations. Tab.3, fig.1 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis C. crassae De Bary, sed cellulis 1.2-1.4 plo longioribus quam latioribus, etiam forma chromatophorum differt, quippe quibus processus minus sint radiantes.*

This species superficially agreed with *C. crassa* De Bary (West, West 1904, p.59, Pl.IV, figs.33-38); but the cells are about 1.2-1.4 times longer than broad and the chloroplasts possess fewer radiating processes. Cells small, unconstricted, subcylindrical, with the apices broadly rounded; cell wall smooth and colorless; chloroplasts stellate with a few radiating processes. Length 28.0-32.0 μm ; breadth 23.0-24.0 μm (Claassen 1961).

2. CYLINDROCYSTIS BREBISSEONII MENEGH.

- VAR. BREBISSEONII

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 62, 123, 128, 129, 226, 430, 431, 434.

Note. Long., 51.0 μm ; lat., 17.0 μm (Fritsch, Stephens 1921).

Very often in all types of the soils (orig.)

- VAR. MINOR W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 62, 237.

Note. Long., 36.0 μm ; lat., 12.0 μm (Fritsch, Stephens 1921).

In article (Hodgetts 1926) indicated this variety with note about dimensions (Long. cell., 32.0-42.0 μm ; lat., 11.0-14.0 μm), but absent information about sample(s) where variety was found.

In (Cholnoky 1955) indicated as *Cylindrocystis brebissonii* Menegh. var. *minus* W. et G.S. West.

3. CYLINDROCYSTIS CAFFRA CLAASSEN

Illustrations. Fab.3, fig.2 (Claassen 1961).

Samples. RSA: 252, 253.

Note. *Affinis C. brebissonii Menegh., sed cellulis latioribus, etiam forma chromatophori differt.*

This species somewhat resembles *C. brebissonii* Menegh. (West, West 1904, p.58, pl.IV, figs.23-32; Pl.V, fig.10); but the cells are broader than in Meneghini's species and the shape of the chloroplast differs. Cells of medium size, cylindrical, unconstricted, about 1.7-2.6 times longer than their diameter, apices rounded, chloroplasts with a few radiating prolongations; cell wall smooth and colorless. Length 36.0-58.0 μm ; breadth 20.0-24.0 μm (Claassen 1961).

4. CYLINDROCYSTIS CRASSA DE BARY

- VAR. CRASSA

- F. CRASSA

Illustrations. Fig.20, A (Fritsch 1918).

Samples. RSA: 24, 25, 31, 49 (here common), **128, 129** (rare), **227.**

Note. Long. cell., 30.0-50.0 μm ; lat. cell., 18.0-25.0 μm .

In sample **49** the individuals mostly had thick membranes, whilst large masses of fat occurred in the cells, which were evidently in more or less of a resting condition. Side by side with specimens of the typical shape were others in which one end was more or less truncate, whilst the other was broadly rounded; one end was sometimes rather broader than the other (Fritsch 1918).

Long. cell., 45.0-60.0 μm ; crass., 24.0-28.0 μm . A form rather larger than the type. Cells were occasionally seen which fell within limits, but usually this size was exceeded. Perhaps it should be regarded as a new form (Hodgetts 1926).

In this material I saw quite short specimen (for example 37.5 μm long and 18.0-19.0 μm wide) (Cholnoky 1955).

Very often in all types of the soils (orig.)

- F. TENUIS HODGETTS

Illustrations. Fig.6, A-C (Hodgetts 1926).

Samples. RSA: 123 (rather rare).

Note. *F. paulo tenuior quam forma typica*. Long. cell., 19.0-27.0 μm ; lat. cell., 12.8-16.0 μm . This should probably be considered as a narrow form of *C. crassa*. The chloroplasts are substellate. The general shape of the cell resembles *C. crassa* rather than *C. brebissonii* f. *minor*, the latter being relatively longer than the present form. The only real difference from the typical form of *C. crassa* is the narrower width of the cells. Frequently, especially in young individuals, one end of the cell was rather broader than the other, and sometimes also more or less truncate (Fig.6, B, C), a condition which has also been noticed in the typical form of *C. crassa* by Fritsch (Fritsch 1918, pt.7, p.541, fig.20, A) (Hodgetts 1926).

5. CYLINDROCYSTIS ORNATA FRITSCH

Illustrations. Fig.20, C (Fritsch 1918).

Samples. RSA: 49 (rare).

Note. *C. mediocris, cellulis diametro ca. duplo longioribus, in media parte modice constrictis; semicellulis ovalibus, prope mediam partem latissimis, polis rotundatis vel exigue truncatis; membrana rubescente, granulis parvis numerosis in tota superficie oblecta; chromatophora processibus paucis magnis, pyrenoide singulo*. Long. cell., 54.0-57.0 μm ; lat. cell., 27.0-30.0 μm .

The species is distinguished from all those hitherto described by the form of the cell and the granulation of the membrane. The latter is faintly reddish and provided with numerous fine granules, which cover it uniformly (Fritsch 1918).

6. CYLINDROCYSTIS PYRAMIDATA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 5

Note. Long. 39.0 μm ; lat. 24.0 μm ; lat. isthm. 22.0 μm (West 1912).

MESOTAENIUM NÄGELI

7. MESOTAENIUM BREBISSONII MENEGH.

- VAR. MINOR W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198 (very rare), **201** (very rare).

Note. Long cell., 27.0-33.0 μm ; lat., 11.0-12.0 μm (Fritsch, Rich 1938).

8. MESOTAENIUM CHLAMYDOSPORUM DE BARY

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 30, 55, 219.

Note. Fritsch (1918) mistakenly indicated "already recorded by Reinsch from summit of Table Mountain".

9. MESOTAENIUM MACROCOCCUM (KÜTZ.) ROY ET BISSET.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 222.

10. (?) MESOTAENIUM MIRIFICUM W. ARCH.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 226.

Note. We think it is a mistake in (Cholnoky 1955) where this algae indicated as *Microtaenium mirificum* Arch. Some of the cells reaches a length of 48.0 μm (Cholnoky 1955).

11. MESOTAENIUM VIOLASCENS DE BARY

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 55.

Members of this genus which was not identified to the species level were occurred in following samples: **RSA: 430, 431.**

NETRIUM (NÄGELI) ITZIGSOHN ET ROTHE EMEND. LÜTKEMÜLLER

12. NETRIUM DIGITUS (EHRENB.) ITZIGS. ET ROTHE

- VAR. **DIGITUS**

Illustrations. Pl.1, Fig.7 (Williamson 1994).

Samples. RSA: 19 (very rare), **49, 89, 91** (common), **92, 205** (rather common), **219, 223-227, 230-235, 240, 253, 256, 259, 265, 269, 270, 290, 292, 293, 294, 299, 300, 332, 336, 356, 358.** - **NAM: 307.**

Note. Long. cell., 180.0-210.0 μm ; lat. cell., 45.0-54.0 μm (Fritsch 1918).

Long. cell., 210.0-300.0 μm ; lat. cell., 84.0-129.0 μm (Fritsch, Rich 1924).

Sides convex; dimensions 200.0 μm x 54.0 μm (Fritsch, Rich 1938).

Long. cell., 130.0-340.0 μm ; lat., 38.0-95.0 μm (Rich 1940).

Sie ist zweifellos die häufigste Desmidiacee der Rayton-Materialien und ich halte es für auffallend, dass sie in Leeufontein überhaupt nicht vorkommt, weshalb die Art eine mehr stenotypisch azidophile sein muss. In manchen der Fundorte konnte ich auch ausserordentlich grosse Exemplare (bis zur 440.0 μm Länge and 73.0 μm Breite) beobachten, die aber sicher zu der Art gehören und durch die lückenlosen Übergänge keinesfalls als Varietäten aufgefasst werden könnten (Cholnoky 1955).

Several of the specimens measured are considerably smaller than in the typical form namely 92.0-126.0 μm long, 33.0-44.0 μm broad and 15.0-20.0 μm broad near the apices (Claassen 1961).

Length 220.0-294.0 μm ; breadth 52.0-61.0 μm . Specimens at sample **336** with zygospores having a diameter of ca. 80.0 μm (Williamson 1994).

In (Williamson 1994) indicated as *Netrium digitum* (Bréb.) Itzigs. et Rothe var. *digitum*.

Very often in Drakensberg Mountains (orig.)

- VAR. **CONSTRUCTUM W. ET G.S. WEST**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 233.

Note. Long., 240.0 μm ; lat. max., 48.0 μm ; lat. med., 45.0 μm . The constriction was a little more pronounced than in the figures given by W. and G.S. West (1904, p.65, Pl.VI, fig.17) (Fritsch, Rich 1938).

Ich halte die Benennung ähnlicher Formen für verfehlt and gänzlich überflüssig, da auch diese mit lückenlosen Übergängen durch Zwischenformen zu dem Typus gebunden sind (Cholnoky 1955).

- VAR. **LAMELLOSUM** (BRÉB. EX KÜTZ.) GRÖNBL.

Illustrations. Pl.4, 5, 6 (Williamson 2000).

Samples. RSA: 392, 398.

Note. The figure shows a large form with length 491.0 μm , breadth (max.) 68.0 μm , breadth (median) 65.6 μm , these being fairly frequent in the sample. Even larger anomalous forms (length 561.0 μm , breadth (max.) 73.5 μm , breadth (median) 72.0 μm) were present whose chloroplast was composed of parietal rows of oblong-shaped bodies. None of these cells possessed the incised chloroplast margins typical of the species, the margins being smooth and undulatory. W. Krieger (1933, pp.56-57, fig.20) illustrates a similar form of these species (Williamson 2000).

- VAR. **LATUM** HUSTEDT

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 300.

Note. Long. cell., 120.0 μm ; lat., 60.0 μm . This is smaller than Hustedt's variety (Hustedt F., 1911, "Desmidiaceae et Bacillariaceae aus Tirol", Archiv für Hydrobiol., etc., Bd.vi, p.314, fig.5), but the proportions are proportions are exactly the same (Rich 1940).

13. **NETRIUM INTERRUPTUM** (BRÉB.) LÜTKEMÜLLER

Illustrations. Fig.153 (Cholnoky 1955).

Samples. RSA: 91, 233.

Note. Long. cell., 336.0 μm ; lat. cell., 77.0 μm ; lat. apic., 32.0 μm (Fritsch, Rich 1924).

Einige der gesehenen Exemplare sind kleiner als der Typus. Einen Teilungszustand habe ich auf der Fig.153 dargestellt, da dieser nicht nur die Entwicklung der Chloroplastenhälften, sondern auch die Teilung der Pyrenoiden tadellos zeigt. Der Chloroplast scheint in die sich mit unregelmässigen Konturen streckende neue Zellhälfte hineinzuwachsen. Es ist auch merkwürdig, dass die Wand der neuen Zellhälfte der inneren Lamelle der Wandung der älteren Hälfte entspricht (Cholnoky 1955).

14. **NETRIUM NAEGELII** (BRÉB.) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 91, 214, 215, 217, 218, 238, 300.

Note. Long. cell., 83.0-99.0 μm ; lat. cell., 30.0-35.0 μm (Fritsch, Rich 1924).

Long. cell., 29.0-35.0 μm ; lat. 115.0-132.0 μm (Rich 1940).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, KwaZulu Natal (orig.).

15. **NETRIUM OBLONGUM** (DE BARY) LÜTKEMÜLLER

- VAR. **OBLONGUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 430.

- VAR. **CYLINDRICUM** W. ET G.S. WEST

- F. **CYLINDRICUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 24, 25, 44, 49, 227, 238, 259.

Note. In sample **238** I've also seen individuals who were actually transitional forms to the species (Cholnoky 1955).

- F. **CURVATA** FRITSCH

Illustrations. Fig.20, *B* (Fritsch 1918).

Samples. RSA: 24, 25, 49, 201.

Note. *Cellulis exacte cylindricis, sed plus minus evidenter curvatis, polis rotundatis.* Long., 48.0-72.0 μm ; lat., 15.0-17.0 μm (Fritsch 1918).

Very similar in shape to the form described by Fritsch from the Cape Province, but smaller. The curvature is very slight. Long., 30.0-37.0 μm ; lat., 10.0-12.0 μm (Fritsch, Rich 1938).

ROYA WEST ET WEST

16. ROYA ANGLICA G.S. WEST

Illustrations. Pl.2, Fig.3 (Williamson 1994).

Sample. RSA: 336.

Note. Length 43.0-106.0 μm ; breadth 5.6-7.7 μm ; apices 3.5-5.0 μm . West and West (1904: 106) expressed the view that *Roya* did not possess apical vacuoles nor moving crystals, but the original description was emended by Hodgetts (1920) to include the presence of apical vacuoles following the discovery of *Roya anglica* West (West and al. 1923: 159). Vacuoles with crystals were clearly seen in the author's specimens and have also been well portrayed by Růžička (1967) (Williamson 1994).

In soils, Transvaal (orig.)

SPIROTAENIA BRÉB. EX RALFS

17. SPIROTAENIA CONDENSATA BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 91, 430, 431, 435. - NAM: 305.

Note. Long. cell., 99.0-150.0 μm ; lat. cell., 19.0-21.0 μm . The dimensions were thus on the whole less than those given by Messrs. West in their monograph, but such small forms have already been recorded by Boergesen and Nordstedt (Fritsch, Rich 1924).

Often in Drakensberg Mountains in high-altitude bogs (orig.)

18. SPIROTAENIA MINUTA THUR.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 226.

19. SPIROTAENIA OBSCURA RALFS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 226.

ORDER: DESMIDIALES (Placoderm Desmids)

SUB-ORDER: CLOSTERIINEAE

FAMILY: GONATOZYGACEAE

GONATOZYGON DE BARY

20. GONATOZYGON ACULEATUM HASTINGS

- VAR. ACULEATUM

Illustrations. Pl.1, Fig.1 (Williamson 1994).

Samples. RSA: 202 (very rare), **343, 356.**

Note. Cells only 8 μm wide. (Fritsch, Rich 1938). In (Fritsch, Rich 1938) mistakenly indicated: previously recorded for the Transvaal.

Length 180.0-281.0 μm ; breadth 8.2-15.7 μm ; apices 10.0-7.0 μm ; ratio of length to breadth 17.8-22.0 (Williamson 1994).

- VAR. GROENBLADII RUZ.

Illustrations. Pl.1, Fig.2 (Williamson 1994).

Samples. RSA: 355.

Note. Length 213.0 μm ; breadth 9.8 μm ; apices 11.2 μm (Williamson 1994).

21. GONATOZYGON BREBISSONII DE BARY

- VAR. BREBISSONII

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 108 (rather rare), **112, 116** (very rare), **238.** - **NAM: 305.**

Note. *Forma brevior*; long. cell., 75.0-120.0 μm ; lat. cell., 10.0-12.0 μm ; *membrana minute est dense granulata.*

Some of the individuals present closely resembled var. *laeve* (Hilse) W. & G.S. West, in the capitate poles, but differed in the width of the cells and the dense granulation of the membrane. There were five pyrenoids in each chloroplast (Fritsch, Rich, 1924).

Note of R. Grönblad: "*Cellulis longissimis*" (Grönblad, Croasdale 1971).

Often in Drakensberg, Magaliesberg Mountains, Western Cape (orig.).

- VAR. LAEVE (HILSE) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 235, 237, 238.

- VAR. MINUTUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 199 (very rare), **226.**

Note. Long., 60.0 μm ; lat., 4.0 μm . Cell-wall minutely granulate (Fritsch, Rich 1938).

22. GONATOZYGON KINAHANI RABENH.

Illustrations. Pl.1, Fig.5 (Williamson 1994).

Samples. RSA: 335.

Note. Length 231.0 μm ; breadth 13.3 μm ; apices 13.5 μm ; ratio of length to breadth 17.4 (Williamson 1994).

23. GONATOZYGON MONOTAENIUM DE BARY

Illustrations. Pl.1, Fig.3 (Williamson 1994).

Samples. RSA: 225, 230, 254. - **NAM: 301, 105, 306, 307, 349.**

Note. Length 210.0-230.0 μm ; breadth 8.0-10.0 μm ; apices 10.0 μm ; ratio of length to breadth 23.0-26.0. All the specimens examined had punctate cell wall. There was no evidence of stumpy or reduced spines. This is reminiscent of

Croasdale's forma *punctatum* (1965, Pl.1, Fig.3) which according to Růžička (1977) is invalid (Art. 37d. Int. Code) (Williamson 1994).

24. GONATOZYGON PILOSUM WOLLE

Illustrations. Pl.1, Fig.4 (Williamson 1994).

Samples. RSA: 213. - SWA: 378.

Note. The fine spines on cell wall surface are a little longer (up to 7.0-8.0 μm) than of European ones but all another features of studied cells as wel as the chloroplasts are very typical (Cholnoky 1954b).

Length 273.0 μm ; breadth 11.6 μm ; apices 12.6 μm ; ratio of length to breadth 23.5. Cell wall projections long and hair-like, not spiny (Williamson 1994).

FAMILY: PENIACEAE

PENIUM BRÉBISSON EX RALFS

25. PENIUM AUSTRALE RACIB.

- VAR. MINUS HODGETTS

Illustrations. Fig.6, *E* (Hodgetts 1926).

Samples. RSA: 124, 125, 126.

Note. Long. cell., 35.0-39.0 μm ; lat., 22.4-24.0 μm ; lat. isthm., 19.0-21.5 μm . This agrees in shape with *P. australe*, especially with the forma *brevior* W. et G.S. West (Journ. Linn. Soc. Bot., xxxviii, 1907, p.108, Tab.6, fig.3), but is much smaller, and has, therefore, been considered as a new variety. The chloroplast is exactly that of a *Penium* rather than a *Cosmarium*, having seven very regular longitudinal ridges which tend to broaden out near the cell-wall. The cell-wall is colourless and punctate. It can be compared with *Cosmarium cucurbita* var. *attenuatum* G.S. West (West, West 1908, p.108, Tab.73, figs.34-36), which, however, is relatively narrower, and has the cemicells more attenuated towards the apices. Also, *C. cucurbita* has an axile chloroplast with "several very irregular ridges" (Hodgetts 1926).

26. PENIUM BARBARICUM CLAASSEN

Illustrations. Tab.3, fig.6 (Claassen 1961).

Samples. RSA: 254, 275, 276.

Note. *Affinis P. margaritaceo* (Ehrenb.) Bréb., *sed granulis membranae diffuse (neque in seribus longitudinalibus) dispositis, membranaque achroa differt.*

This species superficially resembles *P. margaritaceum* (Ehrenb.) Bréb. (West, West 1904, p.83, Pl.VIII, figs.32-35); but the cell wall is colourless and furnished with numerous scattered granules. Cells of medium size, about 3.2-6.3 times longer than their diameter, with a distinct median constriction, apices rounded. Length 70.0-144.0 μm ; breadth 18.0-23.0 μm (Claassen 1961).

27. PENIUM BREBISSONII KÜTZING

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 1.

Note. *Longit. 0.033-0.084 mm, latit. 0.0168 mm. In chartae particula collectioni adita massulae expansae erant compositae ex hac specie* (Reinsch 1878).

28. PENIUM CONSPERSUM WITTRÖCK

- VAR. CAPENSE FRITSCH

Illustrations. Fig.21 (Fritsch 1918).

Samples. RSA: 49 (not uncommon), **50.**

Note. *Semicellulis inflatione exigua, spatio variabili a media cellula posita munitis; membrana achroa; alioqui typo similis est. Long. cell., 65.0-96.0 μm ; lat., 18.0-22.0 μm .*

I believe this form is remarkable to Wittrock's *P. compressum*, of which, however, I have seen no figure. It tallies with the description of this species, except in the fact that the cemicells almost constantly exhibit a more or less marked inflation, some little distance above the base, so that the cell is narrower at its middle than further towards the poles. Moreover, the membrane is colourless. Each chloroplast had two pyrenoids, and there was often a conspicuous mass of fat at either end of the cell. The extremities of the cells vary

considerably in the degree of rounding. Nordstedt (Desm. Arctoeae, Ofvers. K. Vet.-Ak. Foerhandl., 1975, No.6, p.14) also described the membrane as colourless, and Schmidle figures (Weitere Beitr. z. Algenfl. d. Rheinebene u. d. Schwarzwaldes, Hedwigia, xxiv, 1895, p.69, Tab.III, figs.1,2) the granules as being much less densely arranged than in the type or the variety above established (Fritsch 1918).

29. PENIUM COSTATUM HODGETTS

Illustrations. Fig.6, *F* (Hodgetts 1926).

Samples. RSA: 113 (very rare).

Note. *P. cellulis cylindraceis diametro 4-5 plo longioribus, in medio modice constrictis, utrinque levissime attenuatis, apicibus late rotundatis; membrana brunneola, costis longitudinalibus granulatis praedita; granulis costis transversalibus vel plus minusve irregularibus connexis.* Long. cell., 96.0-105.3 μm ; lat. bas. semicell., 22.0-24.0 μm ; lat. apic., 16.0-18.0 μm ; lat. isthm., 18.0-21.3 μm .

The cell-wall is brownish in colour, and furnished with longitudinal granulate ridges (10-11 ridges visible across the cell), the granules being placed at irregular intervals. These longitudinal ridges are connected at irregular intervals by numerous rather finer transverse ridges, each of the latter running from a granule on one ridge to another granule on an adjacent longitudinal ridge, and running either transversely or rather obliquely. At the apex of each semicell the anastomosing ridges become more irregular. The isthmus is free of granules and ridges.

In each semicell is an axile chloroplast with longitudinal ridges (number not determined), and with three pyrenoids, while towards the apex of the semicell is a large vacuole, which (in the living cell) may perhaps contain a few moving granules. The size of the cells, the colour of the cell-wall, and the distribution of the granules recall *P. margaritaceum* (Her.) Bréb., but the peculiar ridges on the cell-wall at once distinguish the present species. Very few individuals were seen, as it was very rare (Hodgetts 1926).

30. PENIUM CRASSIUSCULUM DE BARY

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 230.

31. PENIUM CRUCIFERUM (DE BARY) WITTR.

Illustrations. Fig.154 (Cholnoky 1955); Tab.3, figs.16-17 (Claassen 1961).

Samples. RSA: 120, 214, 219, 221, 224, 227, 228, 230, 232, 265.

Note. Long. cell., 14.0-17.0 μm ; lat., 7.3-8.0 μm . Cells either unconstricted, or with a slight median constriction (Hodgetts 1926).

Manchmal habe ich auch etwas grössere oder zu den grössten bisher bekannten Individuen gehörige Exemplare gesehen. So ein grosses Individuum stellt die Fig.154 dar (Cholnoky 1955).

Penium species ad P. cruciferum (De Bary) Wittr. *Cellulae cum P. crucifero valde congruentes praeterquam quod paulo minores sunt neque ullae costae in chromatophora visae sunt. Zygospora inventa est sed P. cruciferi zygospora adhuc ignoratur.*

This comes very near *P. cruciferum* (De Bary) Wittr. (West, West 1904, p.100, Pl.X, figs.18-19), but the cells are slightly smaller and no ridges were observed in the chloroplasts. A zygospora was found, but the zygospora of *P.*

cruciferum has hitherto been unknown. The cells are very small, about 1.7-2.2 times longer than their diameter; ellipsoid-subcylindrical with slight median constriction, apices rounded; cell wall smooth and colourless; each chloroplast with a central pyrenoid. Zygospore subquadrate, sides concave; cell wall straw-coloured. Length 12.0-13.0 μm ; breadth 6.0-7.0 μm ; diameter of zygospore 12.0-14.0 μm (Claassen 1961).

32. PENIUM CUCURBITINUM BISS.

- VAR. CUCURBITINUM

- F. CUCURBITINUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 221, 269, 430, 436.

- F. BOTESII CLAASSEN

Illustrations. Tab.3, figs.15 (Claassen 1961).

Samples. RSA: 261.

Note. *Affinis P. cucurbitino formae minori* West, *sed cellulis multo minoribus, apice hebetato, punctis in 8 series longitudinales ordinatis differt.*

This species somewhat resembles *P. cucurbitinum* f. *minor* West (West, West 1904, p.95, Pl.IX, fig.16); but the cells are much smaller, with the apices truncate; cell wall punctate, punctae arranged in about eight longitudinal rows. Cells small, about twice as long as broad, with a slight median constriction; chloroplasts with about four longitudinal ridges. Length 24.0-28.0 μm ; breadth 11.0-14.0 μm ; breadth of isthmus 7.0-10.0 μm . Named after Mr. P.W. Botes of Moddernek, Nylstroom (Claassen 1961).

33. PENIUM CURTUM BRÉB.

- VAR. CURTUM

Illustrations. Fig.155 (Cholnoky 1955).

Samples. RSA: 200 (common), **232, 244, 247, 263.**

Note. Long. cell., 28-30 μm ; lat., 16-17 μm (Fritsch, Rich 1938).

Die gesehenen Exemplare waren zwar schlank, durch ihre typische Form kann aber kein Zweifel bestehen, dass auch diese hierher gehören, vielleicht könnten sie als „Forma“ besonders benannt werden (Cholnoky 1955).

- VAR. WATERBERGENSE CLAASSEN

Illustrations. Tab.3, figs.9 (Claassen 1961).

Samples. RSA: 262, 277, 278, 279, 280, 283, 288.

Note. This agree somewhat with the typical form, but differs in the absence of a cell wall thickening at the apices and in the sculpture of the cell wall. Cell wall punctate, punctae arranged an about eight longitudinal rows. Length 27.0-33.0 μm ; breadth 18.0-20.0 μm ; breadth of isthmus 16.0-18.0 μm (Claassen 1961).

34. PENIUM CUTICULARE W. ET G.S. WEST

Illustrations. Fig.156 (Cholnoky 1955).

Samples. RSA: 225.

Note. Da die Art bisher nur selten beobachtet wurde, habe ich ein Exemplar auf der Fig.156 dargestellt (Cholnoky 1955).

35. PENIUM CYLINDRUS (EHRENB.) BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 228, 235, 300.

Note. In (Hodgetts 1926) indicated some notes about dimensions and another features (Long. cell., 34.6 μm ; lat., 10.6 μm . Cells wall brownish, and with uniformly scattered granules as figured by W. and G.S. West (1904, p.84, Tab.6, fig.2)) but absent information about sample(s) in which species was found.

In (Rich 1940) indicated as *Penium cylindrus* (Ehr.) Ralfs.

Cell wall dark brown in colour, furnished with minute scattered granules (Rich 1940).

36. PENIUM GONATOZYGIFORME CLAASSEN

Illustrations. Figs.8-20 (Claassen 1976); Fig.2 (Coesel, van Geest 2008).

Samples. RSA: 308 (fairly abundant), **309** (rather scarce). – **NAM: (?) 419-424. – BOT: (?) 400-418.**

Note. Cells about 5-13.6 times longer than their diameter, cylindrical, with a slight median constriction, apices truncately rounded. Cell wall colourless and furnished with numerous scattered acute spines. Chloroplasts axial, two in each semicell, with 1-3 pyrenoids each. Zygospore subglobose and smooth, surrounded by a lamellated mucous sheath.

Length without spines 80.0-237.0 μm ; with spines 81.5-240.0 μm ; width without spines 12.4-13.3 μm ; with spines 16.8-17.6 μm ; width of apices without spines 10.6-12.4 μm ; with spines 14.0-15.0 μm ; zygospore 28.0 μm x 32.0-33.5 μm ; sheath 36.0-42.0 μm x 46.0-52.0 μm .

This taxon does not correspond to any other *Penium* species in literature available to the author but has a superficial resemblance to *Gonatozygon aculeatum* Hastings (Förster, 1974, Pl.1, Figs.2-12). It is however distinguished from the latter by the placoderm nature of the cell wall and the two chloroplasts contained in each semicell (Claassen 1976).

Most striking characteristic is its cell wall ornamentation in the form of numerous small spines. In that respect *P. gonatozygiforme* resembles given representatives of the genus *Gonatozygon*, in particular *G. aculeatum* Hastings. However, contrary to *Gonatozygon*, a shallow but nevertheless distinct sinus, as well as clearly marked girdle bands may be distinguished. For that matter, from French Guiana Bourrelly (1977) described *G. chadefaudii*, a species very much resembling *Penium gonatozygiforme* and anyhow better to be placed in the genus *Penium*.

In Okavango Delta it appeared to be widely distributed and locally rather common on the site of Chief's Island (Coesel, van Geest 2008).

37. PENIUM JENNERI RALFS

Illustrations. Fig.157 (Cholnoky 1955).

Samples. RSA: 230-232, 235, 240.

Note. Einige Exemplare waren wohl etwas dicker, als es durch die Diagnosen angegeben wird, diese können aber doch keine besondere „Forma“ bilden, and so sind die Diagnosen in dem Sinnen zu verändern, dass einzelne Individuen eine Breite von 17 μm erreichen können. Da die Chromatophoren bisher unbekannt waren stelle ich ein Individuum (nach einem lebenden Exemplar) auf der Fig.157 dar (Cholnoky 1955).

38. PENIUM LIBELLULA (FOCKE) NORDST.

- VAR. LIBELLULA

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 224, 231.

- VAR. **INTERMEDIUM** ROY ET BISS.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 112, 113 (very rare), **226, 228.**

- VAR. **INTERRUPTUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 220, 221, 223, 228, 230, 234, 235.

Note. Einige der gesehenen Exemplare sind wohl bis 110.0 μm lang gewesen, die ich aber doch durch die Struktur ihrer Chromatophoren hier einteilen musste (Cholnoky 1955).

- VAR. **SCHWEICKERDTH** CLAASSEN

Illustrations. Tab.3, fig.7 (Claassen 1961).

Samples. RSA: 120, 265.

Note. *Affinis P. libellulae var. interrupto* W. et G.S. West, *sed cellulis 3.8-5 plo longioribus quam latioribus chromatophoris constrictis neque interruptis differt.*

This approaches *P. libellula* var. *interruptum* W. et G.S. West (West, West 1904, p.74, Pl.VII, figs.9-10); but the cells are shorter, and 3.8-5 times longer than their diameter; chloroplasts constricted and not transversely divided. Cells of medium size, unconstricted, fusiform, apices slightly truncately rounded; chloroplasts with about 10 longitudinal ridges. Length 68.0-108.0 μm ; breadth 16.0-25.0 μm ; breadth near apices 6.0-12.0 μm . Named after Prof. Dr. H.G. Schweickerdt, Head of the Department of General Botany, University of Pretoria (Claassen 1961).

39. PENIUM MARGARITACEUM (EHRENB.) BRÉB.

- VAR. **MARGARITACEUM**

Illustrations. Tab.3, fig.3 (Claassen 1961); Pl.2, Fig.4 (Williamson 1994).

Samples. RSA: 102, 103 (rather rare), **249, 252, 253, 299, 326, 332, 337, 348, 350, 354, 372, 382.**

Note. Long. cell., 120.0-213.0 μm ; lat. cell., 21.0-27.0 μm . The specimens were quite typical, except for the fact that the membrane was colourless (Fritsch, Rich 1924).

In (Huber-Pestalozzi 1929) indicated as *Penium margaritaceum* Ralfs.

Long. cell., 80.0-90.0 μm ; lat., 20.0 μm . There is a distinct median constriction, and the wall is furnished with longitudinal rows of granules (Rich 1940).

Tab.3, fig.3 shows a form during cell-division in which the cell wall is furnished with longitudinal rows of granules, but the granules are irregularly scattered at the apices (Claassen 1961).

Length 85.0-170.0 μm ; breadth 20.0-24.0 μm ; apices 14.5-17.0 μm ; ratio of length to breadth 4.5-8.5 (Williamson 1994). In (Williamson 1994) indicated as *Penium margaritaceum* (Ehrenb.) ex Bréb.

- VAR. **BREVIOR** CLAASSEN

Illustrations. Tab.3, fig.5 (Claassen 1961).

Samples. RSA: 249, 253.

Note. *A typo speciei cellulis valde latioribus fere 3.6-4.8-plo longioribus quam latioribus differt.*

Length in proportion to breadth differs from the typical form; cells 3.6-4.8 times longer than their diameter. Length 84.0-96.0 μm ; breadth 20.0-23.0 μm (Claassen 1961).

- VAR. **INCOGNITUM** CLAASSEN

Illustrations. Tab.3, fig.4 (Claassen 1961).

Samples. RSA: 249.

Note. *A typo speciei semicellulis as basim tumidis similiter ac apud genus Pleurotaenium Näg. differt.*

This variety differs from the typical form in possessing a basal inflation in each semicell to that found in the genus *Pleurotaenium* Näg. Cells large, 7.7-8.4 times longer than their diameter, apices rounded; cell wall yellowish-brown and furnished with longitudinal rows of granules; chloroplasts with about 10 longitudinal plates (or ridges) and showing a median interruption. Length of cell 184.0-185.0 μm ; breadth at base of semicell 22.0 μm ; near basal inflation 18.0-18.5 μm ; at middle of semicell 22.0-24.0 μm ; at apices 16.0-17.0 μm (Claassen 1961).

- VAR. **IRREGULARIUS** W. ET G.S. WEST

Illustrations. Fig.6, C (Fritsch, Stephens 1921).

Samples. RSA: 21, 74 (not uncommon).

Note. Long. cell., 90.0 μm ; lat., 18.0 μm . The cell membrane is colourless, the granules are small, numerous, and scattered; otherwise like type. The dimensions are smaller than those given in the original diagnosis, but G.S. West (Alg. Yan Yean Reservoir, Journ. Linn. Soc., Bot., xxxix, 1909, p.53) has already described a smaller form (Fritsch 1918).

Long. cell., 141.0-204.0 μm ; lat., 22.0-25.0 μm . The specimen in the present sample were rather larger, but still appreciably smaller than those originally described by Messrs. West from the Orkneys and Shetlands (W. et G.S. West, Freshw. Alg. Orkneys and Shetlands, Trans. and Proc. Bot. Soc. Edinburgh, xxiii, 1905, pp.14, 15, fig.23). Another difference lies in the small size of the granules (Fritsch, Stephens 1921).

- VAR. **OBESUM** CUSHMAN.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 299.

Note. Long. cell., 52.0-66.0 μm ; lat., 20.0 μm . The rows of granules, except just near the poles, are fused to form longitudinal striae. Shorter, and relatively stouter, than the type (Rich 1940).

40. PENIUM MESIANUM CLAASSEN

Illustrations. Tab.3, figs.10-13 (Claassen 1961).

Samples. RSA: 241, 258, 261.

Note. *Affinis P. phymatosporo Nordst., sed membrana cellulae granulata haud striata differt.*

This is near *P. phymatosporum* Nordst. (West, West 1904, p.91, Pl.VI, figs.9-11); but the cell wall is furnished with minute granules and is not striated. Cells small, more than twice as long as broad, with a slight median constriction; apices truncate rounded; cell wall conspicuously covered with granules; each chloroplast has a single pyrenoid. Length 32.0-42.0 μm ; breadth 13.0-16.0 μm . Named after the late Prof. Dr. M.G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria (Claassen 1961).

41. PENIUM MINUTISSIMUM NORDST.

Illustrations. Fig.6, D (Hodgetts 1926).

Samples. RSA: 119 (very rare), **175** (rather common).

Note. Long. cell., 13.0-13.5 μm ; lat., 8.0-9.0 μm . A few zygospores were seen (Fig.6, D), their shape being subquadrate with slightly prominent corners, to which were attached the empty semicells. The wall of the zygospore was smooth and a brownish tint (Hodgetts 1926).

Long. cell., 14.0-16.0 μm ; lat., 7.0-8.0 μm . All the individuals showed flat, almost parallel sides, and many exhibited a slight constriction (Fritsch, Rich 1930).

42. PENIUM MINUTUM (RALFS) CLEVE

- VAR. PRODUCTUM F.E. FRITSCH

Illustrations. Fig.6, D (Fritsch, Stephens 1921).

Samples. RSA: 62 (rare).

Note. *P. multo brevior et paullo latior quam typo; cellulis in media parte constrictione exigua late aperta praeditis et paullo ante polos rotundato-truncatos levissime constrictis; membrana glabra, hyalina.* Long., 63.0-65.0 μm ; lat., 18.0-20.0 μm .

This variety comes near to var. *tumidum* Wille (*cf.* West, West 1904, p.104, Pl.X, fig.5), in which, however, the median constriction is more pronounced and the subapical contraction is absent; the latter feature gives the ends of the cells of var. *productum* a protruded appearance. The sides of the semi-cell, however, in both cases converge towards the ends, so that the greatest width is a little way above the base. Borge ("Alg. erst. Regnellschen Exped., ii, Desmid.", 'Arkiv. f. Bot.', i, 1903, Tab.I, fig.4) has figured specimens of this species under the name of var. *crassum* West in which there is also a slight convergence of these sides which are not parallel, as in the typical var. *crassum*. These specimens seem to link up vars. *crassum* and *tumidum* (Fritsch, Stephens 1921).

43. PENIUM NAVICULA BRÉB.

- VAR. NAVICULA

- F. NAVICULA

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 237, 240, 277, 278, 279, 280, 282, 283, 287.

- F. MAJOR HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. Long., 91.0 μm ; lat., 15.6 μm ; lat. at ends, 5.5 μm (Huber-Pestalozzi 1930).

- VAR. CRASSUM W. ET G.S. WEST

Illustrations. Figs.158, 159 (Cholnoky 1955).

Samples. RSA: 221, 228, 237.

Note. In alien angeführten Materialien habe ich sehr oft ausserordentlich kurze und dicke Individuen gesehen, die ich aber doch zu dieser bisher nur selten gesehenen Form einteilen musste. Die Exemplare haben oft kaum eine Länge von 30.0 μm bei einer Breite von 10.0-15.0 μm erreicht. Zwei der gesehenen Individuen wurden auf den Figs.158-159 dargestellt (Cholnoky 1955).

- VAR. INFLATUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 214.

44. PENIUM PLYMATOSPORUM NORDST.

- VAR. PLYMATOSPORUM

Illustrations. Fig.20, D (Fritsch 1918).

Samples. RSA: 49 (not uncommon), **231, 240.**

Note. *Forma paullo latior, lateribus leviter convexis, constrictione mediana plane manifesta.* Long. cell., 39.0-43.0 μm ; lat., 18.0-21.0 μm (Fritsch 1918).

The specimens differ from the typical ones in having faintly convex sides and a slightly greater breadth in proportion to the length; the median constriction is also rather more pronounced. This form may be compared with one figured by Borge (Ueb. trop. u. subtrop. Suesswasserchlorophyc., Bih. K. Sv. Vet.-Ak. Handl., xxiv, Afd.3, No.12, Tab.I, fig.7), which, however, lacks the faint longitudinal striations.

The chloroplast appears to be provided with a considerable number of longitudinal ridges, which exhibit frequent interruptions (Fritsch 1918).

- VAR. CRASSULUM CHOLNOKY

Illustrations. Fig.160 (Cholnoky 1955).

Samples. RSA: 229.

Note. Die gesehenen Exemplare waren nur 30.0 μm lang, aber 18.0 μm breit. Sonst stimmen sie mit den Beschreibungen überein. Ich muss aber bemerken, dass hier die Streifung der Wände nur im Phasenkontrast deutlich hervortritt (Cholnoky 1955).

45. PENIUM PSEUDOFURESCENS CLAASSEN

Illustrations. Tab.3, figs.14 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis P. rufescenti Cleve, sed cellula dimidio minore differt; constrictura media haud visa, membrana achroa.*

Near *P. rufescens* Cleve (West, West 1904, p.99, Pl.VI, figs.12, 13); but the cells are only about half the size of those of Cleve's species; no trace of a constriction in the middle of the cell was found; cell wall colourless. Cells small, about 2.5-3 times longer than their diameter, slightly attenuated towards the apices, which are rounded; cell wall smooth. Length 28.0-30.0 μm ; breadth 9.0-12.0 μm (Claassen 1961).

46. PENIUM RUFESCENS CL.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 226.

47. PENIUM RUPESTRE KÜTZING

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 2.

Note. *Latit. cellul. 0.0112-0.013 mm. Longit. 0.0168-0.0196 mm. In massulis gelatinosis inter Jungermannias et Chroolepum Montis Tabulae* (Reinsch 1877).

48. PENIUM SPIROSTRIOLATUM BAKER

Illustrations. Pl.2, Fig.5 (Williamson 1994).

Samples. RSA: 214, 358.

Note. Length 137.0 μm ; breadth 19.0 μm ; apices 9.0-11.0 μm ; ratio length to breadth ca. 7.0. Different sections of a given cell wall may have varying numbers of striae eg. 6-9 in 10.0 μm (Williamson 1994).

49. PENIUM SUBCUCURBITINUM CLAASSEN

Illustrations. Tab.3, fig.8 (Claassen 1961).

Samples. RSA: 269.

Note. *Affinis P. cucurbitino* Biss., *sed cellulis fere duplo longioribus quam latioribus, apice hebetato nec non sculptura membranae differt.*

Near *P. cucurbitinum* Biss. (West, West 1904, p.94, Pl.IX, figs.13, 14); however the cells are about two times longer than their diameter, and the apices are truncate; it also differs in the sculpture of the cell wall. Cells small, subcylindrical, with a slight median constriction, gradually attenuated towards the apices; cell wall furnished with granules. Length 39.0 μm ; breadth 20.0 μm (Claassen 1961).

50. PENIUM VARIOLATUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198.

Note. Smaller than the specimens described from Ceylon (West W, and G.S., 1902, "A Contribution to the Freshwater Algae of Ceylon," Trans. Linn. Soc. (Bot.), vi, 2 ser., p.135). Long. cell., 20.0 μm ; lat., 7.0 μm (Fritsch, Rich 1938).

FAMILY: CLOSTERIACEAE

CLOSTERIUM NITZSCH EX RALFS

51. CLOSTERIUM ABRUPTUM W. WEST

- VAR. ABRUPTUM

- F. ABRUPTUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 238.

Note. In (Cholnoky 1955) indicated as *Cl. abruptum* W. et G.S. West.

- F. AFRICANA FRITSCH ET RICH

Illustrations. Fig.6, A and B (Fritsch, Rich 1924).

Samples. RSA: 91 (rare).

Note. *Cellulis diametro 6-8 plo longioribus, latioribus quam in typo, apicibus interdum paulullum recurvatis, membrana crassa fuscescenti.* Long. cell., 162.0-200.0 μm ; lat. cell., 24.0-26.0 μm ; lat. apic., 12.0-13.0 μm .

The general form of the cells is much like that shown in W. West's original figure (Journ. Roy. Microscop. Soc., 1892, p.719, Pl.IX, fig.1), but relatively shorter. The figures in the monograph (West, West 1904, p.158, Pl.XX, figs.6-10) hardly bring out the straight character of the median portion of the cells which is very obvious in the right-hand individual depicted in W. West's figures, and was very noticeable in some of our specimens (Fig.6, A). Certain individuals also showed an obliquely truncate apex (Fig.6, A, B), like that visible at the lower end of the right-hand cell in W. West's figure. In some cases the apices were very slightly enlarged (Fritsch, Rich 1924).

- VAR. WESTIORUM CLAASSEN

Illustrations. Tab.6, figs.9, 10 (Claassen 1961).

Samples. RSA: 240.

Note. *Affinis C. abrupto var. breviori* W. et G.S. West, *sed cellulis minus arcuatis vel rectis et polis hebetatis differt.*

Near *C. abruptum* var. *brevius* W. et G.S. West (West, West 1904, p.160, Pl.XX, figs.11, 12); but the cells are less curved or practically straight and the apices are more truncate. Cells about 5.9-6.5 times longer than their diameter. Chloroplasts with about eight ridges and a central series of 2-3 pyrenoids. Length 75.0-84.0 μm ; breadth 12.0-13.0 μm ; breadth of apices 6.0-7.0 μm . Named after Messrs. W. and G.S. Smith (Claassen 1961).

52. CLOSTERIUM ACEROSUM (SCHRANK) EHRENBERG

- VAR. ACEROSUM

Illustrations. Pl.2, Fig.2 (Williamson 1994).

Samples. RSA: 6, 7, 20, 42, 43, 58, 59, 76, 117, 118, 120, 156 (rather rare), **299, 341, 343, 344, 350, 390, 392.**

Note. The specimens in sample **20** had very markedly truncate apices (*lat. apic.*, 6.0 μm), although otherwise typical; some of the individuals were, however, rather short (long. cell., 255.0-480.0 μm ; lat., 36.0-37.0 μm). The specimens with a truncate apex were described by Gutwinski as var. *truncatum*, but Messrs. West (West, West 1904, p.148) consider that the character is so variable that it is not enough to warrant a special variety; in sample **20**, however, all the specimens seen possessed this character to a very pronounced extent (Fritsch 1918).

Long., 330.0-405.0 μm ; lat., 34.0-40.0 μm (Fritsch, Stephens 1921).

In sample **117** a few zygospores were seen (diam. 79.0 μm , with a smooth colourless wall) (Hodgetts 1926).

Long. cell., 307.0-370.0 μm ; lat., 37.0-43.0 μm . The specimens had truncate apices, like those of var. *truncatum* Gutwinski (Sprawozdan. kom. fiz. Ak. Umiej. Krakowie, ześć ii, xxvi, 1892, Tab.I, fig.7), which the Wests regard as synonymous with the type (Fritsch, Rich 1930).

In (Rich 1940) indicated as: ? *Closterium acerosum* (Schrank) Ehrenb.

Long. cell., 400.0 μm ; lat., 30.0 μm . Cell wall brown, striolate, but near the apices faintly granulate. Very few individuals seen (Rich 1940).

Length 329.0-500.0 μm ; breadth 31.0-45.0 μm ; apices 5.5-7.0 μm ; ratio of length to breadth 8.0-13.5 (Williamson 1994). In (Williamson 1994) indicated as *Closterium acerosum* (Schrank) Ehrenb. ex Ralfs.

Indicated as *Closterium acerosum* (Schr.) Ehr. ex Ralfs (Williamson 2000).

- VAR. **ANGOLENSE** W. ET G.S. WEST

Illustrations. Pl.3, Fig.2 (Williamson 1994).

Samples. RSA: 350, 374.

Note. Length 700.0-742.0 μm ; breadth 35.0-43.0 μm ; apices 4.2-5.6 μm ; ratio of length to breadth 20.0-21.0 (Williamson 1994).

- VAR. **ELONGATUM** BRÉB.

Illustrations. Pl.2, Fig.1 (Williamson 1994).

Samples. RSA: 350, 374.

Note. Length 642.0-1142.0 μm ; breadth 36.0-46.0 μm ; apices 5.6-7.0 μm ; ratio of length to breadth 17.0-24.0 (Williamson 1994).

- VAR. **MINUS** HANTZSCH

Illustrations. Pl.3, Fig.6 (Williamson 1994).

Samples. RSA: 341.

Note. Length 210.0-220.0 μm ; breadth 20.0-22.0 μm ; apices 5.5 μm ; ratio of length to breadth 9.5-11.0 (Williamson 1994).

- VAR. **WATERBERGENSE** CLAASSEN

Illustrations. Tab.4, figs.6-7 (Claassen 1961).

Samples. RSA: 280.

Note. *Affinis C. aceroso* var. *elongato* Bréb., *sed cellulis valde minoribus et polis hebetatis differt.*

This comes near *C. acerosum* var. *elongatum* Bréb. (West, West 1904, p.148, Pl.XVIII, fig.1); but differs in having smaller cells with truncate apices. Cells of medium size, about 9.5-10.5 times longer than their diameter, inner margin slightly concave, gradually attenuated towards the apices, which are truncate; cell wall yellowish-brown, striated, about 40 striae visible across the cell; chloroplasts with about eight ridges and a central series of 10-15 pyrenoids; terminal vacuoles with a number of moving granules. Length 398.0-432.0 μm ; breadth 41.0-42.0 μm ; breadth of apices 8.0 μm (Claassen 1961).

53. CLOSTERIUM ACICULARE T. WEST

- VAR. **ACICULARE**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 428 (dominant), **429, 430, 434, 436.**

Note. In (Allanson and al. 1974) this species published as *Closterium aciculare*, without indication of authors of taxon.

Closterium ? aciculare T. West was studied for the full period. This desmid was present in low numbers during the summer months, increasing to reach seasonal maxima at the end of the cool season or beginning of the cool/hot transitional periods in 1970/71 although the peak was apparently later in 1969.

Vertical distribution of this species at station I (see map of stations in article), July 6, 1973 (densities given as cells per 0.5 ml).

Depth	0	1	2	3	4	5	6	7	8	9
Density	29	48	30	22	14	31	24	25	47	29
Depth	10	11	12	15	20	25	30	35		
Density	25	22	19	24	40	28	90	39		

Seasonal maxima of this species occurred in the late cool or early cool/warm transitional periods (July/August 1970, August/September 1971) when circulation extended to the bottom at the routine site (Hart, Hart 1977).

- VAR. **SUBPRONUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 320, 325.

54. CLOSTERIUM ACUTUM (LYNGB.) BRÉB.

- VAR. **ACUTUM**

Illustrations. Pl.3, Fig.5 (Williamson 1994).

Samples. RSA: 179 (only 1 specimen was observed), **383, 430, 434.** - **NAM: 307.**

Note. In (Nyygard 1932) this species published as *C. acutum* Bréb.

The specimen seen was 153.0 μm long and 3.0 μm broad; it had four pyrenoids per semicell and one moving granule in the terminal vacuoles, which were not very long, somewhat as in fig.12 (West, West 1904, p.177, t.23, fig.12); cell almost straight, its form corresponding very well to fig.11 (West, West 1904, p.177, t.23, fig.11).

Since only one individual was observed, it is impossible to decide with certainty whether it really belongs to *A. acutum* Bréb. According to E. Wehrle (1927, p.271), this species was in Northern Europe found exclusively in acid water (pH=4.1-62). Since it has, however, been found in Tanganyika, which undoubtedly has water with an alkaline reaction, this fact does not exclude its also occurring in Florida Lake (Nyygard 1932).

In (Hancock 1973) indicated as *C. acutum* (Lyngeb.) Breg.

Length 88.0-126.0 μm ; breadth 5.0-6.0 μm ; apices 1.4 μm ; ratio of length to breadth 17.0-21.0 (Williamson 1994). In (Williamson 1994) indicated as *Closterium acutum* Bréb.

Indicated as *C. acutum* Bréb. in Ralfs (Williamson 2000).

- VAR. **LINEA** (PERTY) W. ET G.S. WEST

- F. **LINEA**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 115, 116, 120, 198.

Note. Long., 73.0-90.0 μm ; lat., 4.6 μm (Hodgetts, 1926).

Zygospore oblong-rectangular, ends concave, angles produced into conical prolongations; long. cum proc., 40.0 μm ; lat. (med.) 14.0 μm (Fritsch, Rich 1938).

- F. **MINOR** CLAASSEN

Illustrations. Tab.6, figs.22 (Claassen 1961).

Samples. RSA: 256.

Note. *A. varietate linea* (Perty) W. et G.S. West *cellulis multo brevioribus (nec angustioribus) differt.*

The cells are considerably shorter than those in var. *linea* (Perty) W. et G.S. West (West, West 1904, p.178, Pl.XXIII, fig.15), but have the same breadth. Cells 16-18 times longer than their diameter; chloroplasts with 3-4 pyrenoids; terminal vacuoles with one moving granule. Length 64.0-88.0 μm ; breadth 4.0-5.0 μm (Claassen 1961).

55. CLOSTERIUM ATOMICUM CLAASSEN

Illustrations. Tab.5, fig.16 (Claassen 1961).

Samples. RSA: 241.

Note. *Affinis C. striolata* Ehrenb., sed differt cellulis multo minoribus, margine ventrali medio incrassato, membrana cellulae 14 striis quae videre possunt ornata.

This is near *C. striolatum* Ehrenb. (West, West 1904, p.122, Pl.XIII, figs.7-16); but the cells are considerably smaller, inner margin tumid in median part. Cells of medium size, 7-8 times longer than their diameter, curved, inner margin concave and tumid in the median portion, gradually attenuated towards the apices, which are slightly truncate; cell wall yellowish-brown, about 14 striae visible across the cell. Length 160.0-196.0 μm ; breadth 22.5-26.0 μm ; breadth of apices 9.0-12.0 μm (Claassen 1961).

56. CLOSTERIUM ARCHERIANUM CLEVE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (May), 329.

Note. Long., 185.0 μm ; lat., 17.0 μm (11 times longer than wide). Cell wall yellowish, striped (Huber-Pestalozzi 1930).

Width, 17.0-18.0 μm ; distance between apices, 180.0 μm (Rich 1932).

57. CLOSTERIUM BARBARICUM CLAASSEN

Illustrations. Tab.6, figs.4-6 (Claassen 1961).

Samples. RSA: 240.

Note. *Affinis C. parvulo* Näg., sed cellulis minus arcuatis, polis hebetatis, vacuolis terminalibus granulo singulo se moventi praeditis differt.

This species differs from *C. parvulum* Näg. (West, West 1904, p.133, Pl.XV, figs.9-12) in the cells having a smaller curvature, the apices being acute and in the terminal vacuoles containing only one moving granule. Cells small, 7-9 times longer than their diameter, curved, inner margin concave, not tumid, gradually attenuated towards the apices, which are truncately-rounded; cell wall smooth and colourless; chloroplasts with six ridges and six pyrenoids. Figs. 5 and 6 show cells which have atypical apices, possibly owing to the fixative used. Length 66.0-92.5 μm ; breadth 8.0-11.5 μm (Claassen 1961).

58. CLOSTERIUM BOYANUM CLAASSEN

Illustrations. Tab.5, fig.13 (Claassen 1961).

Samples. RSA: 282, 283, 288.

Note. *Affinis C. stellenboschensi* Hodgetts, sed cellulis maioribus, minusque arcuatis et apice utroque poro praedito differt.

Near *C. stellenboschense* Hodgetts (W.J. Hodgetts, Trans. Roy. Soc. of S.A., Vol.XIII, 1926, p.74, fig.8); but the cells are larger and less curved, there is a pore at each apex. Cells of medium size, 7.3-7.4 times longer than their diameter, inner margin concave, slightly tumid in the median portion, gradually attenuated towards the apices, which are slightly acutely-rounded; cell wall smooth, straw-

coloured or yellowish, with a pore at each apex; chloroplasts with about six ridges and a central series of five pyrenoids; terminal vacuoles large, with a number of moving granules. Length 167.0-174.0 μm ; breadth 23.0-24.0 μm (Claassen 1961).

59. CLOSTERIUM CAFFRORUM CLAASSEN

Illustrations. Tab.8, figs.4 (Claassen 1961).

Samples. RSA: 288.

Note. *Affinis C. cynthiae* De Not, *sed cellulis multo minus arcuatis et polis hebetatis differt. Membrana cellulae plus minusve 9 striis quae videri possunt ornata.*

This species is near *C. cynthiae* De Not (West, West 1904, p.113, Pl.XI, figs.1-3); but the cells are less curved and have truncate apices. Cells small, curved, inner margin concave, apices truncate; chloroplasts with six ridges and a central series of about four pyrenoids; cell wall yellowish-brown and striated, about nine striae being visible across the cell; terminal vacuoles with a single moving granule. Length 100.0-104.0 μm ; breadth 13.5-14.0 μm (Claassen 1961).

60. CLOSTERIUM CALOSPORUM WITTR.

- VAR. BRASILIENSE BÖRGES

Illustrations. Pl.3, Fig.4 (Williamson 1994).

Samples. RSA: 341, 350, 356.

Note. Length 100.0-183.0 μm ; breadth 7.5-11.0 μm ; apices 1.5-3.0 μm ; ratio of length to breadth 14.5-17.0 (Williamson 1994).

- VAR. MINOR CLAASSEN

Illustrations. Tab.6, figs.20 (Claassen 1961).

Samples. RSA: 241.

Note. *A typo speciei cellulis multo minoribus ad apices hebetato-rotundatis et minus curvatis differt.*

These specimens differs from the typical form (West, West 1904, p.138, Pl.XVI, figs.1-4) in having smaller cells, truncately-rounded apices and a smaller curvature. Cells about 7.7 times longer than their diameter; chloroplasts with a single series of about two pyrenoids. Length 54.0 μm ; breadth 7.0 μm (Claassen 1961).

61. CLOSTERIUM CAPENSE RABENH.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA, near Cape Town, between *Spirogyra capensis* Rabenh. (Rabenhorst 1855).

Note. 1/15-1/12" long, slightly sickle-shaped curve, not bulbous. Ends similar to those in *Cl. acutum* Ralfs (Brit. Desm. T.XXX, F.5) and *Cl. parvulum* Näg. (Einzell. T.VI, C.F.2) however much less, sharply pointed and curved (Rabenhorst 1855).

62. CLOSTERIUM CERATIUM PERTY

- VAR. ANGUSTUM CLAASSEN

Illustrations. Tab.6, figs.14 (Claassen 1961).

Samples. RSA: 241.

Note. *A typo speciei cellulis multo angustioribus (cellula 49.1-56.1 plo longior quam latior) differt. Formae intermediae non visae.*

Cells narrower than in the typical form (West, West 1904, p.176, Pl.XXIII, figs.6-8). Cells about 49.1-56.1 times longer than their diameter; straight for

almost the whole length of the cell; chloroplast with 11-12 pyrenoids. Length 123.5-124.0 μm ; breadth 2.2-2.5 μm (Claassen 1961).

63. CLOSTERIUM CLAASSENII LEVANETS (SYN.: *CLOSTERIUM PSEUDOLUNULA* CLAASSEN 1961, BOTHALIA 7, P.575, TAB.4, FIG.1; NON *CLOSTERIUM PSEUDOLUNULA* BORGE 1909)

Illustrations. Tab.4, fig.1 (Claassen 1961).

Samples. RSA: 264, 265.

Note. *Affinis C. lunulae* (Müll.) Nitzsch, *sed apicibus cellulae herbetatis et minus recurvatis, etiam cellulis angustioribus differt.*

Near *C. lunula* (Müll.) Nitzsch (West, West 1904, p.150, Pl.XVIII, figs.8, 9), but the apices of the cells are truncate and less recurved and the cells are narrower and shorter. Cells of medium size, about 7-8 times longer than their diameter, straight, inner margin fairly straightly tumid in the median part of the cell, gradually attenuated towards the apices, which are truncately rounded; cell wall smooth and colourless; each chloroplast with about 10 ridges and numerous scattered pyrenoids; terminal vacuoles large, with a number of moving granules. Length 372.0-412.0 μm ; breadth 51.5-58.0 μm ; breadth of apices 14.0-16.0 μm (Claassen 1961).

64. CLOSTERIUM CORNU EHRENB.

- VAR. **CORNU**

Illustrations. Fig.1, G (Rich 1940); Pl.3, Figs.1-7 (Williamson 1994).

Samples. RSA: 299, 373, 392. - NAM: 304, 307.

Note. Long. cell., 112.0 μm ; lat., 8.0 μm (Rich 1940).

Length 100.0-130.0 μm ; breadth 5.0-6.6 μm ; apices 1.5 μm ; ratio of length to breadth 20 (Williamson 1994). In (Williamson 1994) indicated as *Closterium cornu* Ehrenb. ex Ralfs.

Indicated as *Closterium cornu* Her. ex Ralfs (Williamson 2000).

- VAR. **ANGUSTUM** CLAASSEN

Illustrations. Tab.6, figs.24 (Claassen 1961).

Samples. RSA: 240.

Note. *A var. minori* Claassen *cellulis paulo angustioribus et polis multo acutioribus differt.*

Near var. *minor* Claassen; but the cells are narrower and the apices more acute. Cells 12.5-19 times longer than their diameter. Length 75.0-77.0 μm ; breadth 3.4-4.0 μm (Claassen 1961).

- VAR. **MINOR** IRÉNÉE-MARIE (SYN.: *CLOSTERIUM CORNU* EHRENB. VAR. *MINOR* CLAASSEN)

Illustrations. Tab.6, figs.23 (Claassen 1961); Pl.1, Figs.4, 5 (Williamson 1994).

Samples. RSA: 256.

Note. *A typo cellulis multo minoribus et poli minus acutis differt. Formae intermediae non visae.*

Cells considerably smaller than in the typical form (West, West 1904, p.157, Pl.XX, figs.1-5), being about 13-17 times longer than their diameter; chloroplasts with about three pyrenoids. Length 64.0-74.0 μm ; breadth 4.0-5.0 μm ; breadth of apices 2.2-2.6 μm (Claassen 1961).

Length 72.0-77.0 μm ; breadth 5.5-6.0 μm ; apices 1.5-2.0 μm ; ratio of length to breadth ca. 13.0. Claassen (1961: 571, Tab.6, fig.23) has described a var. *minor* of *C. cornu* from Transvaal as a new variety but this seems to be identical with the

var. *minor* of Irénée-Marie (1952: Pl.1, Figs.4, 5) (Williamson 1994). In (Williamson 1994) indicated as *Closterium cornu* Ehrenb. ex Ralfs var. *minor* Irénée-Marie. Sample in which this variety was discovered was not pointed in article.

65. CLOSTERIUM CYMBELLAEFORMIS CLAASSEN

Illustrations. Tab.5, figs.15 (Claassen 1961).

Samples. RSA: 240.

Note. *Nulla affinitate obvia. Cellulae naviculares, margo ventralis tenuiter convexus apices hebetati, et membrana cellulae paulo incrassata.*

Cells of medium size, boat-shaped, inner margin slightly convex, apices truncate with a slightly thickened cell wall; cell wall smooth and colourless; chloroplasts with about 10 ridges and a central series of four pyrenoids; subterminal vacuoles large, with a number of moving granules. Length 168.0-171.5 μm ; breadth 28.0-29.0 μm ; breadth of apices 8.0-10.0 μm (Claassen 1961).

66. CLOSTERIUM CYNTHIA DE NOT

- VAR. CYNTHIA

Illustrations. Pl.4, Fig.1 (Williamson 1994).

Samples. RSA: 221, 222, 232, 299, 357, 364. - NAM: 307.

Note. In (Rich 1940) indicated as ? *Closterium cynthia* De Not.

Dist. inter apic., 76.0-86.0 μm ; lat., 12.0-13.0 μm . Cell wall yellow and striolate; one moving granule. The girdle-band was not observed (Rich 1940).

Length 103.0-106.0 μm ; breadth 13.0-14.0 μm ; apices 3.8-4.8 μm ; ratio of length to breadth 7.5-7.7 (Williamson 1994).

- VAR. LATUM (SCHMIDLE) KRIEG.

Illustrations. Pl.4, Fig.2 (Williamson 1994).

Samples. RSA: 341, 350, 390.

Note. Length 66.0-75.0 μm ; breadth 12.5-13.5 μm ; apices 3.5-4.2 μm ; ratio of length to breadth 5.0-5.7. These specimens had an ars ca. 160° with a stout robust appearance. Růžička (1977) however expresses doubt about this variety (Williamson 1994).

- VAR. WATERBERGENSE CLAASSEN

Illustrations. Tab.8, figs.3 (Claassen 1961).

Samples. RSA: 288.

Note. *Differt a typo speciei cellulis minus arcuatis pauloque latioribus, polis minus acutis et membrana plus minusve 13striis quae videri possunt ornata.*

The cells are less curved than in the typical form (West, West 1904, p.113, Pl.XI, figs.1-3); they are slightly broader, the apices are less acute and the cell wall has about 13 striae visible across the cell. Inner margin slightly tumid; cell wall yellowish-brown; chloroplasts with about six ridges and a central series of four pyrenoids; terminal vacuoles with one moving granule. Length 115.0-119.0 μm ; breadth 18.5-20.0 μm (Claassen 1961).

67. CLOSTERIUM DECORUM BRÉB.

- VAR. MINOR CLAASSEN

Illustrations. Tab.5, fig.12 (Claassen 1961).

Samples. RSA: 241, 287, 430.

Note. *Differt a typo cellulis multo minoribus et membrana striis 23-24 quae videri possunt disposita.*

Cells considerably smaller than in the typical form (West, West 1904, p.184, Pl.XVII, figs.7, 8; Pl.XXVIII, figs.1-3) and the cell wall with more striae. Cells of medium size, 10-14.6 times longer than their diameter, curvature somewhat variable, inner margin concave, slightly but broadly tumid in the median portion, gradually attenuated towards the apices, which are truncate; cell wall straw-coloured or yellowish-brown; each chloroplast with a central series of 6-11 pyrenoids. Length 176.0-292.0 μm ; breadth 17.0-20.0 μm ; breadth of apices 4.0-5.0 μm (Claassen 1961).

68. CLOSTERIUM DIANAE EHRENBERG

- VAR. DIANAE

Illustrations. Fig. nostr.3, *F* (Fritsch, Rich 1938); Pl.4, Fig.3 (Williamson 1994).

Samples. RSA: 8, 200, 204, 299, 328, 341, 390. - NAM: 307.

Note. A small form, but otherwise quite typical; long. inter apic. 224.0 μm ; lat. 19.0 μm (West 1912).

Forma minor. Long., 161.2 μm ; lat., 13.0 μm ; 12 times longer than wide, with 6-8 pyrenoids in semicell (Huber-Pestalozzi 1930).

Forma. Dist. inter apic., 197.0-210.0 μm ; lat. med., 17.0-20.0 μm ; lat. apic., circa 6.0 μm .

The Wests lay special stress on the apices in describing this species, emphasizing that the dorsal margin at each apex is obliquely truncate and thickened, and this feature is clearly evident in most of their figures. A considerable number of the other published figures of the species do not, however, show this character, nor is it evident in the individuals encountered in this collection (Fig.3, *F*). The chloroplasts were provided with well-marked ridges (Fritsch, Rich 1938).

Two forms were observed in sample **299**:

(a) Approaching the type (West, West 1904, pl.xv, figs.1, 5). Dist. inter apic., 120.0-124.0 μm ; lat., 16.0 μm . The curvature of the outer margin is about 130° of arc, the inner margin not tumid. The dorsal margin at each apex is obliquely truncate and thickened. Cell wall colourless. The individuals observed seem to be intermediate between the type and var. *arcuatum* (Bréb.) Rabenh.

(b) *Forma* Krieger (Krieger, "Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiol., Suppl. Bd.xi, 1932, p.160, pl.iii, fig.17). Dist. inter apic., 80.0 μm ; lat., 9.0 μm . The curvature of the outer margin is about 120° of arc. I should have ascribed the specimens I found to a variety of *Cl. parvulum* Näg. were it not for the apices of the cells which were characteristic of *Cl. diana*e. Krieger (see above) mentions a form coming in dimensions very near that now under consideration (Rich 1940).

Length 186.0 μm ; breadth 21.6 μm ; apices 4.0 μm ; ratio of length to breadth 8.6. Unfortunately only one specimen was seen, for this remarkably, had a densely punctate cell wall. This feature has been noticed by the author on specimens of *C. diana*e var. *arcuatum* from Shetland Islands but punctae have not been previously described as present in the walls of *C. diana*e (Williamson 1994). In (Williamson 1994, 2000) indicated as *Closterium diana*e Ehrenb. ex Ralfs.

- VAR. ARCUATUM (BRÉB.) RABENH.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 329.

Note. Long., 208.0 μm ; lat., 23.4 μm ; cell wall smooth, yellowish (Huber-Pestalozzi 1930).

- VAR. MINUS DUCCELL.

Illustrations. Pl.4, Fig.4 (Williamson 1994).

Samples. RSA: 192, 351, 371.

Note. Dist. inter apic., 200.0 μm ; lat., 20.0-22.0 μm (Rich 1932).

Length 133.0-148.0 μm ; breadth 10.5-13.5 μm ; apices 2.0-3.0 μm ; ratio of length to breadth 11.0-12.5 (Williamson 1994). In (Williamson 1994) indicated as *Closterium diana* Ehrenb. ex Ralfs var. *minus* Hieron.

69. CLOSTERIUM DIDYMOTOCUM CORDA

Illustrations. Absent in literature on Southern African desmids

Samples. RSA: 321.

Note. Colorless form, 320 μm long, 13.0 μm width (Huber-Pestalozzi 1929).

70. CLOSTERIUM EHRENBORGII MENEGHINI

- VAR. EHRENBORGII

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 9, 56, 57, 59, 75 (?), 76, 191, 271, 299, 331, 430, 431,

434, 435.

Note. Rather small form; long. 364.0 μm ; lat. 56.0 μm (West 1912).

Width, 72.0-90.0 μm ; distance between apices, 473.0-550.0 μm (Rich 1932).

Long. cell., 560.0 μm ; lat. 100.0 μm (Rich 1940).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

- VAR. CONCAVUM SCHMIDLE

Illustrations. Fig.6, A (Fritsch, Stephens 1921)

Samples. RSA: 74.

Note. *Forma major, margine ventrali in media parte cellulae fere recta.*

Long. cell., 529.0-570.0 μm ; lat., 90.0-102.0 μm (Fritsch, Stephens 1921).

- VAR. MINUTISSIMUM CLAASSEN

Illustrations. Tab.6, fig.21 (Claassen 1961).

Samples. RSA: 269.

Note. *Affinis C. ehrenbergii* Menegh., *sed cellulis fere 5-7-plo minoribus, plis plus hebetatis, vacuolis terminalibus granulo singulo se moventi praeditis differt.*

The cells are about 5-7 times smaller than in the typical form, the apices are more truncate and the terminal vacuoles have a single moving granule. Cells small, 4.1-4.8 times longer than their diameter; cell wall smooth and yellowish; chloroplasts with about six ridges and a central series of five pyrenoids. Length 75.5-77.0 μm ; breadth 16.0 μm ; breadth of apices 5.0-6.0 μm (Claassen 1961).

71. CLOSTERIUM EXIGUUM W. ET G.S. WEST

Illustrations. Pl.4, Fig.7 (Williamson 1994).

Samples. RSA: 170 (rather common), **351, 360.**

Note. Dist. inter apic., 73.0-83.0 μm ; diam., 4.0-6.0 μm (Fritsch, Rich 1930).

Length 62.0-70.0 μm ; breadth 3.5-4.0 μm ; apices <10.0 μm ; ratio of length to breadth 15.4-20.0 (Williamson 1994).

Western Cape, Magaliesberg (orig.).

72. CLOSTERIUM GRACILE BRÉB.

- VAR. GRACILE

Illustrations. Fig.8 (Grönblad, Croasdale 1971); Pl.4, Fig.6 (Williamson 1994).

Samples. RSA: 189, 197, 200, 299, 328, 351. - NAM: 307.

Note. Long., 143.0 μm ; lat., 5.2 μm (Huber-Pestalozzi 1930).

Long. cell., 152.0-170.0 μm ; lat., 4.0-5.0 μm (Fritsch, Rich 1938).

Long. cell., 204.0 μm ; lat., 4.0 μm (Rich 1940).

Long., 147.0 μm ; lat., 4.6 μm (32x). Our forms has narrower apices than the plants figured by Krieger (1937, p.310, 30: 7-9), but Ralfs (1848, p.221) speaks of a "short beak", and this is shown by many authors. R. Grönblad suggested "*Cl. pronum* Bréb. f." but this species is much larger and relatively longer (Grönblad, Croasdale 1971).

Length 226.0 μm ; breadth 6.6 μm ; apices 2.0 μm ; ratio of length to breadth 34.0 (Williamson 1994). In (Williamson 1994) indicated as *Closterium gracile* Bréb. ex Ralfs.

- VAR. BREVIUS CLAASSEN

Illustrations. Tab.6, fig.12 (Claassen 1961).

Samples. RSA: 277, 278, 280, 288.

Note. *A typo speciei cellulis multo latioribus differt. Formae intermediae non visae.*

Cells broader than in the typical form (West, West 1904, p.166, Pl.XXI, figs.8-12). Cells about 11-15.5 times longer than their diameter; chloroplasts with about six ridges and a single series of 4-6 pyrenoids; terminal vacuoles with one moving granule. Length 112.0-136.0 μm ; breadth 8.5-12.0 μm ; breadth of apices 2.2-3.0 μm (Claassen 1961).

- VAR. ELONGATUM W. ET G.S. WEST

Illustrations. Pl.4, Fig.8 (Williamson 1994).

Samples. RSA: 215, 373.

Note. Some of the specimen were shorter than in diagnosis, only 250.0-255.0 μm long, and I use it as transitional forms to the type (Cholnoky 1954b).

Length 287.0 μm ; breadth 5.6 μm ; apices 2.0 μm ; ratio of length to breadth 51.0 (Williamson 1994). In (Williamson 1994) indicated as *Closterium gracile* Bréb. ex Ralfs var. *elongatum* W. et G.S. West.

- VAR. TENUE (LEMM.) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 200.

Note. Long. cell., 111.0-118.0 μm ; lat., 3.5 μm (Fritsch, Rich 1938).

73. CLOSTERIUM HUTCHINSONII RICH

Illustrations. Fig.5, D-G (Rich 1932).

Samples. RSA: 192 (rather common).

Note. *C. mediocre, circ. 9 plo long. quam lat., cum cingulo medians, cellulis leviter curvatis, margine ventrali levissime concavo haud tumido, in parte mediana interdum recto, apices versus leviter curvato, apicibus late truncatis angulis rotundatis; membrane luteo-fusca, striata, striis saepe indistinctis 10-16 trans cellulam manifestis; chromatophoris cum ca. 6 costis longitudinalibus praeditis, pyrenoidibus 7-10 in serie axiilli vel sparsis. Dist. inter apic., 235.0-320.0 μm ; lat. cell., 30.0-33.0 μm ; lat. apic., 7.0-10.0 μm .*

The curvature of the outer margin is from 43° to 53° of arc. The moving granules at the ends of the cells could not be made out at all. The striae on the wall could only be seen in a few individuals. It resembles *Cl. striolatum* Ehrenb., but is distinguished from this species by its straighter inner margin and its narrower apices. It also resembles *Cl. wittrockianum* Turner, but its apices are more truncate (Rich 1932).

74. CLOSTERIUM IDIOSPORUM W. ET G.S. WEST

Illustrations. Pl.5, Fig.2 (Williamson 1994).

Samples. RSA: 349, 360.

Note. Length 200.0-252.0 μm ; breadth 8.0-11.5 μm ; apices 1.4-2.0 μm ; ratio of length to breadth 22.0-24.5 (Williamson 1994).

75. CLOSTERIUM INCURVUM BRÉB.

- VAR. INCURVUM

Illustrations. Pl.4, Figs.35-42 (Williamson 1994).

Samples. RSA: 113, 115, 116 (very rare), **374.** - **NAM: 307.**

Note. Long. cell., 57.0-61.0 μm . Some individuals were seen with only pyrenoid in each chloroplast, but otherwise typical (Hodgetts 1926).

Length 80.0 μm ; breadth 12.0 μm ; apices 1.5 μm ; ratio of length to breadth 6.0-7.0 (Williamson 1994).

- VAR. ELABORATUM CLAASSEN

Illustrations. Tab.6, fig.19 (Claassen 1961).

Samples. RSA: 283, 284, 287.

Note. *A typo speciei cellulisminus arcuatis polis minus acutis, vacuolibus terminalibus singulo se moventi granulo praeditis differt.*

This differs from the typical form (West, 1904, p.136, Pl.XV, figs.28-30) in the smaller curvature of the cells, in the terminal vacuoles containing only one moving granule and in the less acute apices. Cells 4.5-6 times longer than their diameter, apices acutely rounded; chloroplasts with six ridges and a central series of two pyrenoids. Length 51.0-52.0 μm ; breadth 8.5-11.0 μm ; breadth of apices 1.5-2.5 μm (Claassen 1961).

76. CLOSTERIUM INSOLITUM CLAASSEN

Illustrations. Tab.8, fig.5 (Claassen 1961).

Samples. RSA: 269.

Note. *Nulla affinitate obvia. Cellulae solum plus minusve 2.8-plo longiores quam latiores, valide arcuatae ad apices rotundatae, membrana achroa glabraque. Chromatophora binis seriebus 2 vel 3 pyrenoidorum ornata.*

This differs from other species of *Closterium* in the cells being rather broad in proportion to their length. Cells of medium size, about 2.8 times longer than their diameter, strongly curved, apices rounded; cell wall smooth and colourless; chloroplasts with about four ridges and two series of 2-3 pyrenoids each. Length 124.0 μm ; breadth 44.0 μm (Claassen 1961).

77. CLOSTERIUM INTERMEDIUM RALFS

- VAR. INTERMEDIUM

Illustrations. Fig.6, D (Fritsch, Rich 1924); Pl.5, Fig.1 (Williamson 1994).

Samples. RSA: 95 (rare), **341, 356, 390, 430.**

Note. *Forma apicibus magis attenuatis, 6-7 μm latis, pyrenoidibus in quaque semicellula 12-13. Dist. inter apic., 298.0 μm ; lat. cell. med., 16.0 μm .*

Groenblad (Act. Soc. pro Fauna et Flora Fennica, xlvii, p.18, Tab.IV, figs.6-9) has already recorded forms of this species with narrower apices than are mentioned in Messrs. West's monograph (West, West 1904, p.125, Pl.XIV, figs.1-5) (Fritsch, Rich 1924).

Length 308.0-315.0 μm ; breadth 26.0-28.0 μm ; apices 11.0 μm ; ratio of length to breadth 11.0-12.0. Cell wall with 5 costae in 10.0 μm (Williamson 1994).

- VAR. **MESIANUM** CLAASSEN

Illustrations. Tab.4, fig.3 (Claassen 1961).

Samples. RSA: 273.

Note. *Affinis* *C. intermedio* var. *hibernico* West, *sed polis non valde arcuatis, membrana cellulae glabra et achroa (quae colore caret) differt.*

This superficially resembles *C. intermedium* var. *hibernicum* West (West, West 1904, p.126, fig.6); but the poles are less incurved; cell wall smooth and colourless and the cells are considerably longer than in West's variety. Cells of medium size, about 19-22.7 times longer than their diameter, moderately curved, inner margin straight in median portion, gradually attenuated towards the apices, which are truncate and slightly incurved; chloroplasts with about eight ridges, and 12-13 pyrenoids in one axile series; terminal vacuoles with a number of moving granules. Length 324.0-364.0 μm ; breadth 16.0-18.0 μm ; breadth of apices 4.0 μm . Named after the late Prof. Dr. M.G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria (Claassen 1961).

78. CLOSTERIUM JENNERI RALFS (SYN.: *CLOSTERIUM CYNTHIA* DE NOT. VAR. *JENNERI* (RALFS) RABENH.)

- VAR. **JENNERI**

Illustrations. Fig.5 (Grönblad, Croasdale 1971).

Samples. RSA: 115, 119 (very rare), **238, 261**. – **NAM: 205.**

Note. In terminal vacuoles I mostly saw only one granule (Cholnoky 1955).

Forma. A relatively thick form that is abruptly and extremely curved. Long., 84.0 μm ; lat., 15.0 μm (5.6x); lat. apic. circa 3.0 μm , 190° of an arc. R. Grönblad has said, in mss, "I would like to keep *Cl. cynthia* and *Cl. jenneri* apart". He suggested both "*Cl. jenneri* var.?" and "*Cl. venus* Kütz. var.?" for this form, but the apices are very thick for *Cl. venus* (Grönblad, Croasdale 1971).

- VAR. **DUBITALIBUS** CLAASSEN

Illustrations. Tab.6, fig.7 (Claassen, Rich 1961).

Samples. RSA: 241.

Note. *Affinis* *C. jenneri* var. *robustum* G.S. West, *sed cellulis minus arcuatis differt.*

This is near *C. jenneri* var. *robustum* G.S. West (West, West 1904, p.136, Pl.XV, figs.26, 27); but the cells are less curved than in West's variety. Cells small, about 6.5-7.4 times longer than their diameter; cell wall smooth and yellowish-brown; chloroplasts with about six ridges and five pyrenoids; terminal vacuoles with 1-2 moving granules. Length 84.0-86.0 μm ; breadth 11.5-13.0 μm ; breadth of apices 5.0-6.0 μm (Claassen 1961).

- VAR. **ROBUSTUM** G.S. WEST

Illustrations. Pl.5, Fig.4 (Williamson 1994).

Samples. RSA: 341, 390.

Note. Length 80.0 μm ; breadth 14.0 μm ; apices 3.0-4.0 μm ; ratio of length to breadth 5.7. Růžička (1977) regards the species as "unklare Art" (Williamson 1994).

79. CLOSTERIUM JUNCIDUM RALFS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 112, 113 (very rare).

80. CLOSTERIUM KNYSNANUM HUBER-PESTALOZZI

Illustrations. Tab.7, Fig.8 (Huber-Pestalozzi 1930); Fig.3, *D, E* (Fritsch, Rich 1938).

Samples. RSA: 200, 205, 299, 300, 329.

Note. 7 times longer than wide, long., 215.8 μm ; lat. in the middle, 31.2 μm ; lat. in the ends, 10.0 μm (Huber-Pestalozzi 1930).

Forma major, apicibus non diverse coloratis. Long. cell., 270.0-340.0 μm ; lat., 25.0-33.0 μm ; lat. apic., 10.0-12.0 μm .

The membrane is reddish-yellow in young, brown in adult individuals. There are rather prominent longitudinal striations extending the whole length of the cell, from 10 to 14 being visible across the middle. Puncta are present between striae. This species stands rather close to *C. striolatum* Ehrenb., with which we had at first identified it. We doubt whether the different colours of the apices upon which Huber-Pestalozzi lays emphasis is a character of much importance (Fritsch, Rich 1938).

Long. cell., 183.0-230.0 μm ; lat., 25.0-30.0 μm ; lat. apic., 12.0-13.0 μm . There were about seventeen striae visible across the middle of the cell. The apices of some individuals showed the darker coloration noted by Huber-Pestalozzi ("Algen aus dem Knysnawalde" Zeitschr. für Botanik., 1930, 23, p.443 et seq.) in his original description (Rich 1940).

81. CLOSTERIUM KRANSKOPENSE CLAASSEN

Illustrations. Tab.4, fig.4, 5 (Claassen 1961).

Samples. RSA: 286.

Note. *Prima facie forma cellulae plus minusve C. cornu* Ehrenb. congruens, sed cellulis 7-plo maioribus, membrana luteo-brunea apicem versus incrassata et plus minusve 60 striis disposita differt.

The shape of the cell (low magnification) agrees with that of *C. cornu* Ehrenb. (West, West 1904, p.157, Pl.XX, figs.1-5); but the cells are about seven times as large as those in Ehrenberg's species; the cell wall is yellowish-brown and striated, with about 60 striae visible across the cell, and the cell walls are thickened at the apices. Cells large, 15-16 times longer than their diameter, moderately curved, inner margin concave, gradually attenuated towards the apices, which are truncately rounded; cell wall with a distinct thickening at each apex; chloroplasts with about six ridges, and a central series of 14-23 pyrenoids; terminal vacuoles with a number of moving granules. Length 765.0-854.0 μm ; breadth 52.0-54.5 μm (Claassen 1961).

82. CLOSTERIUM KUETZINGII BRÉB.

- VAR. KUETZINGII

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 99 (rather rare), **121** (very rare), **192, 328, 430, 434.** - **NAM: 307.**

Note. *Dist. inter apic., 360.0-420.0 μm ; lat. cell., 18.0-19.5 μm* (Fritsch, Rich 1924).

Long., 455.0 μm ; lat., 18.2 μm ; ends, 2.5 μm . Indicated as *Closterium kützingii* Bréb. (Huber-Pestalozzi 1930).

In (Hancock 1973) indicated as *C. kutzingii* Breb.

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.6, fig.1 (Claassen 1961).

Samples. RSA: 241.

Note. *A typo speciei differt quod cellulae media pars multo longius est incrassata.*

The differs from the typical form (West, West 1904, p.186, Pl.XXV, figs.6-11) in the cells being tumid in the median part for a greater distance. Cells about 24 times longer than their diameter; about 16 striae visible across the cell. Length 336.0 μm ; breadth 14.0 μm ; breadth of apices 3.0 μm (Claassen 1961).

- VAR. **VITTATUM** NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 226.

83. CLOSTERIUM LAGOENSE NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 217.

84. CLOSTERIUM LANCEOLATUM KÜTZING

- VAR. **LANCEOLATUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 5, 10, 11, 56, 59, 76, 77, 88 (rare), **96** (rather common).

Note. Long. 264.0-312.0 μm ; lat. 42.0-48.0 μm (West 1912).

Long. cell., 387.0-405.0 μm ; lat., 57.0-66.0 μm (Fritsch, Stephens 1921).

Dimensions: long., 352.0 μm , lat., 45.0 μm (sample **88**); and long., 232.0-278.0 μm , lat., 27.0-30.0 μm (sample **96**). In the individuals found in sample **96** the apices were not as pointed as shown in Messrs. West's monograph (West, West 1904, p.149, Pl.XVII, figs.9, 10), being more like those represented by them in the "Freshwater Algae of Madagascar" (Trans. Linn. Soc. Bot., v, 1895, Pl.IX, fig.21) (Fritsch, Rich 1924).

- VAR. **PARVUM** W. ET G.S. WEST

Illustrations. Fig.6 (Grönblad, Croasdale 1971).

Samples. NAM: 306.

Note. Long., 158.0 μm ; lat., 22.0 μm (7.2x); lat. apic., 4.0 μm ; dorsal margin 33° of an arc; ventral margin 17° of an arc; wall smooth; one crystal in terminal vacuole. R. Grönblad suggested "*Cl. libellula* Focke var. *angustum* var. nov.", but our plant has too great a difference in its degree of curvature of the dorsal and ventral margin. It seems to fit *Cl. lanceolatum* quite well except for its smaller size (Grönblad, Croasdale 1971).

85. CLOSTERIUM LEIBLEINII KÜTZING

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 5, 22, 34, 48, 73, 90 (rare, *forma minor*), **94** (rare, *forma major*), **95** (rather common, *forma major*), **98** (rare, *forma minor*), **108** (common, *forma minor*), **109** (common, *forma minor*), **160** (rare), **163** (rare), **164** (rare), **165** (rare), **166** (rare), **172** (rare).

Note. Lat. 27.0 μm (West 1912).

Some of the specimens had only two pyrenoids in the one chloroplast or other (Fritsch 1918).

Long., 208.0 μm ; lat., 35.0 μm (Fritsch, Stephens 1921).

Forma minor. *Dist. inter apic.*, 90.0-165.0 μm ; *lat. cell.*, 15.0-25.5 μm . The individuals present in the different samples varied considerably in size and in the degree of prominence of the median tumidity. Some specimens from rock crevices in Tugela Gorge approached the var. *minima* Schmidle (Ber. Deutsch. Bot. Ges., xi, 1893, p.548, Pl.XXVIII, fig.1), although more curved.

Forma major. *Dist. inter apic.*, 160.0-210.0 μm ; *lat. cell.*, 27.0-32.0 μm . These larger specimens much resembled the forms of *C. moniliferum* (Bory) Ehrenb., figured by Borge (Arkiv. f. Bot., viii, p.4, fig.4), although not as wide and without the recurved apices. All such forms could with almost equal justification be referred to either species, according as one lays more stress on the degree of curvature or the size (Fritsch, Rich 1924).

Dist. inter apic., 129.0-175.0 μm ; *diam.*, 21.0-30.0 μm (Fritsch, Rich 1930).

86. CLOSTERIUM LIBELLULA FOCKE

- VAR. LIBELLULA

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 35.

Note. Long. cell., 220.0-375.0 μm ; lat., 39.0-51.0 μm ; *lat. apic.*, 6.0-9.0 μm . Some of the individuals had unequally convex sides (Fritsch 1918).

- VAR. INTERMEDIUM ROY ET BISS.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 300. – NAM: 305, 307.

Note. In (Rich 1940) indicated as *Closterium libellula* (Focke) Nordst. var. *intermedium* Roy et Biss.

Long. cell., 83.0-126.0 μm ; lat., 20.0-28.0 μm (Rich 1940).

In article (Grönblad, Croasdale 1971) indicated as *Closterium libellula* Focke var. *intermedium* (Roy et Biss.) G.S. West.

- VAR. INTERRUPTUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 300.

Note. Long. cell., 106.0-120.0 μm ; lat., 27.0 μm (Rich 1940).

87. CLOSTERIUM LINEATUM EHRENB.

- VAR. LINEATUM

Illustrations. Pl.6, Fig.3 (Williamson 1994).

Samples. RSA: 99 (very rare), **184** (rare), **191, 192** (May), **341, 358, 390.**

Note. *Dist. inter apic.*, 600.0 μm ; *lat. cell.*, 26.0 μm (Fritsch, Rich 1924).

Cells 23-30 times longer than their diameter; 19-20 striae visible across the cell. Length 480.0-564.0 μm , breadth 19.0-21.0 μm , breadth of apices 6.0-7.0 μm .

The specimens differ from *C. lineatum* Ehrb., as described by G. and G.S. West only in the cells being 23-30 times as long as broad; W. and G.S. West give 16-24 times (West, West 1904, p.181, t.24, figs.1-5) (Nyygard 1932).

Width, 18.0-22.0 μm ; length, 580.0-690.0 μm . Specimens with the curious double zygospore characteristic of this species were present in Rietfontein (Rich 1932).

Length 554.0-585.0 μm ; breadth 24.0-33.0 μm ; apices 8.5-10.5 μm ; ratio of length to breadth 17.0-26.0. Zygospores observed in sample **358**; length 98.0 μm ; breadth 52.0 μm (Williamson 1994). In (Williamson 1994, 2000) indicated as *Closterium lineatum* Ehrenb. ex Ralfs.

- VAR. **ELONGATUM** (ROSA) CROASD.

Illustrations. Pl.5, Fig.6 (Williamson 1994).

Samples. RSA: 373. – SWA: 377.

Note. Length 756.0-814.0 μm ; breadth 21.5-23.5 μm ; apices 6.0 μm ; ratio of length to breadth 35.0 (Williamson 1994). In (Williamson 1994) indicated as *Closterium lineatum* Ehrenb. ex Ralfs var. *elongatum* (Rosa) Croasd.

- VAR. **MAJOR** HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. Long., 850.0 μm ; lat. in the middle, 66.3 μm ; lat. at ends, 15.6 μm (Huber-Pestalozzi 1930).

88. CLOSTERIUM LITTORALE GAY

- VAR. **CRASSUM** W. ET G.S. WEST

Illustrations. Pl.6, Fig.1 (Williamson 1994).

Samples. RSA: 90 (not uncommon), **344.**

Note. *Dist. inter apic., 234.0-270.0 μm ; lat. cell., 31.0-33.0 μm .* It seems probable that f. *crassior* Borge (Algenfl. d. Tåkernsees, Stokholm, 1921, p.14, Pl.I, fig.6) should be merged in this variety (Fritsch, Rich 1924).

Length 242.0-273.0 μm ; breadth 30.0-31.6 μm ; apices 5.4-6.2 μm ; ratio of length to breadth 7.0-9.0. This taxon is generally considered as smooth-walled and although Růžička (1977) doubts that there are striations, Bourrelly (1961) comments upon and describes fine striae on both the typical plant and the var. *crassum*. On all specimens fine striae, difficult to discern and varying form 17-22 in 10.0 μm were observed (Williamson 1994).

89. CLOSTERIUM LUNULA (MÜLL.) NITZSCH

- VAR. **LUNULA**

- F. **MINOR** W. ET G.S. WEST

Illustrations. Absent in literature on South African desmids.

Samples. RSA: 223.

- VAR. **MAXIMUM** BORGE

- F. **MAXIMUM**

Illustrations. Fig.9 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 608.0 μm ; lat., 159.0 μm (3.8x)(Grönblad, Croasdale 1971).

- F. **CRASSISSIMUM** CROASD.

Illustrations. Fig.10 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Forma magna crassissimaque.* Long., 547.0 μm ; lat., 213.0 μm (2.6x). This form has an exceptionally great relative breadth (Grönblad, Croasdale 1971).

90. CLOSTERIUM MALINVERNIANUM DE NOT. (SYN.: *CLOSTERIUM EHRENBERGII* MENEGH. VAR. *MALINVERNIANUM* (DE NOT.) RABENH.)

- VAR. **MALINVERNIANUM**

- F. **MALINVERNIANUM**

Illustrations. Tab.4, figs.8-11 (Claassen 1961); Fig.4 (Grönblad, Croasdale 1971).

Samples. RSA: 93 (rather rare), **94** (common), **95** (common), **277**, **278**, **279**, **280**, **282**, **283**, **299.** – **NAM: 307.**

Note. *Dist. inter apic.*, 540.0-570.0 μm ; *lat. cell.*, 99.0-120.0 μm . Many of the individuals approached forma *major*, Fritsch recorded from Cape Colony (Ann. S. Afr. Mus., ix, 1918, p.544, fig.22). On the differences, mentioned by Messrs. West (West, West 1904, p.146), between this species and *C. ehrenbergii* Menegh., the coloration and striation of the wall appear to be the only constant ones (Fritsch, Rich, 1924).

Dist. inter apic., 320.0 μm ; *lat.*, 54.0 μm (Rich 1940).

Up to 68 striae visible across the cell. Figs.9-11 are cells soon after division (Claassen 1961).

R. Grönblad preferred to separate *Cl. ehrenbergii* and *Cl. malinvernianum*. Long., 562.0 μm ; *lat.*, 122.0 μm (4.8x); 142° of an arc; 16-18 striae in 10.0 μm (Grönblad, Croasdale 1971).

- F. MAJOR FRITSCH

Illustrations. Fig. 22 (Fritsch 1918).

Samples. RSA: 33 (rare), **299**.

Note. *Differt a typo paullo plus incurvatis, inflatione ventrali indistincta, margine ventrali fere recta usque ad apices incurvatos. Apicibus inter se distantibus, 600.0 μ ; lat. cell., 112.0 μ .*

I have only seen very few specimens of this form, which in dimensions and shape is more like *C. ehrenbergii* Menegh. (cf. especially the var. *conconvum* of Schmidle, in Engler's Bot. Jahrb., xxiii, 1897, p.256), whilst the yellowish-brown colour and fine striation of the membrane bring it nearer to *C. malinvernianum* De Not. Towards the ends of the cells the striae give the impression of being composed of numerous minute granules (Fritsch 1918).

Forma approaching f. *major* Fritsch (1918, p.544). *Dist. inter apic.*, 360.0 μm ; *lat.*, 90.0 μm . The cell wall is yellow and finely striolate. It is wider than the type, but is not so large as the form found by Fritsch in the Cape Peninsula (Rich 1940).

91. CLOSTERIUM MINUTUM ROLL

Illustrations. Tab.7, Fig.7 (Huber-Pestalozzi 1930).

Samples. RSA: 330.

Note. *Forma tenuior.* Long., 31.2 μm ; *lat.*, 3.9 μm (index 8x1), 2 pyrenoids in semicell (Huber-Pestalozzi 1930).

92. CLOSTERIUM MONILIFERUM (BORY) EHRENBERG

- VAR. MONILIFERUM

Illustrations. Fig.36 (Nyygard 1932); Pl.6, Fig.5 (Williamson 1994).

Samples. RSA: 9, 33, 60, 61, 63, 64, 66, 71, 74, 76, 77, 78, 86 (rare), **88** (rather rare), **95** (rare), **96** (rather rare), **116** (very rare), **184** (only 2 specimens were observed), **187** (in this samples and in a pool near), **242, 243, 250, 332, 340, 341, 351, 353, 372, 383, 389, 390, 392, 430, 431, 434.**

Note. *Lat. 46.0 μm* (West 1912).

No indication of the exact sampling locality (Rabenhorst 1855).

Small individuals; *dist. inter apic.*, 180.0-262.0 μm ; *lat. cell.*, 35.0-45.0 μm (Fritsch, Rich 1924).

In (Rabenhorst 1855; Nyygard 1932) indicated as *Closterium moniliferum* Ehrb.

Cells of medium size, 4.4-5.3 times longer than their diameter, outer margins 118-129° of an arc, inner margin inflated in the medium part; cells gradually attenuated towards the rounded apices; cell-wall smooth and colorless;

chromatophores with about ten ridges and a more or less central series of 4-9 pyrenoids. Length 246.0-272.0 μm , breadth 51.5-56.0 μm , breadth of apices 7.0-10.0 μm .

The specimens are rather closely allied to *C. moniliferum* Ehrb. and *C. ehrenbergii* Menegh. The latter, however, differs from the present specimens in the numerous pyrenoids scattered in the chromatophores and in the very large cells. The two specimens observed differ from *C. moniliferum* Ehrb. in their greater curvature, their relatively shorter cells, and the greater number of ridges on the chromatophores; further, the number of pyrenoids (4-9) does not agree with that of *C. moniliferum* Ehrb. (6-7), and the pyrenoids are not disposed in the median series as in that species. O. Borge has described and figured a series of forms of this species from British East Africa (1928, p.99, t.1, figs.7-8), which shows that *C. moniliferum* Ehrb. may be very variable, especially in the degree of curvature and the number of pyrenoids per semicell.

Unfortunately I have only found the two species figures, which show some points of difference, so that a certain identification is impossible (Nyygard 1932).

Length 180.0-315.0 μm ; breadth 35.0-43.0 μm ; apices 7.0-10.0 μm ; ratio of length to breadth 5.0-8.6 (Williamson 1994). In (Williamson 1994) indicated as *Closterium moniliferum* (Bory) Ehr. ex Ralfs.

Indicated as *C. moniliferum* (Bory) Ehr. ex Ralfs (Williamson 2000).

- VAR. EPITHEMIOIDES CLAASSEN

Illustrations. Tab.5, fig.14 (Claassen 1961).

Samples. RSA: 249, 250, 251.

Note. *A typo speciei margine ventrali medio minus tumido, membrana staminea et celulis plerumque paulo minoribus differt.*

Inner margin slightly but broadly tumid; cell wall straw-coloured; cells usually somewhat smaller than in the typical form. Cells 5-7 times longer than their diameter; chloroplasts with about eight ridges and a central series of 5-6 pyrenoids. Length 184.0-240.0 μm ; breadth 34.0-38.0 μm ; breadth of apices 6.0-8.0 μm (Claassen 1961).

- VAR. NASUTUM RICH

Illustrations. Fig.5, B, C (Rich 1932); Pl.6, Fig.2 (Williamson 1994).

Samples. RSA: 191, 372.

Note. *C. mediocre, circ. 6-7 plo long. quam lat.; cellulis modice curvatis, margine ventrali leviter inflato, apicibus truncatis triangularibus (C. nasutum Wolle a Borge 1918 depictis similibus); membrana laevi, hyalina; chromatophoribus cum pyrenoidibus ca. 7 in serie axiali. Dist. inter. apic., 285.0 μm ; lat. cell., 36.0 μm .*

Borge describes a variety *recurvatum* of this species, which is similar to the present one but has only 4 pyrenoids and is more tumid in the centre. Somewhat similar apices occur in *Cl. leiblenii* Kütz. var. *podolicum* Gutwinski, but the variety now under consideration is certainly not in the species *leiblenii* (Rich 1932).

Length 224.0-259.0 μm ; breadth 45.0-46.7 μm ; apices 5.0-6.0 μm ; ratio of length to breadth 5.0-5.5. Cell wall finely striated, the striations difficult to discern, about 20 striae in 10.0 μm . Pyrenoids axile, 5-7 in each semicell. Some specimens slightly tumid at the median inner margin. Růžička (1977: 138) has some doubts as to whether the var. *nasutum* belongs to *C. moniliferum* and says further findings must be awaited. The present specimens would now seem to confirm the relationship of this variety to *C. moniliferum* (Williamson 1994). In

(Williamson 1994) indicated as *Closterium moniliferum* (Bory) ex Ralfs var. *nasutum* Rich.

93. CLOSTERIUM NAVICULA (BRÉB.) LÜTKEMÜLLER (SYN.: *PENIUM NAVICULA* BRÉB.)

Illustrations. Fig.3, A (Fritsch, Rich 1938); Pl.6, Fig.7 (Williamson 1994).

Samples. RSA: **91** (rather rare), **96** (rather rare), **200**, **332**, **384**, **385**. – **NAM: 305, 307.**

Note. Long. cell., 70.0-105.0 μm ; lat. cell., 16.5-20.0 μm (Fritsch, Rich 1924).

Long. cell., 65.0 μm ; lat., 14.0 μm ; also *forma major*, long. cell., 92.0 μm ; lat. med., 14.0 μm ; lat. apic., 7.0 μm .

Many of the individuals had broader and more truncate apices than are shown in the figures in British Desmidiaceae (cf. Fig.3, A). A few zygospores were present (Fritsch, Rich 1938).

Length 38.0 μm ; breadth 10.5 μm ; apices 5.6-6.3 μm ; ratio of length to breadth 3.6 (Williamson 1994).

94. CLOSTERIUM NEMATODES JOSHUA

- VAR. *PROBOSCIDEUM* TURNER

Illustrations. Fig.3, B, C (Fritsch, Rich 1938); Pl.6, Fig.4 (Williamson 1994).

Samples. RSA: **200** (common), **358**. - **NAM: 307.**

Note. *Forma minor*. Dist. inter apic., 110.0-125.0 μm ; lat., 9.0-11.0 μm ; diam. zygosp., sine spin., 20.0 μm ; cum spin., 25.0 μm . There is considerable resemblance to some of the figures of var. *proboscideum* that have been published (cf. Dick, "Pfälzische Desmidiaceen," Mitteil. Pollichia, 3, 1930, Pl.III, fig.3), but the apical thickenings are in part indistinct and the size is considerably less than that of any hitherto recorded forms of this species or of its variety. The zygospore of this type is unknown. In the dimensions of the cell and the characters of zygospore there is resemblance to *C. spinosporum* Hodgetts (Contributions to our Knowledge of the Freshwater Algae of Africa. 6. Some Freshwater Algae from Stellenbosch, Cape of Good Hope. Trans. Roy. Soc. S. Afr., 13 (Prt.II), p.72), but the latter has a smooth wall, and the apical thickenings are different (Fritsch, Rich 1938).

Length 118.0-161.0 μm ; breadth 20.0-22.5 μm ; apices 7.5 μm ; ratio of length to breadth 6.0-7.5. Cell wall with 7 rib-like striae across the cell breadth with punctae between. A small form at the lower end of the size range (Williamson 1994).

95. CLOSTERIUM OKAVANGICUM COESEL ET VAN GEEST

Illustrations. Figs.3-5 (Coesel, van Geest 2008).

Samples. BOT: **400** (low cell numbers), **401** (low cell numbers), **415** (low cell numbers).

Note. Cells thick-set, 4-5 times longer than broad and curved with 70-80° of arc. Apices broadly truncate with rounded angles. Cell ends just below the apex slightly recurved. Cell wall smooth, colourless and without gridle bands. Cell length 120.0-145.0 μm , cell breadth 27.0-30.0 μm , breadth of apex 10.0-13.0 μm .

Unfortunately, the formaldehyde fixed cell material did not allow reliable examination of the chloroplast. Remnants of chloroplast suggested the occurrence of longitudinal ridges with scattered pyrenoids.

The species in question, with its remarkably uniform, characteristic morphology is readily to be recognized. The only other *Closterium* species with which it may be confused is *C. compactum* Nordst., known from *Sphagnum* mires in New Zealand (Nordstedt 1888; Skuja 1976). *C. compactum* cells, with a length to breadth ratio of 3-4, are even more compact (thick-set) than those of *C. okavangicum* but otherwise are about similar in morphology (Coesel, van Geest 2008).

96. CLOSTERIUM PARVULUM NÄGELI

- VAR. PARVULUM

- F. PARVULUM

Illustrations. Pl.7, Fig.3 (Williamson 1994).

Samples. RSA: 19, 24, 51, 62, 79, 80, 81, 91 (common), 210-213, 230, 263, 341, 392.

Note. Distances between apices, 108.0-126.0 μm ; lat., 12.0-13.0 μm (Fritsch 1918).

Dist. inter apic., 112.0-135.0 μm ; lat., 11.0-13.0 μm (Fritsch, Stephens 1921).

Dist. inter apic., 101.0-108.0 μm ; lat., 14.0-15.0 μm (Fritsch, Rich 1924).

Typical size, sometimes slightly smaller, for example only 90.0 μm long and 13.0 μm wide (Cholnoky 1954b).

Length 116.0-122.0 μm ; breadth 17.5-18.5 μm ; apices 2.0-2.5 μm ; ratio of length to breadth 6.4-6.6 (Williamson 1994).

- F. MAJOR WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329, 330.

Note. In sample 329: long., 136.5-145.0 μm ; lat., 10.4-11.7 μm . In sample 330: long., 145.6 μm ; lat., 11.7 μm (Huber-Pestalozzi 1930).

- VAR. ANGUSTUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 79, 80, 81, 198, 199, 200, 328. – NAM: 307.

Note. *Dist. inter apic.*, 93.0-96.0 μm ; lat., 6.0 μm (Fritsch, Stephens 1921).

Long., 96.2 μm ; lat., 8.0 μm ; *forma leviter striata* (Huber-Pestalozzi 1930).

Forms described by Borge attain these dimensions, which are slightly greater than those given by W. and G.S. West (Fritsch, Rich 1938).

- VAR. MAIUS (SCHMIDLE) KRIEG.

Illustrations. Pl.7, fig.4 (Williamson 1994).

Samples. RSA: 357.

Note. Length 177.0-185.0 μm ; breadth 19.5 μm ; apices 2.0-3.0 μm ; ratio of length to breadth 9.0 (Williamson 1994).

- VAR. MINOR CLAASSEN

Illustrations. Tab.6, fig.8 (Claassen 1961).

Samples. RSA: 241.

Note. *A typo speciei cellulis multo minoribus et apicibus aliquanto plus hebetatis differt. Formae intermediae haud visae.*

Cells smaller and apices more truncate than in the typical form. Length 76.0-76.5 μm ; breadth 7.0-8.0 μm ; breadth of apices 3.0-4.0 μm (Claassen 1961).

97. CLOSTERIUM PEGLERI F.E. FRITSCH

Illustrations. Fig.6, B (Fritsch, Stephens 1921).

Samples. RSA: 68 (common), 69 (rare).

Note. *C. submediocre*; cellulis singulis vel saepe in fasciculos e cellulis numerosis compositos consociatis, semilunaribus, lanceolatis, medio paullo inflatis, polos versus magis curvatis et sensim attenuatis; apicibus incrassatis oblique truncatis, et illic laterem dorsalem versus plus minus profunde excavatis; membrana glabra rubra vel rubiginosa; suturis medianis 1-6; cellulis granulatis amylaceis magnis repletis, ita ut chromatophora et pyrenoides (in serie axiali?) obscurantur. Dist. inter apic., 195.0-210.0 μm ; lat. med., 24.0-25.0 μm .

The individuals of this species, named after the collector, usually occurred in more or less extensive groups comprising any number of cells up to 50, arranged approximately parallel to one another and in close juxtaposition. The general shape of the cell is not unlike that of *C. leiblenii* Kütz., but the ends are altogether different, and provided with characteristic excavation of the membrane of varying depth (Fig.6, a, b). The cell-wall, although apparently colourless when first secreted, very soon takes on a reddish or brownish-red tinge; in a few cases it showed a very fine granulation. The cells are provided with a varying number of median sutures. The contents invariably included a large number of big starch grains, which made it impossible to decipher the chloroplast; a single axial series of pyrenoids, however, seems to be present.

There is some resemblance between this species and *C. excavatum* Borge ("Süsswasseralg. aus Südpatagonien", 'Bih. K. Sv. Vet.-Akad. Handl.', xxvii, Afd.III, No.10, 1901, p.19, Tab.II, figs.7-9); in the latter, however, the ends are different, the membrane is apparently colourless, and there are no median sutures (Fritsch, Stephens 1921).

98. CLOSTERIUM PERACEROSUM GAY

- VAR. **ARCUATUS** FRITSCH ET RICH

Illustrations. Fig.16, A, B (Fritsch, Rich 1930), Fig.37 (Nyygard 1932)..

Samples. RSA: 143 (common), **153, 176** (rare).

Note. *Cellulis in media parte leviter inflatis, a media parte ad polos gradatim attenuatis, margie ventrali in media parte subrecta, polos versus subito et distincte curvata; polis suboblique truncatis et gracillissimis; chromatophoris cum pyrenoidibus 3-5. Dist. inter apic., 176.0-212.0 μm ; lat., 18.0-21.0 μm .*

If the individuals of this variety were supposed to be straightened out, they would possess to all intents and purposes the same form as typical *C. peracerosum* or as var. *elegans* G.S. West, although not as distinctly tumid in the middle as the latter. Curved forms of var. *aethiopicum* W. et G.S. West have already been described (Fritsch, Ann. d. Biol. lacustr., vii, 1914, p.44). Our specimens show some resemblance to a form of *C. littorale* Gay figured by Strøm (Nyt Mag. f. Naturvidensk., lvii, 1919, Pl.II, fig.13), but this is more robust and less strongly curved, though the ends of the cells are very similar to those of our form. It is evident that *C. peracerosum* and *C. littorale* are closely related species (Fritsch, Rich 1930).

Cells of medium size, usually 9.1-12.5 times longer than their diameter, strongly curved, outer margin about 92-104° of an arc, inner margin not or very slightly tumid, gradually attenuated towards the apices, which are acutely rounded and without thickenings; cell-wall smooth, colourless; chromatophores obscurely ridged, with a single series of 3-5 pyrenoids in each semicell; terminal vacuoles 37.0-54.0 μm long. Distance between apices 197.0-245.0 μm , breadth 19.0-26.0 μm , breadth of apices 2.0-2.5 μm .

The table below gives the measurements for seven individuals; the second column gives the length of cell, the third the breadth, the fourth the relation between length and breadth, the fifth the curvature, and the six the number of pyrenoids per semicell.

No.1	199.0 μm	19.0 μm	10.5 x	101°	3 pyrenoids
No.2	197.0 μm	20.0 μm	9.8 x	96°	4 pyrenoids
No.3	217.0 μm	20.0 μm	10.8 x	92°	4-5 pyrenoids
No.4	238.0 μm	26.0 μm	9.1 x	104°	4 pyrenoids
No.5	245.0 μm	20.0 μm	12.5 x	95°	3 pyrenoids
No.6	202.0 μm	19.0 μm	10.6 x	-	3 pyrenoids
No.7	217.0 μm	22.5 μm	9.6 x	-	3 pyrenoids

Several specimens of this variety were observed in the plankton from Brakpan, taken on September 7, 1927. In the autumnal samples, from February, March and April 1928, it was not found. It should thus be a vernal form. It is characteristic of its ecology that it occurs in the natural pans (Nyygard 1932).

- VAR. ELEGANS G.S. WEST

Illustrations. Tab.6, fig.11 (Claassen 1961).

Samples. RSA: 249, 250, 251, 430, 431, 436.

Note. Ventral margin in the median portion of the cell slightly more tumid than in the typical form, and the cells are shorter. Length 134.0-172.0 μm ; breadth 9.0-15.0 μm (Claassen 1961).

In (Hancock 1973) indicated as *C. peracerosom* Gay var. *elegens* West.

99. CLOSTERIUM POLYSTICTUM NYYGARD

Illustrations. Fig.35 (Nyygard 1932).

Samples. RSA: 181 (fairly rare), **182** (fairly rare).

Note. Cells large, much elongated and narrow, 48-60 times longer than their diameter, slightly and often irregularly curved, median portion of the cell fairly straight and cylindrical, gradually attenuated towards the extremities, near the apices rather suddenly narrowed into a subacute cone; cell-wall smooth and colourless; chromatophores with a median series of 12-16 pyrenoids in each semicell; terminal vacuoles relatively short (25.0-43.0 μm). Length 479.0-585.0 μm , breadth 9.0-11.0 μm , breadth near apices 6.5-7.0 μm .

Characteristic of this species are the abruptly attenuated apices and the elongate chromatophores with the great number of pyrenoids. The long and narrow species of *Closterium*, which sometimes occur in freshwater plankton, generally have cells tapering gradually from the middle towards the apices. The table below, which gives the measurements of two cells, shows that the cell decreases very

Thickness of cell at the middle	Thickness of the cell at the end of chromatophore	Length of vacuoles	Length of cell	Number of pyrenoids per semicell
11.0 μm	7.0 μm and 7.0 μm	25 μm and 29 μm	529.0 μm	14
11.0 μm	7.0 μm and 7.0 μm	27 μm and 43 μm	551.0 μm	15

slightly in the thickness from the middle (11.0 μm) to the ends of the chromatophore (7.0 μm); within the short distance from here to the apex of the cell the abrupt tapering of the cell takes place (Nyygard 1932).

100. CLOSTERIUM PRAELONGUM BRÉB.

- VAR. **PRAELONGUM**

- F. **BREVIOR** W. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 116, 243.

Note. Cell wall yellowish and punctate (Claassen 1961).

- VAR. **BREVIUS** (NORDST.) KRIEG.

Illustrations. Pl.7, Fig.8 (Williamson 1994).

Samples. RSA: 359.

Note. Length 279.0 μm ; breadth 18.0 μm ; apices 3.0 μm ; ratio of length to breadth 15.5. Cell wall smooth, pyrenoids 8-10 axile, 1-2 large crystals in terminal vacuole, apices rounded (Williamson 1994).

101. CLOSTERIUM PRITCHARDIANUM W. ARCHER

- VAR. **PRITCHARDIANUM** (SYN.: *CLOSTERIUM SPETSBERGENSE* BORGE VAR. *AFRICANUM* FRITSCH ET RICH; *CLOSTERIUM PRITCHARDIANUM* W. ARCHER VAR. *AFRICANUM* (FRITSCH ET RICH) KRIEG.)

- F. **PRITCHARDIANUM**

Illustrations. Fig.16, C-G (Fritsch, Rich 1930); Pl.7, Fig.1 (Williamson 1994).

Samples. RSA: 22, 35, 88 (common), **90** (rare), **91** (rare), **95** (rare), **96** (rare), **101** (rare), **102** (rare), **104** (common), **149** (common), **150, 151, 191, 223, 243, 271, 359, 425.**

Note. *Dist. inter apic., 300.0-500.0 μm ; lat. cell., 29.0-45.0 μm .* All of these specimens agree with one another, and differ from those figured in Messrs. West's monograph (West, West 1904, p.172, Pl.XXII, figs.6-14), in exhibiting a less pronounced recurving of the apices, a feature which, indeed, in some cases, is unrecognizable at one or even at both ends of an individual. Such specimens approach rather closely some forms of *C. acerosum* (Schrank) Ehrenb., but, since all that were closely examined showed clearly the structure of the cell-membrane typical of *C. pritchardianum*, they have all been classed under this species, the more as they were connected by imperceptible transitions with relatively typical individuals exhibiting distinct recurving of the apices. In sample **88** all the individuals seen were practically colourless, possessing at the best but faint yellow tinge (Fritsch, Rich 1924).

Cellulis margine ventrali quam in typo, vel plana vel leviter concava, 7.5-8 plo longioribus quam latis, polos truncatos versus sensim attenuatis aut prope polis (qui tum saepe levissime recuati sunt) paraecipue attenuatis; chromatophoris cum ca. 8 costis longitudinalibus paraeditis, pyrenoidibus vel 10-12 in serie axiali vel numerosis per chromatophoram sparsis; membrana hyalina glabra. Dist. inter apic., 440.0-555.0 μm ; crass. cell., 54.0-75.0 μm .

In the general shape of the cell this variety quite resembles the type. Borge's figures (Vidensk.-selsk. Skrift., Mat.-Nat. Kl., Kristiana, 1911, No.11, p.8, fig.5) also show individuals in which the semicells taper quite gradually from the middle towards the apices (*cf.* his fig.5*a* with our Fig.16, C), and such as are markedly attenuated at the apices themselves (his fig.5*a'*; our Fig.16, D, G); in Fig.16, D, the upper semicell shows the one character, the lower one the other.

The essential differences from the type lie in the bigger dimensions, the relative proportions of length and breadth, and the tendency for the pyrenoids to be scattered in the chloroplasts (Fig.16, *D*). As regards the latter feature there are all transitions, and individuals were found in which the pyrenoids were in a single series in one chloroplast and quite irregularly scattered in the other (Fig.16, *E, F*; cf. Carter, Ann. of Bot., xxxiii, 1919, p.229).

Ström (Naturw. Unters. d. Sarekgebirges in Schwedisch-Lappland, Bot., iii, Stockholm, 1923, No.15, p.466) has suggested that *C. spetsbergense* Borge is an arctic variety of *C. lunula* (Müll.) Nitzsch. But the latter species has a slightly tumid ventral margin, and apices which are rounded and recurved, and it would appear to be quite distinct from the former. The var. *africanum* here described, however, certainly serves to link up the two species, and looked at from another point of view it might well be regarded as a variety of *C. lunula*. It depends upon the importance one attributes to the distribution of the pyrenoids in the chloroplasts.

C. affine Gay (Bull. Soc. Bot. de France, xxxviii, 1891, p.xxxi) rather closely resembles some specimens of var. *africanum* and may be identical with it. Another closely related species, which is, however, much smaller, is *C. methueni* Fritsch (Ann. d. Biol. lacustr., vii, 1914, p.44, Pl.I, fig.7). In form the individuals of our variety resemble some specimens of *C. pritchardianum*, but they altogether lack the characteristic membrane-structure, apart from other differences (Fritsch, Rich 1930).

These specimens are generally larger than the typical form. Length 496.0-825.0 μm ; breadth 48.0-58.0 μm ; breadth of apices 5.0-7.0 μm (Claassen 1961).

Length 413.0-569.0 μm ; breadth 36.0-48.0 μm ; apices 4.5-5.5 μm ; ratio of length to breadth 9.5-14.5. These specimens are reminiscent of Fritsch and Rich's (1930) *C. spetsbergense* var. *africanum*, (synonym: *C. pritchardianum* var. *africanum* (Fritsch et Rich) Krieg.). Fritsch and Rich's variety was based on larger dimensions, the proportions of length to breadth, and the disposition of the pyrenoids. Růžička (1977: 161) doubts the validity of Fritsch and Rich's taxon, proposing that it really belongs to *C. pritchardianum* and is likely to be a growth-variation. The author agrees with this view, since the dimensions of Fritsch and Rich's taxon approximate closely to those of the typical plant and since the pyrenoids are mostly axile or occasionally scattered, even if in only one semicell, as observed by Fritsch and Rich. The author's observations seem to confirm Růžička's views and concur in the need for further investigation of these taxa (Williamson 1994).

- F. ALPINUM SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 66, 84 (very rare).

Note. *Forma* ad var. *alpinum* Schmidle (Österr. Bot. Zeitschr., xlv, 1895, p.309, Pl.XIV, fig.19) *valde accedens, sed saepe longior et latior, membrana paene achroa et subtilissime striata, apicibus plerumque magis recurvis quam in specimine a Schmidle depicto. Dimens., 360.0x45.0, 420.0x54.0, 555.0x40.0, 660.0x45.0 μm .*

This form has to some extent the subparallel margins of var. *madagascariense* Fritsch. The work already done on the freshwater Algae of South Africa shows, that *C. pritchardianum* is very widely distributed and exhibits very considerable variability. It is hoped at a later date, when more data have been collected, to give an epitome of the different forms (Fritsch, Stephens 1921).

- F. MINOR FRITSCH

Illustrations. Fig. 23 (Fritsch 1918).

Samples. RSA: 22, 35, 90 (common).

Note. *Long. cell., 264.0-285.0 μm; lat., 36.0-40.0 μm. Margine ventrali fere recta, polis vix recurvis.*

I have been in some doubts about the reference of these specimens to *C. pritchardianum*, but seeing that the general form of the cell and the striation and puctation of the membrane is that characteristic of this species, and that the apices are very similar, it seems justified. *C. pritchardianum*, which is widely represent in South Africa, is evidently very variable in size, since specimens have been encountered from other localities attaining a length of 1700.0 μm (forma *gigantissima*).

In sample 22 there also occurred individuals which approached somewhat to var. *madagascariensis* F.E. Fritsch (Freshw. Alg. Madagascar, Ann. d. Biol. lacustre, Tab.VII, fasc.i), but differed from it in two respects, viz. (a) in being in part shorter and proportionally broader (long., 550.0-700.0 μm; lat., 48.0-55.0 μm), and (b) in the almost straight ventral margin. Such forms tend to link up var. *madagascariensis* and also forma *maxima* Nordstedt (Nonnullae alg. aq. dulc. brasil., Öfvers. K. Sv. Vet.-Ak. Foerhandl., 1877, No.3, p.16) with the type (Fritsch 1918).

Dist. inter apic., 280.0-320.0 μm; lat. cell., 42.0-46.0 μm (Fritsch, Rich 1924).

102. CLOSTERIUM PROLONGUM RICH

Illustrations. Fig.5, A (Rich 1932).

Samples. RSA: 193 (rare).

Note. *Cellulis ca. 8 plo long. quam lat., valde arcuatis, margine ventrali vix tumido, apices versus gradatim attenuatis, apicibus gracillimis rotundatis; membrana laevi, hyalina; chromatophoris cum pyrenoidibus 5-6 in serie axiali. Dist. inter apic., 180.0-202.0 μm; lat. cell., 24.0-25.0 μm.*

This differs from other species of *Closterium* in its rather long drawn-out slender apices. It resembles *Cl. peracerosum* Gay var. *arcuatus* Fritsch et Rich, described for Griqualand West, but it is much more strongly curved and the apices are more slender. In shape it resembles *Cl. porrectum* Nordst. var. *angustatum* W. et G.S. West, but the cell-wall is not strongly striate. The piece of water in which this *Closterium* occurs is slightly brackish and harbours masses of marine Diatoms; the question arises as to whether the contents of this tube had not got mixed with others before leaving South Africa (Rich 1932).

103. CLOSTERIUM PRONUM BRÉB.

Illustrations.

Sample. RSA: 330, 428 (dominant).

Note. *Forma.* Long. 358.8 μm; lat., 13.0 μm, 28 times longer than wider (Huber-Pestalozzi 1930).

In (Allanson and al. 1974) indicated as *Closterium ? pronum*.

104. CLOSTERIUM PSEUDOKUETZINGII WILLIAMSON (SYN.: CLOSTERIUM KUETZINGII BRÉB. FORMA IN WILLIAMSON 1994)

Illustrations. Pl.5, Fig.3, Fig.5 (zygospore) (Williamson 1994), Figs.1-6 (Williamson 1996).

Samples. RSA: 373, 381.

Note. *Forma.* Length 364.0-577.0 μm ; breadth 13.0-16.5 μm ; apices 3.0-3.5 μm ; ratio of length to breadth 22.0-42.0. The majority of the cells had a breadth of 13.0-15.0 μm and with 12-13 striae in 10.0 μm . An occasional cell had 15.0-21.0 striae in 10.0 μm . Zygospores were associated with these specimens but instead of being rectangular with concave sides they were elliptical or lemon-shaped with a slight protrusion at each end. Elliptical zygospore have previously been illustrated by Bourrelly (1961) from Ivory Coast and by Grönblad (1945) from Brasil but both belong to the var. *vittatum* Nordst., the striation of which is entirely different from the specimens under review here. The problematical zygospore has not yet been resolved.

Dimensions are: length 60.0-65.0 μm ; breadth 33.0-34.0 μm , which fits more to *C. kuetzingii* Bréb. than to the var. *vittatum* Nordst. but there are no features in the attached cells which can differentiate them from the typical plant (Williamson 1994).

A large population of this taxon was found in the roadside pond near Warburton. In a paper (Williamson 1994) the taxon was described as a *forma* of *C. kuetzingii* Bréb. since the striation on the cell wall precluded it from being assigned to *C. kuetzingii* var. *vittatum* Nordstedt although the shape of accompanying zygospores resembled those of this latter variety. At the time it was stated that the problematical zygote had not been resolved but further investigation of the preserved material has revealed new features.

The cells are long and slender, 22-24 times longer than broader, tapering from the wider median part to very narrow slightly incurved poles, the apices being slightly inflated with, in most cases, a slightly flat dorsal margin and a clearly discernible end pore. Large numbers of the cells exhibited multiple sutures in their median parts with pseudogirdlebands and segments of the cell walls ranging from colourless to yellow-brown. Striae are present on the cell wall, there usually being 12-14 in 10 μm , and often between adjacent striae there is a fainter but distinct broken line which is assumed to be the bottom of a trough between them. This secondary line can have different degrees of prominence making the counting of striae occasionally difficult. On all cells examined punctae were visible on (?) and between the striae.

The zygospore is elliptical, almost citriform, with rather sharply rounded ends and when viewed from the end is circular. A number of zygospores with attached empty cells has been examined which show that occasionally the semicells of the same cell have different numbers of striae ranging from 9 to 13-16 in 10 μm but all have punctae present. Since the zygospore is so different from that of *C. kuetzingii* Bréb. and the nature and number of striae and the presence of pseudogirdlebands preclude assignment to either the nominal variety or the var. *vittatum* it is proposed to recognize this as a new species.

Length 364.0-557.0 μm ; breadth 13.0-16.5 μm ; apices 3.0-3.5 μm ; striae 10-14 in 10.0 μm .

A sample containing a large population of the new taxon has been deposited with the Natural History Museum, London (Williamson 1996).

105. CLOSTERIUM PSEUDODIANAE ROY

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 327.

Note. Long. cell., 147.0 μm ; lat., 14.3 μm (Huber-Pestalozzi 1930).

106. CLOSTERIUM PSEUDOLEIBLEINII CLAASSEN

Illustrations. Tab.5, fig.8 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis C. leibleinii* Kütz., sed differt et cellulis non tantopere curvatis et polis hebetatis et quod tumor in medio margine ventrali minor est. Membrana cellulæ iuxta ante apices in marginibus ventrali dorsali que incrassata.

This species comes near *C. leibleinii* Kütz. (West, West 1904, p.141, Pl.XVI, figs.9-14); but the cells are less curved, with truncate apices and the ventral margin less tumid; the cell wall has an annular thickening at each apex. Cell of medium size, about 10.5 times longer than their diameter; cell wall smooth and yellowish-brown; the chloroplast has about size ridges and a central series of 6-8 pyrenoids; terminal vacuoles with one large moving granule. Length 231.5 µm; breadth 21.5 µm; breadth of apices 8.5 µm (Claassen 1961).

107. CLOSTERIUM PSEUDOLIBELLULA F.E. FRITSCH

Illustrations. Fig.7 (Fritsch, Stephens 1921).

Samples. RSA: 84 (common).

Note. *C. magnum*; cellulis aut fusiformibus margine ventrali minus convexa quam margine dorsali (forma fusiformis) aut saepe margine dorsali valde convexa margine ventrali deplanata vel (raro) exigue concava (forma genuina), a media parte ad polos gradatim et magis attenuatis; polis truncatis et recurvis (qua nota in speciminibus biconvexis saepe indistincta val abest); membrana primum achroa, mox flavescens, in tota superficie punctis minutis numerosis irregulariter ordinatis oblecta; chromatophora e ca. 10 laminis formata, pyrenoidibus magnis 3-5 in serie axiali in quaque semicellula. Dimens., 351.0x57.0, 354.0x54.0, 378.0x55.0, 390.0x60.0, 400.0x55.0, 405.0x60.0, 420.0x57.0 µm; lat. apic., 6.0 µm.

This rather distinct species occurs in two forms, the one (f. *fusiformis*) showing a marked superficial resemblance to *C. libellula* Focke, the other (f. *genuina*) somewhat resembling a stout specimen of *C. pritchardianum* Arch.; the latter form is the more common.

In f. *genuina* the ventral surface is either quite flat or very slightly convex; in rare cases it is very faintly concave. The ends are truncate (Fig.7, F, H), or sometimes in young specimens rounded-truncate (Fig.7, E, G); they are markedly recurved (Fig.7, D), so that their appearance is very similar to that of the ends in *C. pritchardianum*. In f. *fusiformis* the recurved character is only very faintly indicated as a general rule (Fig.7, B and G) – in fact in some individuals it is altogether indiscernible. A marked characteristic of the species lies in the fact that the membrane very soon takes on a yellowish-brown tinge, and that the entire surface bears a punctation which appears to be due to very numerous minute pits in the wall (cf. Fig.7, E-H). The pits a quite irregularly arranged over all parts of the cell. The colouration of the membrane is in general rather faint. The protoplasmic contents were often highly vacuolate.

In shape f. *genuina* is not unlike some forms of *C. spetsbergense* Borge ('Vid.-selsk. Skrift., Kristiania, I, Mat.-nat. Kl., 1911, No.11, p.8, fig.5a); this species is, however, considerably smaller and has a colourless glabrous membrane. Comparison may also be made with *C. massarti* De Wildeman, *C. fusiforme* Gay and *C. methueni* Fritsch (Fritsch, Stephens 1921).

108. CLOSTERIUM PSEUDOLUNULA BORGE

Illustrations. Pl.7, Fig.2 (Williamson 1994).

Samples. RSA: 339.

Note. Length 245.0-280.0 μm ; breadth 36.6-46.6 μm ; apices 5.0-6.0 μm ; ratio of length to breadth 6.0-7.6. Striae present on the cell wall although almost imperceptible (Williamson 1994).

109. CLOSTERIUM PUSILLUM HANTZSCH

Illustrations. Pl.7, Fig.7 (Williamson 1994).

Samples. RSA: 358.

Note. Length 37.0-44.0 μm ; breadth 4.5-5.0 μm ; apices 2.0 μm ; ratio of length to breadth 7.7-9.6 (Williamson 1994).

110. CLOSTERIUM RALFSII BRÉB.

- VAR. GLENTIGIANUM CLAASSEN

Illustrations. Tab.5, fig.2 (Claassen 1961).

Samples. RSA: 274.

Note. *Affinis var. subralfsii* Claassen, *sed membrana cellulae 32-34 striis et chromatophora 5-7 pyrenoidibus magnis instructa differt.*

Cell wall with 32-34 striae across the cell; chloroplasts with a series of 5-7 large pyrenoids. Apices slightly obliquely-rounded. Length 322-344 μm ; breadth 35-36 μm ; breadth of apices 9-10 μm (Claassen 1961).

- VAR. HYBRIDUM RABENH.

Illustrations. Pl.8, Fig.2 (Williamson 1994).

Sample. RSA: 192 (very rare), **200, 351, 356, 358.** – **NAM: 307.**

Note. The specimens seen much resembled the figures of Borge ("Die in São Paulo gesammelten Süßwasser-algen," Arkiv för Bot., 15, No.13, 1918, p.20, Tab.II, fig.7) (Fritsch, Rich 1938).

Length 395.0-592.0 μm ; breadth 30.0-40.0 μm ; apices 7.0-8.5 μm ; ratio of length to breadth 13.2-16.4 (Williamson 1994). In (Williamson 1994) indicated as *Closterium ralfsii* Bréb. ex Bréb. var. *hybridum* Rabenh.

- VAR. MINOR CLAASSEN

Illustrations. Tab.5, figs.4-5 (Claassen 1926).

Samples. RSA: 241.

Note. *A typo speciei cellulis multo minoribus differt. Membrana cellulae 21-23 striis et chromatophora 10-12 pyrenoidibus instructa. Formae intermediae haud visae.*

Cells considerably smaller than in the typical form. Cells of medium size, 7-10 times longer than their diameter, moderately curved, inner margin concave. Cell wall yellowish-brown, striated, 21-23 striae visible across the cell; chloroplasts with 10-12 pyrenoids. Length 202.0-264.0 μm ; breadth 26.0-32.0 μm ; breadth of apices 8.0-10.0 μm (Claassen 1961).

- VAR. NODOSUM CLAASSEN

Illustrations. Tab.5, fig.3 (Claassen 1961).

Samples. RSA: 271.

Note. *Affinis C. ralfsii var. hybridum* Rabenh. sec. Fukushima et Fujisawa, *sed differt et polis leviter capitatis et quod plusminusve 18 striis, quae vilderi possunt, membrana distincta est.*

This is near *C. ralfsii* var. *hybridum* Rabenh. sec. Fukushima et Fujisawa (H. Fukushima and the late K. Fujisawa, Desmids Flora of Oze. Reprinted from Scientific Researches of the Ozegahara Moor. Tokuo, 1954, p.596, Pl.I, figs.L-M);

but the apices are slightly clavate and about 18 striae are visible across the cell. Cells of medium size, 8.6-8.8 times longer than their diameter, curved, inner margin concave and straight in the median portion, gradually attenuated towards the apices; cell wall yellowish-brown; chloroplasts with about 12 ridges and a central series of 12-13 pyrenoids; terminal vacuoles with a number of moving granules. Length 306.0-310.0 μm ; breadth 35.0-35.5 μm ; breadth of apices 12.0-12.5 μm (Claassen 1961).

- VAR. **SUBRALFSII** CLAASSEN

Illustrations. Tab.5, fig.1 (Claassen 1961).

Samples. RSA: 264, 265.

Note. *Affinis C. ralfsii* var. *hybrido* Rabenh., *sed differt et cellulis minus arcuatis, et quod margo ventralis in media cellula incrassatus non est; et membrana 25-30 striis, chromatophoraque 11-16 pyrenoidibus minoribus instructa differt.*

Near *C. ralfsii* var. *hybridum* Rabenh. (West, West 1904, p.183, Pl.XXIV, figs.8-13); but the cells are less curved, and are without a median inflation; 25-30 striae visible across the cell; chloroplasts with a median series of 11-16 small pyrenoids. Cells of medium size, 9-13 times longer than their diameter, apices truncately rounded; cell wall yellowish-brown; chloroplasts with about six ridges; terminal vacuoles with a number of moving granules. Length 314.0-424.0 μm ; breadth 34.0-38.0 μm ; breadth of apices 8.0-10.0 μm (Claassen 1961).

111. CLOSTERIUM ROSTRATUM EHRENB.

- VAR. **ROSTRATUM**

Illustrations. Pl.7, Fig.5 (Williamson 1994).

Sample. RSA: 79 (with zygospores), **80** (with zygospores), **81, 223, 238, 255, 300, 341, 390.**

Note. Dist. inter apic., 240.0-250.0 μm ; lat., 19.0-20.0 μm . Cell wall yellow or brown; apices of extremities very slightly dilated (Rich 1940).

Some specimens are slightly narrower (17.0 μm) than in the typical form (Claassen 1961).

Length 283.0 μm ; breadth 18.2 μm ; apices 3.5-4.0 μm ; ratio of length to breadth 15.5 (Williamson 1994). In (Williamson 1994, 2000) indicated as *Closterium rostratum* Ehrenb. ex Ralfs.

- VAR. **BREVIROSTRATUM** W. ET G.S. WEST

Illustrations. Absent in literature on South African desmids.

Sample. RSA: 222.

112. CLOSTERIUM SCHWEICKERDTHII CLAASSEN

Illustrations. Tab.5, figs.18 (Claassen 1926).

Samples. RSA: 271, 273.

Note. *Affinis C. stellenboschense* Hodgetts, *sed cellulis multo maioribus et magis arcuatis, polisque acutioribus differt. Apex uterqueporo vacuolaque terminales paucis granulis se moventibus praeditae.*

Near *C. stellenboschense* Hodgetts (W.J. Hodgetts, Trans. Roy. Soc. of S.A., Vol.XIII, 1926, p.74, fig.8); but the cells are considerable larger, the apices are more acute and the cells are strongly curved; each apex furnished with a pore; terminal; vacuoles with a number of moving granules. Cells of medium size, about 6.8-8.5 times longer than their diameter, inner margin tumid in the median portion, gradually colourless; chloroplasts with about eight ridges and a series of 5-9 pyrenoids; terminal vacuoles with 4-5 large moving granules. Length 170.0-

186.0 μm ; breadth 20.0-26.0 μm . Named after Prof. Dr. H.G. Schweickerdt, Head of the Department of General Botany, University of Pretoria (Claassen 1961).

113. CLOSTERIUM SETACEUM EHRENB.

Illustrations. Pl.7, Fig.6 (Williamson 1994).

Sample. RSA: 192 (July), **195, 200** (rare), **202** (rare), **211, 222, 328, 330, 343, 435**. – **NAM: 307**.

Note. In sample **328**: long., 236.0 μm ; lat., 7.8 μm ; ends, 1.5 μm . In sample **330**: long., 302.0 μm ; lat., 8.25 μm (Huber-Pestalozzi 1930).

In Steenbras Reservoir; length, 280-295 μm ; width, 10-11 μm (Rich 1932).

Long. cell., 312.0-390.0 μm ; lat., 7.0-9.0 μm (Fritsch, Rich 1938).

In dem Material habe ich auch etwas breitere – 13.0 μm breite – Exemplare gesehen. Es ist mir nicht ganz deutlich, ob diese Art von der vorherigen wirklich scharf abgegrenzt werden könnte (Cholnoky 1955).

Length 343.0 μm ; breadth 8.2 μm ; apices ca. 1.0 μm ; ratio of length to breadth 42.0 (Williamson 1994). In (Williamson 1994) indicated as *Closterium setaceum* Ehrenb. ex Ralfs.

114. CLOSTERIUM SINUOSUM WILLIAMSON

Illustrations. Pl.7, Fig.9 (Williamson 1994).

Sample. RSA: 359.

Note. Cells in face view moderately and smoothly curved, broad in the mid region, tapering evenly to round sub-acute apices without end pores. Cells sigmoid when turned 90° on longitudinal axis. Wall smooth, colourless. Chloroplast with 2-3 longitudinal ridges; 5-7 pyrenoids in axis of each. Terminal vacuoles with a few scattered crystals. Length 109.0-138.0 μm ; breadth 18.5-21.0 μm ; apices 2.0-2.3 μm .

It is known that the cells of some *Closterium* species may occasionally be sigmoid, but these cells tend to occur as rare specimens within a given population, and are usually regarded as anomalous forms. All members of this moderately abundant population were sigmoid in shape when turned 90° on their longitudinal axis and so can be described as a new species. This desmid has some affinity with *C. parvulum* Näg. but is broader and does not possess the slightly flattened apices with the small end-pore characteristic of that desmid. It is much smaller than *C. sigmoideum* Lagerh. et Nordst. (Williamson 1994).

115. CLOSTERIUM SPETSBERGENSE BORGE

- VAR. SPETSBERGENSE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 192 (May), **300**.

Note. *Forma* Grönblad (Beitrag zur Kenntniss der Desmidiaceen Schlesien, 1926, p.10, figs.13, 14) (Rich 1932).

Long. cell., 320.0-360.0 μm ; lat., 58.0-60.0 μm . One row of pyrenoids, of which there are about 8 in each semicell (Rich 1940).

- VAR. LATICEPS GRÖNBLAD

- F. MAJUS CROASD.

Illustrations. Fig.11 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Our form is much larger, more abruptly tapered and more recurved. Long., 714.0 μm ; lat., 80.0 μm (8.9x); lat. apic., 11.0 μm ; 55° of an arc. R. Grönblad named it: "*Cl. ? spetsbergense* var. *laticeps*". Krieger (1937, p.305) puts

this species (and variety) under *Cl. pseudolunula* Borge (1909, p.3, Fig.2), but this does not seem appropriate. Borge (1911, p.8, Fig.5) also named *Cl. spetsbergense* and his original figures show them to be very different (Grönblad, Croasdale 1971).

- VAR. SUBAFRICANUM CLAASSEN

Illustrations. Tab.4, figs.2 (Claassen 1961).

Samples. RSA: 249, 250, 251.

Note. *Affinis C. spetsbergensi* var. *africano* Fritsch et Rich, *sed differt et forma polorum et quod membrana cellulae striata est. Cellulae multo minores sunt; striarum disposito cum C. pritchardiano* Arch. *valde congruit.*

This is near *C. spetsbergense* Borge var. *africanum* Fritsch et Rich (F.E. Fritsch, F. Rich, Trans. Roy Soc. of S.A., Vol.XVIII, 1930, p.57, fig.16 C-G); but the shape of the apices is different, the cells are considerably smaller, and the cell wall is striated; striae similar to those found in *C. pritchardianum* Arch. Cells about 7-11 times longer than their diameter; cell wall yellowish or yellowish-brown, 35-40 striae visible across the cell; striae composed of fine punctae; chloroplasts with 6-10 ridges, and a central series of 4-9 pyrenoids; terminal vacuoles with a number of moving granules. Length 238.0-394.0 μm ; breadth 34.0-52.0 μm ; breadth of apices 5.0-6.0 μm (Claassen 1961).

116. CLOSTERIUM SPINOSPORUM HODGETTS

- VAR. SPINOSPORUM

Illustrations. Fig.7, A, B (Hodgetts 1926).

Samples. RSA: 112, 113.

Note. *Cl. valde curvum, cellulis diametro 10-11 plo longioribus, venne non inflato (raro leviter inflato), utroque polo gradatim attenuatis oblique truncatis; membrana cellularum luteola vel achroa, glabra, ad extremitates cellularum incrassata; singulae chromatophorae pyrenoidibus 3-4 incrustae; locellus apicalis granulis 3-5 praeditus. Zygospora subglobosa, spinis conicis brevibus obtusis instructa. Crass. cell., 10.6-13.0 μm ; apic., 120.0-129.0 μm inter se distantibus; lat. apic., ca. 2.5 μm . Diam. zygosp. (cum spin.), 27.0-31.0 μm ; long. spin., 2.6-4.0 μm .*

The cell of this species exactly resemble a small form of *C. diana* Ehr., and like this species the apices are obliquely truncated, and have the cell-wall at the apex slightly thickened. *C. diana*, however, has smooth zygosporae. Another species which it appears to resemble closely is *C. paradoxum* Wille (Bidrag til Kundskaben om Norges Ferskvandsalg., i, Vidensk.-Selsk. Forhandl., Christiania, 1880, No.11, p.56, Tab.2, fig.37). The dimensions of the latter are exactly those of the present species, and the cells are said to resemble those of *C. diana*, but the zygosporae (immature) is described by Wille as globose with a verrucose cell-wall. It seems very doubtful, however, whether the zygosporae of *C. paradoxum*, as figured by Wille, would ever develop the conical spines of that of the present species. Apart from the zygosporae there is nothing to distinguish these two species. It seems best, however, to keep them distinct until more is known about *C. paradoxum* (Hodgetts 1926).

- VAR. MINUS HODGETTS

Illustrations. Fig.7, C, D (Hodgetts 1926).

Samples. RSA: 122 (rare).

Note. *Var. minor, cellulis diametro 7.5 plo longioribus; cetera ut in forma typica. Crass. cell., 11.0-11.5 μm ; apic., 87.0-89.0 μm inter se distantibus; lat.*

apic., ca. 3.5 μm . Diam. zygosp. (cum spin.), 23.0-33.0 μm ; diam. zygosp. (sine spin.), 19.0-26.0 μm . Long. spin., .32 μm .

The zygospore of this variety was always found enclosed in a vesicle, which was dark brown in colour, and rather opaque, and to which the empty semicells remained attached (Fig.7, D). The zygospore was rather more globose than that of the typical form of *C. spinosporum*, but had the same obtusely conical spines. A somewhat similar form of zygospore is found in *C. calosporum* Wittr., a species which, however, has the apices of the vegetative cells very pointed, and does not possess the apical thickening of the cell-wall (Hodgetts 1926).

117. CLOSTERIUM STELLENBOSCHENSE HODGETTS

Illustrations. Fig.8, A-C (Hodgetts 1926).

Sample. RSA: 119 (rare), **195**.

Note. *Cl. valde curvatum*; cellulis diametro 6-7½ plo longioribus, ventre leviter inflato, utroque polo gradatim attenuatis, apicibus oblique truncatis; membrana cellularum glabra, pallide lutea vel achroa, ad extremitates cellularum leviter incrassata; quaeque chromatophora brevis, dimidium fere partem semicellulae supplens, pyrenoidibus 2 (perraro 3) instructa; locellus apicalis granulis singulis praeditus.

Zygospora oblongo-quadrangularis, angulis rotundatis et leviter productis, lateribus brevioribus retusis, lateribus longioribus medio inflatis; membrana zygosporae levis, achroa.

Crass. cell., 11.3-15.0 μm ; apic., 84.0-113.0 μm inter se distantibus; lat. apic., ca. 2.6 μm . Long. zygosp., 33.0-36.0 μm ; lat., 25.0-29.0 μm .

The only other species of *Closterium* with a zygospore of this form (Fig.8, C) is *C. venus* Kützing, a species which not only has smaller zygospores, but which differs in several respects from the present species in its vegetative characters. *C. venus* has the cells much more attenuated towards the extremities, and the latter are narrowed, more pointed, and lack the oblique truncation and the apical thickening of the cell-wall of the present species. The cells of *C. stellenboschense* are also larger than those of *C. venus*, and also differ in having the ventral margin inflated in the middle.

The short chloroplasts, each occupying only about half of the length of a semicell, leaving a considerable space towards each end of the cell, are quite a feature of the present species. The terminal region is occupied mainly by cytoplasm, and not entirely by the terminal vacuole, which is comparatively small and has only one granule (Fig.8, A, B). Several individuals were seen in which the two chloroplasts were not completely separated in the middle, but were connected by a narrow lateral bridge of chloroplast material (Fig.8, B). This condition has been observed occasionally in other species of the genus, and occurs more frequently in the allied genus *Roya* (cf. Hodgetts, "*Roya anglica*", Journ. Bot., lviii, 1920, pp.65-69) (Hodgetts 1926).

The apical granule referred to by Hodgetts (1926) was plainly seen; dist. inter apic., 96.0-120.0 μm ; lat., 12.0 μm (Rich 1932).

118. CLOSTERIUM STRIOLATUM EHRENB.

- VAR. STRIOLATUM

Illustrations. Pl.8, Fig.7 (Williamson 1994).

Samples. RSA: 219, 222, 230, 234, 235, 323, 356, 364, 367, 383, 393, 430-432, 435.

Note. In **219** und **222** kommen auch kürzere, kleinere Formen – Länge 200-210 μm , Breite 25 μm - vor, die aber durch gänzlich allmähliche Übergänge zu dem Typus gebunden sind (Cholnoky 1955).

Length 219.0-283.0 μm ; breadth 26.0-33.0 μm ; apices 10.0-11.0 μm ; ratio of length to breadth 8.0-8.5 (Williamson 1994). In (Williamson 1994) indicated as *Closterium striolatum* Ehrenb. ex Ralfs.

Indicated as *C. striolatum* Ehrenb. ex Ralfs (Williamson 2000).

- VAR. **NYLSTROMICUM** CLAASSEN

Illustrations. Tab.5, fig.9 (Claassen 1961).

Samples. RSA: 264, 265.

Note. *A typo cellulis brevioribus et 7-8-plo longioribus quam latoribus, polis plus hebetatis, membrana ad apices leviter incrassata et 13-18 striis praedita differt.*

This differs from the typical form (West, West 1904, p.122, Pl.XIII, figs.7-16) in having shorter cells (about 7-8 times longer than their diameter) with blunter apices; cell wall slightly thickened at the apices, yellowish-brown, with 13-18 striae visible across the cell. Length 192.0-220.0 μm ; breadth 26.0-32.0 μm ; breadth of apices 12.0 μm (Claassen 1961).

- VAR. **SITVENSE** GUTWINSKI

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 195.

Note. Long., 220.0-258.0 μm ; lat., 27.0 μm (Rich 1932).

- VAR. **SUBNYLSTROMICUM** CLAASSEN

Illustrations. Tab.5, fig.10 (Claassen 1961).

Samples. RSA: 280.

Note. *Affinis var. nylstromico* Claassen, *sed differt striis inter se plus approximatis, plus minusve 19 in membrana dispositis, quae ad apices est incrassata.*

Cells of medium size, about 7.5 times longer than their diameter, slightly curved, gradually attenuated towards the apices, which are obscurely-rounded; cell wall yellowish-brown, striated, with 19 striae visible across the cell; each chloroplast with 6-7 pyrenoids; terminal vacuoles with one large moving granule. Length 191.0 μm ; breadth 25.0 μm ; breadth of apices 12.0 μm (Claassen 1961).

119. CLOSTERIUM SUBDECORUM CLAASSEN

Illustrations. Tab.5, fig.11 (Claassen 1961).

Samples. RSA: 240.

Note. *Affinis C. decoro* Bréb., *sed cellulis multo minoribus, margine ventrali pro parte maiore tumido, membrana striis carenti differt.*

This is near *C. decorum* Bréb. (West, West 1904, p.184, Pl.XVII, figs. 7, 8; Pl.XVIII, figs.1-3), but the cells are considerably smaller, the inner margin of the cell is tumid for a longer distance and the cell wall is smooth. Cells of medium size, about 10.4-10.7 times longer than their diameter, curved, gradually attenuated towards the apices, which are obtusely-rounded; cell wall smooth and colourless; chloroplasts with a central series of three pyrenoids; terminal vacuoles with a number of moving granules. Length 203.5-208.0 μm ; breadth of apices 3.5-4.0 μm (Claassen 1961).

120. CLOSTERIUM SUBLAGOENSE CLAASSEN

Illustrations. Tab.5, fig.17 (Claassen 1961).

Samples. RSA: 248.

Note. *Affinis C. lagoensi Nordst., sed cellulis angustioribus, forma poli et margine ventrali medio incrassato differt.*

This species is near *C. lagoense* Nordst. (West, West 1904, p.114, Pl.XI, figs.5-7); but the cells are narrower, the shape of the apices differs and the inner margin is tumid in the median portion. Cells small, 7.5-8.5 times longer than their diameter, strongly curved, gradually attenuated towards the apices, which are somewhat acutely rounded; cell wall yellowish, striated, with about 11 striae visible across the cell. Length 160.0-168.0 μm ; breadth 20.0-21.0 μm (Claassen 1961).

121. CLOSTERIUM SUBSILIQUA CLAASSEN

Illustrations. Tab.5, fig.7 (Claassen 1961).

Samples. RSA: 249, 250, 251.

Note. *Affinis C. siliqua W. et G.S. West, sed cellulis haud curvatis, margine ventrali recto, vel in media cellula leviter incrassata differt.*

This somewhat resembles *C. siliqua* W. et G.S. West (West, West 1904, p.154, Pl.XIX, figs.6-8); but the cells are straight. Cells of medium size, about 8-9.4 times longer than their diameter, more or less straight, inner margin straight or slightly tumid in the median portion, gradually attenuated towards the apices, which are slightly acute, and recurved in some specimens; cell wall smooth and colorless or straw-colorless; chloroplasts with about 10 ridges and a central series of 7-11 pyrenoids; terminal vacuoles with one large moving granule. Length 227.0-264.0 μm ; breadth 26.0-32.0 μm ; breadth of apices 3.0-6.0 μm (Claassen 1961).

122. CLOSTERIUM SUBULATUM (KÜTZING) BRÉB.

Illustrations. Fig.7 (Grönblad, Croasdale 1971).

Samples. RSA: 93 (rather rare), **94** (not uncommon), **95** (not uncommon), **97** (rather rare). – **NAM: 307.**

Note. *Dist. inter apic., 125.0-192.0 μm ; lat. cell., 9.0-10.0 μm .* From four to seven pyrenoids in each semicell (Fritsch, Rich, 1924).

Long., 87.0 μm ; lat., 5.0 μm (17.4x); lat. apic. circa 1.5 μm . In our plant the cells a little shorter than is typical, but the overall appearance is that of *Cl. subulatum*, which is R. Grönblad's suggestion (Grönblad, Croasdale 1971).

123. CLOSTERIUM TRUNCATUM CLAASSEN

Illustrations. Tab.5, fig.6 (Claassen 1961).

Samples. RSA: 255.

Note. *Nulla affiniata notata. Cellulae plus minusve 6.2-plo longiores quam latiores. Margo ventralis in media cellula leviter incrassatus; poli hebetati. Membrana glabra, subflava et apicem versus leviter incrassata.*

Cells of medium size, about 6.2 times longer than their diameter, slightly curved, inner margin somewhat concave, with the median portion slightly tumid, gradually attenuated towards the apices, which are truncate; cell wall smooth, yellowish and with a thickening at the apices; chloroplasts with about 10 ridges and a central series of four pyrenoids; terminal vacuoles large, with a number of moving granules. Length 224.0-225.5 μm ; breadth 36.0 μm ; breadth of apices 8.0-8.5 μm (Claassen 1961).

124. CLOSTERIUM TUMIDULUM GAY

Illustrations. Pl.6, Fig.6 (Williamson 1994).

Samples. RSA: 350.

Note. Length 120.0 μm ; breadth 16.6 μm ; apices 1.5 μm ; ratio of length to breadth 7.2 (Williamson 1994).

125. CLOSTERIUM TUMIDUM JOHNSON

- VAR. TUMIDUM

Illustrations. Tab.6, fig.15 (Claassen 1961).

Samples. RSA: 232, 246, 329.

Note. *Forma.* Long., 78.0-88.4 μm ; lat., 6.5-7.8 μm (ends 2.6 μm) Huber-Pestalozzi 1930).

Cells up to 9.9-13 times longer than their diameter. Length 102.0-114.0 μm ; breadth 9.0-10.5 μm ; breadth of apices 2.5-3.0 μm (Claassen 1961).

- VAR. ANGUSTUM CLAASSEN

Illustrations. Tab.6, fig.13 (Claassen 1961).

Samples. RSA: 241.

Note. *A typo speciei cellulis multo angustioribus et minus arcuatis differt. Cellula 15.5-22-plo longior quam latior.*

Cells narrower than in the typical form, being about 15.5-22 times longer than their diameter, and less curved. Chloroplasts with about nine pyrenoids. Length 108.0-132.0 μm ; breadth 6.0-8.0 μm ; breadth of apices 1.0-1.3 μm (Claassen 1961).

126. CLOSTERIUM TURGIDUM EHRENB.

Illustrations. Fig.12 (Grönblad, Croasdale 1971).

Samples. NAM: "Probably Sample 307" (R. Grönblad) (Grönblad, Croasdale 1971).

Note. Lat. apic., circa 20.0 μm ; 8 striae in 10.0 μm . R. Grönblad' figure is incomplete but helps confirm his identification (Grönblad, Croasdale 1971).

127. CLOSTERIUM VENUS KÜTZING

- VAR. VENUS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 148 (very rare), **192, 242, 246, 255, 299, 383, 386, 430, 434.**

Note. *Dist. inter apic., 80.0 μm ; lat. cell., 10.0 μm* (Fritsch, Rich 1930).

Dist. inter apic., 52.0-60.0 μm ; lat., 8.0-9.0 μm (Rich 1932).

Dist. inter apic., 50.0 μm ; lat., 8.5 μm . Like other specimens found in South Africa there was only one moving granule in the terminal vacuole (Rich 1940).

Indicated as *Closterium venus* Kütz. ex Ralfs. 4.09.1987 (Williamson 2000).

- VAR. DEBEGENICA CHOLNOKY

Illustrations. Fig.105-106 (Cholnoky 1954a); Fig.3 (Grönblad, Croasdale 1971).

Samples. RSA: 208, 209. – NAM: 304, 306, 307.

Note. Different from type in shorter and much thicker cells. Long., 70.0-110.0 μm ; lat., 12.5-15.0 μm (Cholnoky 1954a).

Long. 112.0 μm ; lat., 16.0 μm (7x); 150° of an arc. Our specimen, being relatively shorter than the type, with less pointed apices, fits Cholnoky's variety very well. It differs from Strøm's (1926, p.194, 2:13) f. *major* in its greater curvature and from var. *apollonionis* Croasdale (1965, p.310, I: 18-20) in its broader apices (Grönblad, Croasdale 1971).

- VAR. **INFLATUM** CLAASSEN

Illustrations. Tab.6, figs.16-18 (Claassen 1961).

Samples. RSA: 243, 247.

Note. *A typo speciei differt quod margo ventralis cellulae media in parte leviter inflatus, membranaeque achroa est vel subflava.*

This differs from the typical form in that the inner margin is slightly tumid. Cells about 6.8-7.1 times longer than their diameter; cell wall smooth and colourless or yellowish; each chloroplast with a central series of two pyrenoids; terminal vacuoles with 1-2 moving granules. Length 68.0-70.0 μm ; breadth 9.0-10.0 μm ; breadth of apices 1.5-2.5 μm (Claassen 1961).

128. CLOSTERIUM WARMBADIANUM CLAASSEN

- VAR. **WARMBADIANUM**

Illustrations. Tab.6, fig.2 (Claassen 1961).

Samples. RSA: 277, 278, 279, 280.

Note. *Affinis C. spinosporo* Hodgetts, *sed cellulis brevioribus latioribusque, membrana cellulae ad apices non incrassata sed in medio margine ventrali leviter incrassata differt. Vacuolae terminales granulis paucis globosis seque moventibus praeditae.*

Near *C. spinosporum* Hodgetts (W.J. Hodgetts, Trans. Roy. Soc. of S.A., Vol.XIII, 1926, p.72, fig.7, A-B); but the cells are shorter and broader, the inner margin is slightly tumid in the median portion. The apices are without a cell wall thickening; and the terminal vacuoles are large, with a number of spherical moving granules. Cells small, 6.5-8 times longer than their diameter, curved gradually attenuated towards the apices, which are slightly acutely rounded; cell wall smooth and colourless; chloroplasts with about eight ridges and 2-5 pyrenoids. Length 104.0-118.0 μm ; breadth 14.0-18.0 μm (Claassen 1961).

- VAR. **PORULOSUM** CLAASSEN

Illustrations. Tab.6, fig.3 (Claassen 1961).

Samples. RSA: 283, 287, 288.

Note. *A typo speciei differt quod apex uterque poro est praeditis et vacuolae terminales granula aliquot maiora, elongata, se moventia habent.*

Each apex with a pore in the cell wall; terminal vacuoles with a number of large oblong moving granules. Cell wall colourless or yellowish-brown; chloroplasts with about six ridges and 3-4 pyrenoids. Length 104.0-120.0 μm ; breadth 12.0-15.0 μm (Claassen 1961).

Species of genus which not identified (sterile material) were occurred in following **samples:** Farm Bank-plaats, near Ermelo, in deposit of diatomaceous earth (kieselguhr), in the wet season (coll. Mr. F.N. Searle) (Fritsch, Rich 1925). **185, 188, 191, 207** (observed only in October 2007 and November 1928, when it was very rare (Schuurman 1932)), **425, 427.**

In sample **307** R. Grönblad and H. Croasdale (1971) find *Closterium* sp. (Fig.1, 2 in their article) and their note: Long., 198.0 μm ; lat., 30.0 μm (6.6x), 125° of an arc, (or long., 215.0 μm ; lat., 30.0 μm (7.2x), 150° of an arc if the lower semicell is assumed to be immature. Fig.2 shows a reconstruction, bringing the cell to its presumed full size). R. Grönblad suggested "*Cl. malmei*" Borge, which, however, is broader with swollen apices and more costae. Ours has two costae in 10 μm . If, as it appears, girdle bands are lacking this seems closest to *Cl. pleurodermatum* West et West (1902, p.1939, 18:12), differing in its straight ventral margin and more rounded apices. If girdle bands are present it might be a

form of *Cl. regulare* Bréb., differing, however, in its greater curvature, fewer costae, and less angular apices (Grönblad, Croasdale 1971).

In sample **429** R.C. Hart and R. Hart (1977) find *Closterium* sp. which was studied but low abundance prevented adequate appraisal of its seasonal behavior.

Vertical distribution of this species at station I (see map of stations in article), July 6, 1973 (densities given as cells per 0.5 ml).

Depth	0	1	2	3	4	5	6	7	8	9
Density	4	8	6	5	5	10	3	3	3	9

Depth	10	11	12	15	20	25	30	35
Density	5	4	2	6	5	10	12	7

SUB-ORDER: DESMIDIINEAE

FAMILY: DESMIDIACEAE

ACTINOTAENIUM (NÄG.) TEILING

129. ACTINOTAENIUM CUCURBITUM (BRÉB.) TEILING

Illustrations. Pl.9, Fig.6 (Williamson 1994); Pl.3, 7, Fig.4, 4 (Williamson 2000).

Sample. RSA: 353, 356, 368, 384, 389, 392, 398.

Note. Length 31.0-63.0 μm ; breadth 17.0-28.0 μm ; ratio of length to breadth 1.8-2.3. From sample **353** specimens with an unusual shape were obtained. The cells attenuated from the slight median constriction to evenly convex apices. All cells had slightly concave margins and were covered in pores of equal size. The cells were at the top end of the size range quoted above (Williamson 1994).

Indicated as *Actinotaenium cucurbita* (Bréb.) Teil. Skuja (1949) depicted *C. cucurbita* Bréb. var. *attenuatum* G.S. West on his Pl.26, 1, 2 which is exactly images my specimens. Růžička (1981) reproduced Skuja's figure (Pl.50, 19) but makes Skuja's variety synonymous with the typical (Williamson 2000).

130. ACTINOTAENIUM SILVAE-NIGRAE (RABAN.) KOUWETS ET COESEL

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 384.

Note. 29.01. 1989 (Williamson 2000).

DOCIDIUM BRÉBISSON

131. DOCIDIUM BACULUM BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 198, 200.

Note. Long. cell., 180.0-255.0 μm ; lat. med., 10.0-17.0 μm ; lat. apic., 9.0-12.0 μm (Fritsch, Rich 1938).

PLEUROTOAENIUM NÄGELI

132. PLEUROTOAENIUM ABRUPTUM (TURNER) G. HUBER

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. *Forma longior.* Long., 395.0 μm ; lat. at isthmus, 15.6 μm ; lat. in the middle of the semicell, 18.2 μm ; lat. at apex, 14.3 μm , cells 22 times longer that wide (Huber-Pestalozzi 1930)

133. PLEUROTOAENIUM BACULOIDES (ROY ET BISS.) PLAYF.

Illustrations. Pl.8, Fig.6 (Williamson 1994).

Samples. RSA: 356.

Note. Length 421.0 μm ; breadth 20.3 μm ; apices 15.0 μm ; ratio of length to breadth 20.7. Cell wall punctate (Williamson 1994).

134. PLEUROTOAENIUM CAFFRORUM CLAASSEN

Illustrations. Tab.7, fig.6 (Claassen 1961).

Samples. RSA: 254.

Note. *Affinis P. basiundato* W. et G.S. West, *sed semicellulis iuxta tumorem basalem unica undulatione praeditis differt.*

This comes near *P. basiundatum* W. et G.S. West (West, West 1895, Pl.5, fig.35); but the semicells have a single small undulation above the basal inflation.

Cells of medium size, cylindrical, 25.8-30 times longer than their diameter; semicells gradually attenuated from base to apex, with a distinct basal inflation and a smaller undulation above it; apices abtusedly rounded, bordered by a ring of tubercles, eight in number (four visible across the apex); cell wall punctate. Length 400.0-482.0 μm ; breadth at base of semicells 20.0 μm ; at middle of semicells 15.5-16.0 μm ; at apices 14.4-15.0 μm (Claassen 1961).

135. PLEUROTAENIUM CORONATUM (BRÉB.) RABENH.

Illustrations. Pl.9, Fig.2 (Williamson 1994).

Samples. RSA: 373.

Note. Length 714.0 μm ; breadth 43.3 μm ; apices 40.0 μm ; ratio of length to breadth 16.5 (Williamson 1994).

136. PLEUROTAENIUM EHRENBERGII (BRÉB.) DE BARY

- VAR. EHRENBERGII

Illustrations. Pl.8, Fig.8 (Williamson 1994).

Sample. RSA: 20, 22, 60, 74 (not uncommon), **91** (rather rare, *forma latior*), **102** (not uncommon), **104** (rather rare), **192** (May, July, rare), **198, 201, 214, 223, 224, 230, 234, 235, 254, 326, 329, 332, 345, 348, 374, 382.**

Note. Indicated in article of Fritsch (1918) "previously recorded by Nordstedt from the Cape".

Long. cell., 465.0-502.0 μm ; lat. ad inflat. basal., 27.0 μm ; lat. in media semicellula, 25.0 μm ; lat. apic., 20.0 μm (Fritsch, Rich 1924).

Forma latior inflatione basali unica, tuberculis apicalibus 6. Long., 495.0-558.0 μm ; lat. ad inflat. basal., 39.0-54.0 μm ; lat. in media semicellula, 55.0-63.0 μm ; lat. apic., 36.0-42.0 μm . All the specimens observed in sample **91** were larger than the average and were characterized by the presence of only one basal inflation and of only six apical tubercles. Moreover, the individuals were commonly wider at the middle than towards either end of the semicell. In the last two respects they recalled the var. *tumida* Turner (K. Sv. Vet.-Akad. Handl., xxv, 1892, No.5, p.31, Tab.IV, fig.4), which, however, has far smaller dimensions. The variety is cited in Messrs. West's monograph under the type (West, West 1904, p.205, Pl.XXIX, figs.9-11), but diagnosis of the latter there given does not embrace the special features mentioned by Turner (Fritsch, Rich 1924).

The tubercles at the apex were not distinct; long., 400.0-444.0 μm ; lat. max., 19.0-24.0 μm (Rich 1932).

Long. cell., 258.0-330.0 μm ; lat. bas. cemicell., 18.0-21.0 μm ; lat. apic., 15.0 μm (Fritsch, Rich 1938).

Length 413.0-504.0 μm ; breadth 28.0-30.0 μm ; apices 16.5-20.0 μm ; ratio of length to breadth 14.0-17.0 (Williamson 1994).

- VAR. ELONGATUM WEST

Illustrations. Pl.8, Fig.3 (Williamson 1994).

Sample. RSA: 195, 375.

Note. Long., 430.0-556.0 μm ; lat. max., 22.0 μm (Rich 1932).

Length 570.0-628.0 μm ; breadth 26.0-28.5 μm ; apices 18.5-19.0 μm ; ratio of length to breadth 20.0-22.0 (Williamson 1994). In (Williamson 1994) indicated as *Pleurotaenium ehrenbergii* (Bréb.) De Bary var. *elongatum* (W. West) W. West.

- VAR. UNDULATUM SCHAARSCHM.

Illustrations. Pl.8, Fig.1 (Williamson 1994).

Sample. RSA: 329, 355, 362, 376.

Note. Long., 374.0 μm ; lat., 18.2 μm (33.0 μm at basis); 20 times longer than wider (Huber-Pestalozzi 1930).

Length 399.0-535.0 μm ; breadth 30.0-33.0 μm ; apices 20.0-23.0 μm ; ratio of length to breadth 13.0-17.0 (Williamson 1994).

- VAR. WATERBERGENSE CLAASSEN

Illustrations. Tab.7, figs.7, 8 (Claassen 1961).

Samples. RSA: 256.

Note. *Affinis P. ehrenbergii var. undulato* Schaarschm., *sed differt et membrana luteo-flava et quod semicellulis iuxta tumorem basalem undulatio aut deest aut vix perspicui potest.*

Near *P. ehrenbergii* var. *undulatum* Schaarschm. (W. and G.S. West, The Freshwater Algae of Ceylon, Trans. Linn. Soc. London, Ser.2, Vol.VI, 1901-1902, Pl.18, fig.28); but the cemicells are without or with one very slight undulation above the basal inflation, cell wall yellowish-brown. Cells of medium size, 10.7-11.4 times longer than their diameter; semicells gradually attenuated from base to apex; apices bordered by a ring of pear-shaped tubercles, 4-8 in number (three or five visible across the apex); cell wall punctate. Length 416.0-428.0 μm ; breadth at base of semicells 36.4-41.0 μm ; at middle of semicells 36.0-36.5 μm ; at apices 26.0-29.0 μm (Claassen 1961).

137. PLEUROTAENIUM EUGENEUM (TURN.) W. ET G.S. WEST

- VAR. EUGENEUM

Illustrations. Pl.9, Fig.8 (Williamson 1994).

Sample. RSA: 328, 338.

Note. Length 811.0 μm ; breadth 46.0 μm ; apices 43.0 μm ; ratio of length to breadth 17.6 (Williamson 1994).

- VAR. CAPENSE HODGETTS

Illustrations. Fig.9, A (Hodgetts 1926).

Sample. RSA: 112, 113 (very rare).

Note. *Var. cellulis diametro 14-15 plo longioribus, leviter attenuatis, semicellulis basi inflatis, supra partem basalem leviter 2-undulatis; tuberculis apicalibus a fronte visis 8-9; membrana cellularum regulariter et minute punctata. Long. cell., 480.0-538.0 μm ; lat. ad bas. semicell., 34.6-35.0 μm ; lat. ad apic., 24.0-25.5 μm .*

Differs from the usual form of *P. eugenum* is showing only 8 or 9 elongate granules across the apex, and in the smaller size of the cells, in the two faint undulations above the larger basal one, and in the regular punctulation of the cell-wall (Fig.9, A).

G.S. West has described a form of *P. eugenum* ("Contribution to our Knowledge of Freshwater Algae of Columbia," Mem. de la Soc. Neuchâteloise d. Sci. Nat., 1914, p.1032, Tab.23, fig.62), with the same number of apical granules as the present variety, but with the cells larger in size, and with the semicells 4-undulate at the base. The regular punctulation of the cell-wall shown by present form appears to be unusual in *Pleurothaenium* (Hodgetts 1926). In (Hodgetts 1926) was mistakenly indicated as *Pleurotaenium eugenum* (Turn.) W. et G.S. West var. *capense* Hodgetts.

138. PLEUROTAENIUM MAXIMUM (REINSCH) LUND.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 216, 286.

139. PLEUROTAENIUM MINUTUM DELPONTE

- VAR. **ELONGATUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 198, 199.

Note. Long. cell., 230.0-248.0 μm ; lat. ad bas. semicell., 10.0 μm ; ad apic., 6.0-7.0 μm (Fritsch, Rich 1938).

- VAR. **GRACILE** WILLE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 201.

Note. Long. cell., 156.0-178.0 μm ; lat. ad bas. semicell., 11.0-12.0 μm (Fritsch, Rich 1938).

140. PLEUROTAENIUM MULTITAENIATUM RINO

- VAR. **MULTITAENIATUM**

Illustrations. Pl.9, Fig.7 (Williamson 1994).

Sample. SWA: 378.

Note. Length 970.0 μm ; breadth 108.0 μm ; apices 42.0 μm ; ratio of length to breadth 9.0 (Williamson 1994).

Swaziland (orig.).

- VAR. **CORONATUM** WILLIAMSON

Illustrations. Pl.9, Fig.7a (Williamson 1994).

Sample. RSA: 338.

Note. Differs from the type variety in having a crown of minute granules (14 visible in face view) surrounding the apices. Length 871.0-984.0 μm ; breadth 119.0-147.0 μm ; apices 47.0 μm ; isthmus 73.0-77.0 μm .

This desmid was present as a prolific population in the dam at Kenneth Stainbank Nature Reserve, Durban, on 14.10.1988 and has been present on each subsequent visit though less abundant. When originally found, a high proportion of the cells contained dense blackish clouds composed of hundreds, possibly thousands, of minute crystals which, upon close examination were seen to be often strung together, 3-4 crystals in a series, on an almost imperceptible thread. These threads were arranged across the cell at 90° to the longitudinal axis while the whole mass of crystals oscillated slightly both transversely and longitudinally, first in one direction then another. These crystals were later examined with the Scanning Proton Microprobe in the Nuclear Physics Laboratory of the University of Oxford and were found to consist of Barium sulphate, crystals of which are now well recognised as desmid inclusions (Brook and al. 1980; Wilcock and al. 1989).

The apices of this desmid also proved interesting for it was not until an empty cell was examined that a crown of minute apical granules was noticed, about 14 being arranged across the width. Further examination of cells where at least the apices were empty revealed that almost all had these granules although they were difficult to discern.

Pleurotaenium multitaeniatum was first reported from Mozambique (Rino 1972). The latin diagnosis indicates that the poles do not have verrucae, a fact which is evident from the clear illustration. Compère (1977) also describes and illustrates the apices as smooth. Because of this significant difference from the nominal variety the Durban desmid population is described here as a new variety (Williamson 1994).

141. PLEUROTAENIUM OVATUM NORDSTEDT (= *DOCIDIUM OVATUM* NORDST.)

- VAR. **OVATUM**

Illustrations. Fig.7, *E* (Fritsch, Rich 1924); Tab.8, figs.1, 2 (Claassen 1961); Pl.9, Fig.5 (Williamson 1994).

Sample. RSA: 22, 74, 103 (rather rare), **328, 329, 332, 338, 341, 349, 351, 358, 360, 375, 383, 390, 430.**

Note. Indicated in article of Fritsch (1918) "previously recorded by Nordstedt from the Cape".

Long. cell., 270.0-340.0 μm; lat. max., 81.0-87.0 μm; lat. constr., 45.0-60.0 μm; lat. apic., 25.0-27.0 μm. These dimensions are appreciably less than those originally recorded by Nordstedt (*Alg. aq. dulc. Brasil., Oefvers. K. Sv. Vet.-Akad. Foerhandl., 1877, No.3, p.18*). Slightly smaller specimens have been described by Schmidle (Engler's 'Bot. Jahrb.,' xxvi, 1899, p.23) as var. *minor*, but it is doubtful if this variety can be retained, since the size of the species is subject to much fluctuation.

The specimens in sample 74, while showing the typical shape, exhibited the annular thickening at the constriction figured by W. and G.S. West for var. *tumidum* Maskell ('Ann. Roy. Bot. Garden, Calcutta,' vi, Part II, 1907, Pl.XIII, fig.8) and by Turner for his *Docidium rotundatum* ('Sv. Vet.-Akad. Handl.,' xxv, No.5, 1892, t.vii, fig.2a), which is probably synonymous with the former. They also differed in the fact that the membrane appeared to be not punctate, but delicately and irregularly striate.

Indicated in article of Fritsch and Stephens (1921 "This species has been recorded from the Cape by Nordstedt" (Fritsch, Stephens 1921).

Forma angustior, constrictione profundiore. Long. cell., 305.0-405.0 μm; lat. isthm., 39.0 μm; lat. max., 78.0-81.0 μm; lat. apic., 33.0 μm (Fritsch, Rich 1924).

Long., 265.0 μm; lat. (max.) 78.0 μm; apex, 18.2 μm; isthmus, 44.2 μm (Huber-Pestalozzi 1930).

Pleurotaenium species ad P. ovatum Nordst. Cells of medium size; 3.8-4 times longer than their diameter; semicells tumid, a little broader at the middle than at the base, attenuated from the middle to the apices, without a basal inflation; apices with one or two rings of tubercles, puther ring with 6-10 tubercles (4-6 visible across the apex) and the inner ring with 6-8 (3-4 visible across the cell); cell wall punctate. Length 313.0-356.0 μm; breadth 83.0-90.0 μm; breadth of isthmus 44.0-60.0 μm; breadth of apices 25.0-28.0 μm. Since only the description of *P. ovatum* Nordst. was available, it is impossible to decide with certainty whether these specimens really belong to Nordstedt's species (Claassen 1961).

Length 315.0-413.0 μm; breadth 76.0-105.0 μm; isthmus 43.0-73.0 μm; apices 23.0-31.0 μm; ratio of length to breadth 3.7-4.2 (Williamson 1994).

- VAR. **TUMIDUM** (MASK.) G.S. WEST

Illustrations. Fig.13 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Long., 247.0 μm; lat., 99.0 μm (2.5x); lat. apic., circa 21.0 μm* (Grönblad, Croasdale 1971).

142. PLEUROTAENIUM PSEUDOEHRENBEGII CLAASSEN

Illustrations. Tab.7, fig.2 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis P. ehrenbergii* (Bréb.) De Bary, *sed membrana glabra, apice utrinque tuberculo uno ornato, cellula iuxta tumorem basalem vix undulata differt.*

This species is near *P. ehrenbergii* (Bréb.) De Bary (West, West 1904, p.205, Pl.XXIX, figs.9-11; Pl.XXX, fig.1); but the undulation above basal inflation is very slight, there is one tubercle on each side of the apex, and the cell wall is smooth. Cells of medium size, subcylindrical, 12.4-12.5 times longer than their diameter; semicells with one distinct basal inflation and a small undulation above it, gradually attenuated towards the apices or slightly tumid and then gradually attenuated towards the apices; apices truncate, furnished with two tubercles. Length 408.0-448.0 μm ; breadth at base of semicells 31.0-34.0 μm ; at middle of semicells 32.0-36.0 μm ; at apices 24.0-26.5 μm (Claassen 1961).

143. PLEUROTAENIUM RACIBORSKII CROASDALE IN PRESCOTT, CROASDALE AND VINYARD (SYN.: *PLEUROTAENIUM BREVE* RACIBORSKI VAR. *ENGLERI* (SCHMIDLE) W. KRIEGER)

Illustrations. Figs.1-7 (Claassen 1976), Fig.6 (Coesel, van Geest 2008).

Sample. RSA: 308. – NAM: 420. – BOT: 408, 409, 411, 415.

Note. This desmid was originally described by Schmidle (1898, p.23) as *Pleurotaenium engleri* from material collected in Central East Africa during June 1892. He mentioned that the taxon could be compared with *Pleurotaenium breve* Raciborski. Krieger (1937, p.410) gave the taxon varietal rank under Raciborski's species. From the dimensions given by Schmidle (length 120 μm , width 36 μm) it is assumed that he found only one specimen. No further mention was made of this taxon in literature available to the present author until Lind (1971, p.538) rediscovered it in material collected in Uganda during 1967. From the dimensions given by Lind (length 105.0 μm ; width 36.0 μm) it is assumed that she, to found only one specimen.

Since present author examined more than a hundred slides and found only three specimens in the material collected in 1972 (sample **308**) and none in the material collected in 1975 (sample **309**), it is evident that this taxon is extremely rare. Although these specimens are larger than those found by Schmidle and Lind they are still regarded as members of the same taxon and not as a new form. The dimensions of the specimens are: length 151.8-169.5 μm ; maximum width 46.7-50.8 μm ; width of isthmus 44.0-48.0 μm ; width of apices 19.4-25.0 μm .

None of the previous authors made any mention of the chloroplasts of this taxon nor were any depicted in their drawings. In the Ottosdal specimens each semicell contains one axial chloroplast with about 4-6 longitudinal ridges. No pyrenoids were observed.

Schmidle's specimen has four teeth at the apex of each semicell but Lind could distinguish only two. The Ottosdale specimens agree with that of Schmidle except for one specimen which has a fifth, slightly subapical, tooth in one semicell (Fig.5, bottom semicell) (Claassen 1976).

Information about correct name of this species after taxonomical combination see in (Claassen 1985).

In (Coesel, van Geest 2008) indicated as *Pleurotaenium engleri* Schmidle.

P. engleri is a most characteristic species that hardly can be confused with any other known *Pleurotaenium* species. It was originally described by Schmidle (1898) from Wembere marshes, in Tanzania. To our mind unjustly, Krieger (1937) transferred it as var. *engleri* to *P. breve*, a species described by Raciborski (1895) from British Guiana. When doing so, Krieger (1937) slightly changed

Schmidle's original figure, making it more alike Raciborski's original illustration of *P. breve*. Until now, after Schmidle's (1898) original description, *P. engleri* was only recorded (as *P. breve* var. *engleri*) by Lind (1971) from Uganda, and by Claassen (1976) from Southwestern Transvaal. So, most likely, it can be considered an African endemic. Claassen (1976) referring to the cell dimensions stated by Schmidle and Lind, assumed that both authors found but a single specimen of the species in question. She herself, examining more than a hundred slides, encountered only three specimens and concluded it to be extremely rare taxon (Coesel, van Geest 2008).

144. PLEUROTAENIUM SUBCORONULATUM (TURNER) W. ET G.S. WEST (SYN.: *DOCIDIUM SUBCORONULATUM* W.B. TURNER)

Illustrations. Fig.7, A-D (Fritsch, Rich 1924); Pl.8, Fig.5 (Williamson 1994).

Sample. RSA: 99 (common), **191, 328, 338, 341, 348, 358.**

Note. *Forma longior.* Long., about 600.0 μm ; lat. in the middle, 33.8 μm ; lat. at apex, 36.0 μm . Indicated as *Pleurotaenium subcoronulatum* (Turner) West (Huber-Pestalozzi 1930).

Forma diversae. Long. cell., 570.0-690.0 μm ; lat. ad inflat basal., 38.0-45.0 μm ; lat. in media semicell., 35.0-41.0 μm ; lat. apic., 33.0-38.0 μm . The semicells, which were very slightly attenuated from base to apex, invariably possessed a prominent basal inflation, but for the rest the individuals were rather variable. Some of the semicells were almost straight-sided with a mere suggestion of a waved outline (Fig.7, A), whilst others were more or less undulated along their whole length (cf. Turner's original description and our figure 7, B). Approximately the last sixth of the lateral margins was usually almost straight (Fig.7, C and D) and, where this region commenced, there was often a more or less decided constriction (Fig.7, A), which in the undulate individuals tended to merge in the general waviness of the outline (Fig.7, B). Messrs. West (Trans. Linn. Soc., Bot., v, 1896, p.235, Pl.XIII, figs.2, 3) have described a var. *detum* of *P. subcoronulatum*, in which the chief characteristic lies in such subapical construction. In sample **99** there seemed to be all transitions between normal individuals and such as showed clearly this character of var. *detum*, and it is doubtful if this variety can be maintained.

The apices were crowned with a ring of 18-20 molar-shaped tubercles, 9-11 being visible across the apex (Fig.7, A, B); they often showed the fissure mentioned in Turner's diagnosis. It would seem from the published figures that these tubercles vary rather considerably in form. Below them the cell-wall is often slightly fluted (Fig.7, A-C). The membrane bears irregular punctae which here and there appear in longitudinal rows (Fig.7, A). The individuals were not uncommonly found cohering by their apices (Fig.7, C and D)(Fritsch, Rich 1924).

Similar to some of the forms of this species found in Natal (Fritsch, Rich 1924, xi, p.328). Long., 628.0 μm ; lat. max., 41.0 μm (Rich 1932).

Length 343.0-714.0 μm ; breadth 76.0-105.0 μm ; apices 27.0-50.0 μm ; ratio of length to breadth 11.5-17.0 (Williamson 1994).

145. PLEUROTAENIUM TESSELATUM LAGERH. (SYN.: *DOCIDIUM TESSELATUM* JOSHUA)

Illustrations. Fig.4 (Fritsch, Rich 1938).

Sample. RSA: 199 (rather common).

Note. *Forma semicellulis basin varsus paullo contractis, prominentibus membranae subirregulariter dispositis.* Long. cell., 300.0-430.0 μm ; lat. apic., 25.0-30.0 μm ; lat. isthm., 29.0-36.0 μm .

This should be compared with the forms recorded by Schmidle ("Die ... in Ost-Afrika gesammelten Desmidiaceen", Eng. Bot. Jahrb., xxvi, p.1, 1899, p.22). There are from 9 to 11 transverse series of quadrate elevations, somewhat irregularly disposed, on each semicell. The surface of the membrane is punctate. There is some resemblance to var. *coronatum* Krieger ("Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiologie, Suppl. Bd.xi, 1932, p.169, Pl.VI, fig.12) which, however, has more of the apical tubercles (Fritsch, Rich 1938).

146. PLEUROTAENIUM TRABECULA (EHRENB.) NÄGELI

- VAR. TRABECULA

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 98 (not uncommon), **99** (not uncommon), **222**, **299**, **329**, **396**, **430**, **433**.

Note. Long. cell., 310.0-660.0 μm ; lat. ad inflat. basal., 21.0-43.0 μm ; lat. in media semicell., 28.0-36.0 μm ; lat. apic., 17.0-30.0 μm (Fritsch, Rich 1924).

Long., 380.0 μm , lat., 20.8 μm ; long., 390.0 μm , lat., 26.0 μm . In sample **329** occurred also *forma minor*: long., 330.0 μm ; lat., 20.8 μm (Huber-Pestalozzi 1930).

Long. cell., 72.5 μm ; lat., 23.0 μm (Rich 1940).

Length 561.0 μm ; breadth 30.0 μm ; apices 20.0 μm ; ratio of length to breadth 18.7 (Williamson 1994). In (Williamson 1994, 2000) indicated as *Pleurotaenium trabecula* (Ehrenb.) ex Næg.

- VAR. ANGUSTUM CLAASSEN

Illustrations. Tab.7, figs.3-5 (Claassen 1961).

Samples. RSA: 284, **285**.

Note. *A typo speciei cellulis multo angustioribus differt. Cellulae plus minusve 25.5-28.3-plo longiores quam latiores.*

Cells narrower in proportion to their length in the typical form (West, West 1904, p.209, Pl.XXX, figs.11-13); cells 25.5-28.3 times longer than their diameter. Apices obtusely rounded, without tubercles; cell wall punctate. Length 514.0-568.0 μm ; breadth at base of semicell 24.0-24.5 μm ; at middle of semicell 20.0-21.0 μm ; at the apices 16.0-19.0 μm (Claassen 1961).

- VAR. BARBARICUM CLAASSEN

Illustrations. Tab.7, fig.1 (Claassen 1961).

Samples. RSA: 286.

Note. *Affinis P. trabeculae var. recto* (Delp.) W. et G.S. West, *sed differt quod apex cellulae circulo 6 tuberculorum instructus est, cellulae 14.9-16-plo longioribus quam latioribus, at quam variationis rectum* (Delp.) W. et G.S. West *paulo latiores sunt*.

This closely resembles *P. trabecula* var. *rectum* (Delp.) W. et G.S. West (West, West 1904, p.212, Pl.XXX, figs.9, 10); but the cells are a little broader and the apices tuberculate. Cells of medium size, rather narrow and subcylindrical; semicells somewhat variable in shape, attenuated from base to apex or slightly tumid and then gradually attenuated to the apices, with a distinct basal inflation and one small undulation immediately above it; apices truncate, bordered by a ring of conical tubercles; six in number (four visible across the apex); cell wall

smooth. Length 402.5-420.0 μm ; breadth at base of semicells 27.0-28.0 μm ; at middle of semicells 23.0-27.0 μm ; at apices 18.0-20.0 μm (Claassen 1961).

- VAR. **BREVIS** CLAASSEN

Illustrations. Tab.7, fig.10 (Claassen 1961).

Samples. RSA: 265.

Note. *A typo speciei cellulis valde brevioribus et apicibus tuberculis ornatis differt.*

Cells shorter than in the typical form, apices with one tubercle. Length 359.0 μm ; breadth at base of semicell 28.0-28.5 μm , at middle of semicells 26.0-27.5 μm , and at apices 19.0-20.0 μm (Claassen 1961).

- VAR. **ELONGATUM** CEDERGR.

Illustrations. Pl.8, Fig.4 (Williamson 1994).

Samples. ? (Williamson 1994).

Note. Length 800.0-1013.0 μm ; breadth 40.0-42.0 μm ; apices 26.0-28.0 μm ; ratio of length to breadth 19.5-24.7. Rather longer than usually quoted. Růžička (1977) gives dimensions of 600.0-800.0-(900.0) \times 30.0-40.0-(50.0?) μm whilst Prescott and al. (1975) give length 600.0-830.0 μm and width 24.7-42.0 μm (Williamson 1994). Number of sample was not pointed (Williamson 1994).

147. PLEUROTAENIUM TROCHISCUM W. ET G.S. WEST

- VAR. **GALPINII** CLAASSEN

Illustrations. Tab.8, fig.7 (Claassen 1961).

Samples. RSA: 295.

Note. *A typo cellulis multo brevioribus et 7.2-8-plo longioribus quam latioribus, margine apicali circulo tuberculorum fere 8 ornato differt.*

The cells are considerably shorter than in the typical form (W. and W.S. West, North American Desmidiaceae, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, pl.13, figs.4, 5), and are about 7.2-8 times longer than their diameter; apices bordered by a ring of tubercles, about eight in number (five visible across the apex). Length 252.0-264.0 μm ; breadth at base of semicell 33.0-35.0 μm ; at middle of semicell 30.0-32.0 μm ; at apices 20.0-23.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

148. PLEUROTAENIUM TRUNCATUM (BRÉB.) NÄG.

- VAR. **TRUNCATUM**

Illustrations. Absent in literature on Southern African desmids..

Samples. RSA: 223.

- VAR. **MATTIEI** CLAASSEN

Illustrations. Tab.8, fig.6 (Claassen 1961).

Samples. RSA: 255.

Note. *Affinis P. truncato var. granulato West, sed cellulis multo brevioribus, semicellulis media in parte minus tumidis, margine apicali tuberculis paucioribus ornato differt.*

Near *P. truncatum* var. *granulatum* West (West, West 1904, p.205, Pl.XXIX, figs.7, 8); but the cells are much shorter, they are less tumid in the median part of the semicells and the apical margin has fewer tubercles. Cells small, about 7.-7.2 times longer than their diameter; semicells with one basal inflation, slightly tumid in the middle of the semicells; apices bordered by a ring of tubercles, 2-4 in number (2-3 visible across the apex); cell wall punctate. Length 272.0 μm ; breadth at base of semicell 36.0 μm , at middle of the semicell 38.0-39.0 μm , at apices 26.0-28.0 μm (Claassen 1961).

149. PLEUROTAENIUM WESTIORUM CLAASSEN

Illustrations. Tab.7, fig.9 (Claassen 1961).

Samples. RSA: 239.

Note. *Affinis P. monilifero* W. et G.S. West, *sed aocibus cellulae multo latioribus (modo non tam latis quam ad semicellulae basim) differt.*

This is near *P. moniliferum* W. et G.S. West (W. and G.S. West, The Freshwater Algae of Madarascar, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.5, fig.32); but with broader apices (about as broad as at the base of the semicells). Cells large, 16-16.5 times longer than their diameter; semicells slightly tumid in the middle, with a slight basal inflation and two smaller undulations above it; apices truncate, and bordered by a ring of pear-shaped tubercles, 24- in number (13 visible across the apex); cell wall smooth. Length 796.0-800.0 μm ; breadth at base at base of semicells 40.0-50.0 μm , near base of semicells 44.0-46.0 μm ; at middle of semicells 48.0-50.0 μm ; near apices 40.0-44.5 μm ; at apices 44.0-47.0 μm . Named after Messrs. W. and G.S. West (Claassen 1961).

Members of this genus which not identified to the species level were occurred in following samples: **RSA: 430.**

TRIPLASTRUM IYENGAR ET RAMANATHAN

150. **TRIPLASTRUM ABBREVIATUM** (W.B. TURNER) IYENGAR ET RAMANATHAN (SYN.: *TRIPLOCERAS ABBREVIATUM* TURNER)

Illustrations. Figs.11-13 (Coesel, van Geest 2008).

Samples. NAM: (?) 400-418. – BOT: (?) 419-424.

Note. This species was originally described by Turner (1892) as *Triploceras abbreviatum*, Iyengar and Ramanathan (1942) transferred it to the newly erected genus *Triplastrum*, In our opinion, a number of other *Triplastrum* species described later on belong to this same species, for there is no essential difference between *T. abbreviatum*, *T. indicum* Iyengar et Ramanathan, *T. spinulosum* (Kisselev) Gauthier-Lièvre and *T. simplex* (Allorge) Iyengar et Ramanathan.

When taking this wider species conception, *T. abbreviatum* is known from tropical and subtropical regions in both Asia, Africa and (incidentally) Europe. In the Okavango Delta it appeared to be widely distributed and locally rather common on the site of Chief's Island (samples **400-411**). In sample **409** it was found in sporulating condition. Until then, zygospores were only described by Iyengar and Ramanathan (1942). As appears from our figures, zygospores are about pumpkin-shaped (compressed spherical, in top view with undulate margins) (Coesel, van Geest 2008).

151. **TRIPLASTRUM SPINULOSUM** (KISSELEV) GAUTHIER-LIÈVRE (SYN.: *TRIPLOCERAS SPINULOSUM* KISSELEV, *TRIPLASTRUM INDICUM* IYENGAR ET RAMANATHAN, *TRIPLASTRUM SPINULOSUM* (KISSELEV) GAUTHIER-LIÈVRE VAR. *INDICUM* (IYENGAR ET RAMANATHAN) GAUTHIER-LIÈVRE, *TRIPLASTRUM SPINULOSUM* (KISSELEV) GAUTHIER-LIÈVRE VAR. *AFRICANUM* GAUTHIER-LIÈVRE)

Illustrations. Figs.1-44 (Claassen 1977).

Samples. RSA: 309 (fairly abundant), **310** (very rare), **311** (very rare).

Note. In the material collected in the Transvaal the Ottosdal specimens have either three-lobed apices (Figs.1-3, 16 – upper cell, 17-22, 31, 32, 33 – cell on left, 34-38) or four-lobed apices (Figs.4. 9, 16 – lower cell, 25, 33 – cell on right) while some specimens have one semicell with a three-lobed apex and the other

semicell with a four-lobed apex (Figs.10, 11, 26-28, 39). The Mosdene specimens have only four-lobed apices (Figs.5-8, 14). Figs.1 and 13 (upper semicell) as well as some of the specimens with four-lobed apices (Figs.7, 8, 14) resemble one another in that the apices are weakly dilated, and the polar lobes hardly divergent and bi- or tridenticulate and seldom quadridenticulate (Fig.13).

According to Gauthier-Lièvre (1960), *Triplastrum spinulosum* var. *indicum* (Iyengar et Ramanathan) Gauthier-Lièvre differs from typical variety in its larger dimensions and longer more divergent polar lobe. Iyengar and Ramanathan's figures (1942, p.228, Figs.1-5) for this variety agree with Fig.2 (lower semicell) and 17 (cell on left) of the present paper as well as with some of the cells with four-lobed apices (Figs.4-6). The dimensions of these cells overlap both those of the type and var. *indicum*.

Triplastrum spinulosum var. *africanum* (Gauthier-Lièvre, 1960, p.64, Figs.2, *q-t*) differs from the typical variety in that the cells are slightly narrower below the apices and the polar lobes are strongly divergent, bidenticulate and seldom tridenticulate. The majority of the Ottosdal specimens (Figs.2 – upper semicell, 3, 19-22, 31, 32, 34-38) agree with Gauthier-Lièvre's figures for this taxon, but bidenticulate and tridenticulate polar lobes are approximately equal.

Iyengar and Ramanathan (1942) observed two chloroplasts each with a central pyrenoids in each semicell. Gauthier-Lièvre (1960) reported 1 or 2 pyrenoids per semicell for the type and 1-3 pyrenoids for her var. *africanum*. In the material collected in Transvaal, the majority of the specimens observed had two chloroplasts per semicell (Figs.1, 2, 4-8, 11, 12, 14, 19, 21, 23, 24, 26-28, 31, 32, 41), some had three chloroplasts per semicell (Figs.9, 25) or one semicell contained two chloroplasts and the other three (Figs.3, 20, 22). Each of these chloroplasts contained a central pyrenoid. Only a few specimens were observed in which the delineation of the chloroplasts was indistinct and there appeared to be only one chloroplast per semicell, but each contained two pyrenoids.

In the Ottosdal material one specimen (Figs.9, 25) was found which was considerably larger than the others: length without spines 141.0 μm ; with spines 144.0 μm ; maximum width 14.0 μm ; width of isthmus 11.0 μm ; width of apices 17.0-18.5 μm . If this specimen is taken into consideration, the dimensions of the Transvaal specimens overlap those of Gauthier-Lièvre's three varieties of *Triplastrum spinulosum*. The dimensions of the other Transvaal specimens are as follows:

	Ottosdal	Mosdene
Length without spines	61.0-97.0 μm	56.0-66.0 μm
Length with spines	63.0-102.5 μm	59.0-68.0 μm
Maximum width	9.0-11.0 μm	9.3-10.0 μm
Width of isthmus	8.5-10.5 μm	8.8-9.3 μm
Width of apex	11.0-18.0 μm	10.5-14.0 μm

Zygospores, found in the Ottosdale material collected during April 1972 (Figs.17, 18, 34-39), resemble those found by Iyengar and Ramanathan (1942) but are slightly smaller. The dimensions are 34.0-38.0x26.0-40.0 μm .

When all the characters found in Transvaal specimens were taken into consideration it is decided that the specimens studied belonged to one species, namely *Triplastrum spinulosum* and that the two varieties *indicum* and *africanum* should be regarded as synonyms.

The two varieties are thus placed into synonymy and the circumscription of the species is amplified.

Diagnosis. Cells small, about 6-10 times longer than broad, with a slight but well-defined median constriction; semicells straight, cylindrical, with sides nearly parallel or slightly attenuated from base to just below the apex; apices more or less inflated, three- or four-lobed, lobes slightly to strongly divergent, each lobe bearing 2-4 short spines; cell-wall colorless, pores minute. Chloroplasts axial, 1 (?) or 2-3 in each semicell, arranged in a median series, each chloroplast with radiating plates (stellate) and a central pyrenoid. Zygospore spherical to subspherical, thick-walled, margin crenate. Length without spines 56.0-99.5 (144.0) μm ; maximum width near base of semicell 9.0-144.0 μm ; width of isthmus 8.5-12.0 μm ; width of apices 11.0-18.0 (18.5) μm ; zygospore 38.0-42.0x36.0-42.0 μm .

It seems that this species is very rare and that usually only a few specimens are found in samples collected. In sample **309**, however, it was fairly abundant. As could be expected in a fairly large population anomalous specimens were also found. In the Ottosdal material one specimen was found where, in each semicell, one of the polar lobes was under-developed, without spines and somewhat subapical (Figs.12, 41). In another specimen only one of the semicells was like this (Fig.13, lower semicell). Several asymmetrical cells were found (Figs.11, 29, 40) and one very narrow semicell was observed (Fig.30). The most anomalous specimen was a single semicell with a prominent basal inflation encircled by a whorl of eight lobes similar to the polar lobes (Figs.15, 42-44). In the Mosdene material one anomalous specimen was found with the polar lobes of one semicell undeveloped (Fig.14) (Claassen 1977).

TETMEMORUS RALFS EX RALFS

152. TETMEMORUS BREBISONII (MENEHGH.) RALFS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 200 (very rare), **202, 224.**

Note. Long. cell., 182.0 μm ; lat. bas. semicell., 30.0 μm ; lat. apic., 22.0 μm . In the front view there is a very slight constriction above the isthmus and another just below apex (Fritsch, Rich 1938).

153. TETMEMORUS EUASTROIDES A.M. SCOTT ET PRESCOTT

- VAR. AFRICANUS COESEL ET VAN GEEST

Illustrations. Fig.7 (Coesel, van Geest 2008).

Samples. NAM: 420. – BOT: 401, 402, 415.

Note. Differs from the nominate variety by capitate cell ends. Cell length 97.0-105.0 μm , cell breadth 25.0-29.0 μm , breadth of isthmus 12.0-14.0 μm .

The algal form pictured in our figure most likely is identical to *Tetmemorus pseudoeuastroides*, described by Bourrelly and Couté (1991) from Madagascar. According to Bourrelly and Couté (1991) *T. pseudoeuastroides* would differ from *T. euastroides*, described by Scott and Prescott (1958) from Australian Arnhem Land, in the presence of cell wall granules that are lacking in *T. euastroides*. However, the illustration of *T. pseudoeuastroides* in Bourrelly and Couté (1991, Pl.2-2) shows perfectly smooth cell outlines without any indication of granules. The present authors, in their Okavango samples, encountered cells quite similar in morphology to those pictured in Bourrelly and Couté (1991) but definitely smooth-walled. So, most likely, Bourrelly and Couté mistook cell wall pores (or their mucilage extrusions) for cell wall granules (for that matter, cell wall

granules are unknown in the genus *Tetmemorus*). The only difference the nominate variety of *T. euastroides* and var. *africanus* is in the shape of the cell ends: attenuate in var. *euastroides*, capitate in var. *africanus* (Coesel, van Geest 2008).

154. TETMEMORUS GRANULATUS (BRÉB.) RALFS EX RALFS

Illustrations. Pl.9, Fig.4 (Williamson 1994).

Samples. RSA: 231, 368, 398.

Note. Length 163.0-216.0 μm ; breadth 33.0-35.0 μm ; isthmus 30.0 μm ; ratio of length to breadth 4.9-6.0 (Williamson 1994).

155. TETMEMORUS LAEVIS (KÜTZ.) RALFS

- VAR. LAEVIS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 122 (very rare), 240, 327, 430.

Note. Long., 80.6-83.2 μm ; lat., 20.8-23.4 μm ; ends lat., 9.0 μm (Huber-Pestalozzi 1930).

Western Cape, Magaliesberg, Drakensberg (orig.).

- VAR. MINUTUS (DE BARY) KRIEG.

Illustrations. Pl.9, Fig.3 (Williamson 1994).

Samples. RSA: 226, 231, 368, 398.

Note. Length 45.0-48.0 μm ; breadth 18.0-19.0 μm ; ratio of length to breadth 2.5-2.6 (Williamson 1994).

EUASTRUM EHRENBERG EX RALFS

156. EUASTRUM AFRICANUM (BOURRELLY) COESEL ET VAN GEEST (BAS.: EUASTRUM EVOLUTUM (NORDST.) W. ET G.S. WEST VAR. GLAZIOVII (BØRGESSEN) W. ET G.S. WEST FORMA AFRICANUM BOURRELLY)

Illustrations. Figs. 17, 18 (Grönblad, Croasdale 1971); Figs.22-24 (Coesel, van Geest 2008).

Sample. NAM: 301, 307, (?) 419-424. – BOT: 400, (?) 401-418.

Note. Long., 40.0-42.0 μm ; lat. without spines 32.0-34.0 μm (1.23-1.25x); isthm., 7.5.0-8.0 μm ; lat. apic., 18.0-20.0 μm . Our plants are somewhat more compressed than Bourrelly's form (1957, p.1061, 3: 27, 28) but otherwise resemble it very closely. R. Grönblad suggested *E. flammeum* Josh., which, however, has a very different polar lobe and a paired central ornamentation (Grönblad, Croasdale 1971).

No doubt, the taxon represented in our figures is identical to *Euastrum evolutum* var. *glaziovii* forma *africanum* described by Bourrelly (1957) from Mali. However, it should be also clear that it has but little to do with *Eu. evolutum* as originally described by Nordstedt (1877, as *Eu. abruptum* var. *evolutum*) from Brazil. Whereas *Eu. evolutum* is characterized by marked lateral lobes in between the apical and the basal semicell lobes, there is no trace of such lateral lobes in our alga under discussion. In respect of that, *Eu. evolutum* var. *glaziovii* described by Børgesen (1980, as *Eu. glaziovii*) from Brazil somewhat better fits our material but still the morphological differences are big enough to justify distinction at species level. Actually, our newly named *Eu. africanum* rather resembles *Eu. sachlanii* as described by Scott and Prescott (1961) from Sumatra (see also Coesel and Dingley 2005). Differences. However, are in cell length to breadth ratio, depth of the median apical incision and arrangement of cell wall granules on the central semicell inflation.

In Okavango Delta, *Eu. africanum* appeared to be one of the commonest desmid species, encountered in almost all samples. Zygosporangia were found in sample **400** (Coesel, van Geest 2008).

157. EUASTRUM ANSATUM RALFS

- VAR. ANSATUM

Illustrations. Figs.142-144 (Cholnoky 1955); Tab.9, fig.8 (Claassen 1961); Fig.15 (Grönblad, Croasdale 1971).

Samples. RSA: 220, 223, 224, 230, 232-236, 241, 259, 264, 265, 266, 280, 281, 430. – NAM: 307.

Note. Die Art ist in den Rayton-Materialien, besonders in den **234** und **235** sehr reichlich vertreten, demzufolge konnte ich auch die Zellteilung der Art näher beobachten und feststellen, dass die Zellen erst auf die bekannte Weise die Anfänge der neuen Zellhälften ausbilden. Vor diesem Zustand ist die Kernteilung schon abgeschlossen, da man in den ganz jungen, unentwickelten Zellhälften deutlich das Vorhandensein von Ruhekernen feststellen kann. Die durch die Teilung voneinander geschiedenen Chromatophorhälften wachsen durch eine Ausstülpung in die neuen Zellhälften ein (ob hier eine selbständige Bewegung der Chromatophoren vorliegen sollte, muss dahingestellt bleiben). Ein Pyrenoid eilt voraus, da es schon in ganz jungen Zuständen in den wachsenden Zellhälften vorhanden ist (Fig.142). Die Kerne wandern etwas später nach der Mitte, nehmen aber ihre gewöhnliche Ruhelage im Isthmus nicht ein da sie einsteilen in den alten Zellhälften zu sehen sind. In diesem Zustand teilen sich die Pyrenoide, wodurch ihre Zweifzahl per Zellhälfte (per Chromitophor) wieder hergestellt wird. Die Teilung der beiden Pyrenoide geht aber nicht simultan, das in der älteren Zellhälfte eilt mehr oder minder voraus (Fig.143). Die Teilung des Chromatophors erfolgt nach dem Abschluss der Pyrenoidenteilung und tritt wahrscheinlich erst ein, wenn die neue Zellhälfte vollkommen entwickelt ist. Der Kern nimmt seine gewöhnliche Ruhelage nur nach der Chromatophorenteilung ein, da er auch in beinahe ganzlich entwickelten Tochterzellen vor der Chromatophorenteilung noch in der älteren Zellhälfte, in der Nähe des Isthmus zu finden ist. Die gewöhnliche Ruhelage der Pyrenoide ist ebenfalls nur nach der Chromatophorenteilung wieder hergestellt (Fig.144). Hier muss noch bemerkt werden dass während der Teilung, besonders während der Chromatophorenwanderung, auch eine passive Erweiterung des Isthmus zu beobachten war (Cholnoky 1955).

Fig.8 shows a cell with dividing pyrenoids (Claassen 1961).

Long., 87.0 μm ; lat., 38.0 μm (2.3x); isthm., 11.0 μm ; lat. apic., 17.0-18.0 μm (Grönblad, Croasdale 1971).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, KwaZulu Natal (orig.).

- VAR. **DIDELTIFORME** DUCCELL.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 299.

Note. Long. cell., 80.0 μm ; lat., 40.0 μm . Very similar to the form figured by Ducellier ("Contribution à l'Étude de la Flore Desmidiologique de la Suisse", 1918, p.42, fig.17), but a little smaller (Rich 1940).

- VAR. **ROBUSTUM** DUCCELL.

- F. **GRACILIOR** HUBER-PESTALOZZI

Illustrations. Tab.3, Fig.3 (Huber-Pestalozzi 1930).

Samples. RSA: 327.

Note. Long. cell., 85.8 μm ; lat., 35.0-39.0 μm (Huber-Pestalozzi 1930).

158. EUASTRUM ATTENUATUM WOLLE

- VAR. **BRASILIENSE GRÖNBLAD**

Illustrations. Fig.30 (Grönblad, Croasdale 1971).

Samples. NAM: 306.

Note. *Forma.* Long., 52.0 μm ; lat., 35.0 μm (1.5x); isthm., 12.0 μm ; lat. apic., 17.0 μm . R. Grönblad named this plant without comment; his figure is incomplete, but because of the closed sinus and relatively broad apical lobe it seems more appropriate to call it a forma (Grönblad, Croasdale 1971).

- VAR. **GROENBLADII COESEL ET VAN GEEST**

Illustrations. Fig.36 (Coesel, van Geest 2008).

Samples. NAM: (?) 419-424. – BOT: (?) 400-401, 402, (?) 403-418.

Note. Differs from nominate variety by a shorter polar lobe, undivided basal lobes and a widely open sinus. Cell length 52.0-60.0 μm , cell breadth 28.0-31.0 μm , breadth of isthmus 10.0-11.0 μm .

Eu. attenuatum was originally described by Wolle (1884) from the United States. Afterwards, quite a series of intraspecific taxa have been described. None of those taxa fits the combination of characters given for our var. *groenbladii*. Grönblad and al. (1958) figured the same taxon under the name *Eu. attenuatum* var. *splendens* (F.E. Fritsch et F. Rich) Grönblad et A.M. Scott, neglecting the fact that cells of *Eu. splendens* as originally described by Fritsch and Rich (1937) are characterized by a lower length to breadth ratio and distinctly bilobed basal lobes.

As far as could be checked, *Eu. attenuatum* var. *groenbladii* is only known from Sudan (Grönblad and al. 1958), Botswana and Namibia (our finds). Its closest relatives are *Eu. attenuatum* var. *brasiliense* described by Grönblad (1945) from Brazil, and var. *japonicum* described by Hinode (1962) from Japan, both differing from var. *groenbladii* by bilobed basal lobes. In our area of investigation *Eu. attenuatum* var. *groenbladii* was widely distributed (all four sites) but nowhere abundant) (Coesel, van Geest 2008).

159. EUASTRUM BAINSII WILLIAMSON

Illustrations. Pl.11, Fig.2 (Williamsom 1994).

Samples. RSA: 368.

Note. Cells of medium size, truncate-pyramidal in shape and three-lobed. The basal lobes are rounded, the margin being symmetrically and moderately retuse to the lateral lobe which is round, sometimes semi-granular, and the main axis of which is divergent from the main vertical axis of the cell. The lateral and apical lobes are separated by a widely-open rounded incision. The apical lobe very broadly cuneate with a slight median invagination, the apical angles round, semi-granulate or roughly thickened. Cell wall with large scrobiculationsn all over but without any protuberances or swellings. Side view smoothly elliptical. Vertical view narrowly elliptical with rather sharply rounded poles. Length 80.0-83.0 μm ; breadth 60.0-66.0 μm ; crass., 31.0-33.6 μm .

When first examined this desmid seemed to bear a close resemblance to *E. pectinatum* (Bréb.) ex Bréb., however careful examination revealed clear differences in front, lateral and vertical view as well as in the contours of the cell wall since all these South African specimens lacked swellings or protrusions (Williamsom 1994).

160. EUASTRUM BICEPS FRITSCH ET RICH

Illustrations. Fig.5, A-C (Fritsch, Rich 1938).

Samples. RSA: 198, 199 (rare), **200**.

Note. *E. mediocre*, plus quam duplo longius quam latius, profunde constrictum, sinu lineari introrsum leviter ampliatio; semicellulae a fronte visae subtrapeziformes, incisura mediana profunda et valde ampliata, angulis inferioribus subrectangularibus plus minus rotundatis, lateribus in parte inferiore retusis, in parte superiore rectis vel leviter concavis, apicibus rotundatis, membrana cum verrucis rotundatis in lobulis apicalibus vel in parte basali semicellulae diverse dispositis; semicellulae a latere visae in parte basali rotundatae, lobo polari rectangulari, vertice recta, marginibus lateralibus verrucosis.

Long. cell., 53.0-60.0 μm ; lat. med., 24.0 μm ; isthm., 6.0 μm ; crass., 12.0-16.0 μm .

A characteristic feature of this species is the very deep polar incision which widens out very considerably at its lower extremity so that the whole polar sinus is roughly triangular. The two polar lobes meet together in the middle line and show a thickening of the membrane at their apices. The upper part of the lateral margin of the cemicell is very slightly concave, but just above the level of the lower end of the polar sinus the margin suddenly curves inwards, the protuberances thus created often bearing two very indistinct teeth. The lower parts of the lateral margins are again divergent and slightly convex. The markings of the surface of the semicell are not very distinct, and differ on different individuals as well as on different parts of the same individual (Fig.5, C). There is an irregular group of rounded nodules (some occasionally almost of the size of tumors) on the two polar lobes, and another irregular group in the basal part of the semicell, so disposed as to leave the region of the isthmus unthickened (*cf.* also the side-view in Fig.5, B). When the semicells are slightly tilted the pair of nodules just beneath the apex of each lobe appear as a pair of minute teeth. In side-view the lower part of each semicell appears circular, while the upper part is rectangular with sub-parallel sides and a smooth truncate apex. The lateral margins bear irregular blunt teeth (the nodules of the front-view) in two separate groups.

This species bears some resemblance to *E. bilobum* Lütkenmüller ("Desmidiaceen aus der Umgebung des Attersees in Oberoesterreich", Verhandl. Zool. Bot. Ges. Wien, xlii, 1892, p.561) and *E. fissum* W. et G.S. West ("A Contribution to the Freshwater Algae of Ceylon", Trans. Linn. Soc. (Bot.), vi, 2 ser., 1902, p.154), both of which have a deep polar incision, which is, however, not widened out as in *E. biceps*, nor is the shape of the semicells of the characteristic type found in the latter species (Fritsch, Rich 1938).

161. EUASTRUM BINALE (TURP.) EHRENB.

- VAR. **BINALE**

- F. **BINALE**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 210, 212, 213. - NAM: 301.

Note. *Forma* (Grönblad, Croasdale 1971).

- F. **GUTWINSKII** SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

- VAR. **JUVAE** CROASD.

Illustrations. Fig.28 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Cells small and compressed, with all angles broadly rounded and sides rather deeply concave, isthmus broad, apex with a shallow incision with a small submarginal granule on either side. Long., 12.5 μm ; lat., 10.5 μm (1.19x); isthm., 5.0 μm ; lat. apic., 9.5 μm . Named in honour of its collector, Professor Mikko Juva. R. Grönblad also suggested that this might be a form of *E. angolense* (West et West) Krieg., which, however, is larger, relatively longer, and has its apical angles projected upward, effecting quite a different shape to the semicell (Grönblad, Croasdale 1971).

162. EUASTRUM BOMBAYENSE (GONZALVES ET GANGLA) BRANDHAM

- VAR. **SIMPLEX** RINO

Illustrations. Pl.10, Fig.3 (Williamsom 1994).

Samples. RSA: 348, 362, 374.

Note. Length 46.0-53.0 μm ; breadth 33.0-39.0 μm ; isthmus 12.5-14.0 μm ; ratio of length to breadth 1.28-1.5; thickness 20.0-21.0 μm . There are three main characteristics of this desmid, it is 3-lobed, asymmetric and bears granular facial protrusions. The author hardly agrees with its inclusion under *Euastrum*, for the occurrence of the convex apex without an incision is exceptionally rare in that genus. However Gonzalves and Gangla (1947) point out the presence of a thickening of the wall in the median part of the apices which they regard as a much reduced apical notch. Such a thickening was certainly present in many of the specimens examined although it must also be said that apical thickenings are quite common in *Cosmarium* and some *Actinotaenium* species (Williamsom 1994).

163. EUASTRUM BRASILIENSE BORGE

- VAR. **BRASILIENSE**

- F. **MINOR** BORGE

Illustrations. Fig.8, A-C (Fritsch, Rich 1924).

Samples. RSA: 91 (rather rare), **430.**

Note. *Forma cum f. minor* Borge (Arkiv f. Bot., xv, 1918, p.60, Pl.V, fig.4), *valde congruens, sed paullo major; lateribus loborum lateralium plus minusve parallelis et retusis.* Long. cell., 64.0-83.0 μm ; lat. cell., 32.0-43.0 μm ; lat isthm., 12.0-15.0 μm (Fritsch, Rich 1924).

In sample **91** (rather common) were found another form, *forma lateribus loborum lateralium convergentibus, forma* Borge (Arkiv f. Bot., xv, 1918, p.60, Pl.V, fig.5) *similis, sed latior et apicibus rotundato-truncatis.* Long. cell., 96.0-102.0 μm ; lat. cell., 48.0-52.0 μm ; lat isthm., 15.0-16.0 μm (Fig.8, F).

Both these forms had the typical rounded central protuberance of *E. brasiliense* and were connected by occasional transitional forms (Fig.8, D and E). They differed considerably among one another in the degree of undulation of the lateral margins. The membrane was obscurely and irregularly punctate (Fritsch, Rich 1924).

In (Hancock 1973) indicated as *Eu. brasiliense* Borge.

164. EUASTRUM CAPENSE FRITSCH

- VAR. **CAPENSE**

Illustrations. Fig.24, A-E (Fritsch 1918).

Samples. RSA: 23 (very common), **24, 28, 50, 330.**

Note. *E. parvum*, circiter $1\frac{1}{4}$ pro longuis quam latum, profunde constrictum, sinu angusto-lineari extremo paullo ampliato. Semicellulae obscure trilobae, sinu late concavo inter lobos; lobo polari lato, apice plus minus convexo, incisura mediana non profunda extus ampilata; marginibus lateralibus apicis plus minus concavis, angulis apicalibus dente exiguo munitis, marginibus lateralibus lobi polaris subparalleli; lobis lateralibus bilobulatis, iis superioribus rotundatis, iis inferioribus olus minus truncatis etiam leviter emarginatis, lobulo utroque plerumque dente exiguo instructo; semicellulis plerumque granulis ca. 9 intra lateralem utrumque, et granulis 4-5 intra angulum apicalem utrumque, tumore centrali nullo. A latere visae globoso-ellipticae, apice rotundato, tumore parvo prope basin utrobique. A vertice visae ellipticae, polis ca. 5-6 dentibus exiguis munitis, inflatione mediana aliquantula acuta. Long. cell., 36.0 μm ; lat. lob. pol., 21.0 μm ; lat. isthm., 8.0 μm ; crass., 17.0-18.0 μm .

The species appears to be not uncommon in the Cape Peninsula. It is distinguished by the character of the apex from all the other *Euastra* of small dimensions, and the end-view as also rather characteristic. It belongs to the species without elaborate ornamentation, and may best be compared with *E. binale* (Turp.) Ehrenb. (especially forma *gutwinski* Schmidle), *E. elegans* (Bréb.) Kützing, and *E. dubium* Nägeli, with the last of which it perhaps shares most points of resemblance.

The shape of the apex is somewhat variable and the almost of granulation also varies to some extent in different individuals (Fritsch 1918).

Forma. With flat side view. Long., 23.4 μm ; lat., 18.2 μm ; lat. at apex, 11.7-13.0 μm ; isthmus, 5.5 μm (Huber-Pestalozzi 1930).

- VAR. **KNYSNANUM** HUBER-PESTALOZZI

Illustrations. Tab.3, Fig.2a-d (Huber-Pestalozzi 1930).

Samples. RSA: 327.

Note. Dimensions: long., 27.3-28.6 μm , lat., 20.8-23.4 μm , lat. apex, 15.6-18.2 μm , isthmus, 6.5-7.8 μm (Huber-Pestalozzi 1930).

165. EUASTRUM CAPITATUM HUBER-PESTALOZZI

Illustrations. Tab.7, Fig.2 (Huber-Pestalozzi 1930).

Samples. RSA: 328.

Note. Dimensions: 67.6 μm : 37.7 μm : 72.8 μm : 39.0 μm , isthmus, 10.6 μm (Huber-Pestalozzi 1930).

166. EUASTRUM COMPEREANUM COESEL ET VAN GEEST (SYN.: *EUASTRUM SUBHYPOCHONDRUM* F.E. FRITSCH ET F. RICH VAR. *CROASDALEAE* COMPÈRE)

Illustrations. Fig.34 (Coesel, van Geest 2008).

Samples. NAM: 420 (occasionally). – **BOT: 415** (occasionally).

Note. *Eu. subhypochondrum* belongs to the group of desmids that provisionally was defined the *Eu. mononcyllum* group (Coesel 2000). Comparison of *Eu. subhypochondrum* var. *croasdaleae* with the nomine variety of *Eu. subhypochondrum* (Figs.34 and 25) shows essential morphological differences. Semicells of var. *croasdaleae* are marked by lateral lobes that are strongly curved upward and the semicell centre is in want of the concentric series of granules that are characteristic of all other species of the *Eu. mononcyllum*-allied species complex. In our opinion, those differences are big enough to consider var. *croasdaleae* a species of its own. The name of *Eu. croasdaleae* already having

been given (Grönblad 1956), we like to name it after Pierre Compère who contributed so much to our knowledge of African desmids (Coesel, van Geest 2008).

167. EUASTRUM CORPULENTUM GRÖNBLAD ET A.M. SCOTT

Illustrations. Fig. 14 (Coesel, van Geest 2000).

Samples. BOT: 415.

Note. *Eu. corpulentum* was described by Grönblad and al. (1958) from Sudan. Despite the fact that it concerns a rather large-sized, characteristically shaped species, no later records are known. In our samples we encountered only one single cell, so, presumably, we have to do with a rare, African species (Coesel, van Geest 2008).

168. EUASTRUM CUNEATUM JENNER

- VAR. **MINOR** CLAASSEN

Illustrations. Tab.9, figs.13, 14 (Claassen 1961).

Samples. RSA: 241.

Note. *Cum typo speciei valde congruens, sed cellulis multo minoribus et incisura apicali multo angustiore bene distincta. Formae intermediae haud visae.*

Cells much smaller than in typical form (West, West 1905, p.25, Pl.XXXVI, fig.9) and the apical incision is narrower. Cell wall finely punctate. Length 64.0-68.0 μm ; breadth 25.0-27.0 μm ; breadth of isthmus 9.0-12.0 μm ; thickness 20.0 μm (Claassen 1961).

169. EUASTRUM DEGII WILLIAMSON

Illustrations. Pl.11, Fig.4 (Williamson 1994).

Samples. RSA: 368, 398.

Note. The cells are small and more or less elliptical in general outline and 1.42-1.53 times longer than broad. Basal lobes sub-parallel and either retuse, extending to a point slightly below the horizontal axis of the semicell, or with a minute undulation in the middle of the retuse margin.

Between the basal and upper lateral lobe is an almost rectangular excavation. The upper lateral lobes are rounded and tipped at the margin with a pointed granule. Between the upper lateral lobe and the apical lobe is another rectangular excavation with an acute base. The apical lobe is divided into two rounded lobules by an acutely-open incision, each lobule being tipped at the margin with an acute granule. Cell wall with a small supra-isthmial granule and a prominent protrusion in the centre of the semicells. Within the basal lobes are four small granules and within the upper lateral lobes and apical lobes there are two granules and one respectively. Semicells in side view ovate, attenuating to rounded apices and with a prominent protrusion on each lateral margin. In vertical view the semicells are elliptical with a protrusion on each side and with sharply rounded poles. Length 28.0-30.0 μm ; breadth 18.8-19.6 μm ; crass., 14.0 μm .

Named after Mr. H. Deg who assisted with transportation in the Cape area (Williamson 1994).

170. EUASTRUM DENTICULATUM (KIRCHN.) GAY

Illustrations. Fig.5, *F-H* (Fritsch, Rich 1938); Fig.27 (*forma*) (Grönblad, Croasdale 1971).

Samples. RSA: 27, 33 (very rare), **198, 200, 201, 211, 212, 258, 299, 327**. – **NAM: 301** (type and *forma*), **304** (type and *forma*), **305** (type and *forma*), **307** (*forma*), **328**.

Note. Long., 19.5-20.8 μm ; lat., 15.6 μm (Huber-Pestalozzi 1930).

Formae. Long. cell., 18.0-22.0 μm ; lat., 14.0-18.0 μm ; isthm., 3.5-4.5 μm ; crass., 9.0-13.0 μm .

Several different forms of this very variable species were present, characterized by the fact that the upper part of the lateral margins were less concave than in the type; see, for instance, the form figured in Fig.5, *F-H*. Another form resembled that described by Krieger ("Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiologie, Suppl. Bd.xi, 1932, p.212, Pl.XX, fig.14) from Sumatra, while others approached var. *elongatum* Nordst. ("Freshwater Algae collected in New Zealand and Australia", K. Sv. Vet.-Akad. Hundl., 22, No.8, 1888, Pl.III, fig.10) although they did not attain to the dimensions of that variety (Fritsch, Rich 1938).

Forma Fritsch and Rich (Contributions to our Knowledge of the Freshwater Algae of Africa. 13. Algae from the Belfast Pan, Transvaal, 1938, *Trans. Roy Soc. S. Africa*, **25**, Pt.II: fig.5, *F-H*). Long. cell., 23.0-24.0 μm ; lat., 17.0-18.0 μm (Rich 1940).

Forma. A rather small form with reduced granulation. Long., 16.0-18.0 μm ; lat., 13.0-14.0 μm (1.23-1.28x); isthm., 4.0-5.0 μm ; lob. apic., 9.0-11.0 μm (Grönblad, Croasdale 1971).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

171. EUASTRUM DIDELTOIDES W. ET G.S. WEST

Illustrations. Fig. nostr.5, *I, J* (Fritsch, Rich 1938).

Samples. RSA: 198, 200.

Note. Long. cell., 93.0-117.0 μm ; lat., 41.0-69.0 μm ; isthm., 12.0-14.0 μm ; lat. lob. pol., 21.0-24.0 μm ; crass., 33.0 μm .

The individuals present only differed from type as figured by W. et G.S. West ("A Contribution to the Freshwater Algae of Ceylon", *Trans. Linn. Soc. (Bot.)*, vi, 2 ser., 1902, p.147) in insignificant particulars. They were a trifle smaller than those described by these authors from Ceylon, those in sample **200** being larger than those in **198**. The exact arrangement of the tumours in front view could not be determined (Fritsch, Rich 1938).

172. EUASTRUM DIVARICATUM LUND.

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.24, figs.1-3 (Claassen 1961).

Samples. RSA: 269, 430.

Note. *Cum typo speciei plus minusve congruens, sed paulo major; lobus apicalis dentibus duobus parvis, lobis lateralis infimus dentibus 3 parvis munitis. A latere visus processus supra isthmmu glaber singularisque, sed a vertice bipartitus videtur.*

The cells are slightly larger than in the typical form (West, West 1905, p.42, Pl.XXXVIII, figs.3, 4). Lower lateral lobules with three teeth and upper lobules with two teeth each; protuberance in each semicell above the isthmus single in lateral view and bilobulate in vertical view. Length 52.0 μm ; breadth 36.0 μm (with teeth 41.0 μm); breadth of isthmus 8.0-9.0 μm ; breadth of apex 20.0 μm (Claassen 1961).

173. EUASTRUM DIVERGENS JOSHUA

- VAR. DIVERGENS

Illustrations. Fig.29 (Coesel, van Geest 2008).

Samples. NAM: (?) 421-424. – **BOT:** (?) 400-411.

Note. *Eu. divergens* belongs to the *Eu. mononcyllum*-allied species group. It is widely distributed on both the Asian, the Australian and the African continent (record from South America refer to other species). Our material best fits var. *subbifidum* described by Claassen (1961) from South Africa. However, in our opinion, the morphological differences between this variety and the nominate variety are too small to justify distinction of a separate taxon.

Eu. divergens was occasionally encountered in a number of samples from the sites of Chief's Island and Caprivi (Coesel, van Geest 2008).

- VAR. GALPINII CLAASSEN

Illustrations. Tab.29, fig.3 (Claassen 1961).

Samples. RSA: 292.

Note. *Affinis E. divergenti* var. *subbifido* Claassen, *sed lobis lateralibus multo brevioribus latioribusque (quam prioris varietatis) et forma lobi polaris differt.*

Upper part of lateral lobes shorter than in var. *subbifidum* Claassen, and the shape of the polar lobe is different. Length 55.0 μm ; breadth 48.0 μm (with spines 53.0 μm); breadth of isthmus 12.0 μm , maximum breadth of polar lobe 24.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

- VAR. ORNATUM (BORGE) SCHMIDLE

Illustrations. Figs.34, 136 (Grönblad, Croasdale 1971); Pl.10, Fig.6 (Williamsom 1994).

Samples. NAM: 307. – **SWA:** 378.

Note. Long., 64.0 μm ; lat., 55.0 μm without spines (1.16x); isthm., 14.0 μm ; lat. lob. pol. 21.0 μm . A large, ornate form (Grönblad, Croasdale 1971).

Length 54.6 μm ; breadth 51.8 μm ; isthmus 12.6 μm ; ratio of length to breadth 1.05 (Williamsom 1994).

- VAR. RHODESIENSE RICH

Illustrations. Figs.35 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. *Forma.* A form with the basal lobe more developed, as in var. *ornatum*. Long., 52.0 μm ; lat. without spines, 48.0-55.0 μm ; isthm., 12.0-15.0 μm ; lat. lob. pol. 12.0-20.0 μm (Grönblad, Croasdale 1971).

- VAR. SUBBIFIDUM CLAASSEN

Illustrations. Tab.9, fig.3 (Claassen 1961).

Samples. RSA: 254.

Note. *Affinis E. divergenti* var. *bifido* Schmidle, *sed praecipue forma lobi polaris et cellulis multo minoribus differt.*

This variety has a greater resemblance to var. *bifidum* Schmidle (W. Schmidle, Engler Botan. Jahrb., Vol.26, 1899, p.44, Taf.II, fig.34) than to Joshua's species (W. Joshua, Burmese Desmidiaceae, Journ. Linn. Soc. Bot., Vol. XXI, p.640, Pl.23, figs.8, 9). However, it differs from Schmidle's variety in having relatively smaller cells and in the shape of the polar lobes. Cells small, about 1.2 times longer than broad, deeply constricted; sinus narrowly linear; semicells deeply 3-lobed; granules above central inflation in concentric arrangement; lateral lobes semifusiform, ends truncate, upper part of lobes elongated, lobes ornate with granules; polar lobe quadrate in lower part and

widening at the apex. Length 44.0-50.0 μm ; breadth 36.0-42.0 μm ; breadth of isthmus 10.0-12.0 μm ; maximum breadth of polar lobe 20.0 μm (Claassen 1961).

174. EUASTRUM DUBITALIBILIS CLAASSEN

Illustrations. Tab.9, fig.9 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis E. inerme* (Ralfs) Lund., *sed discrepantia latitudinis ad basin et ad apicem multo minore bene distincta.*

This species is near *E. inerme* (Ralfs) Lund (West, West 1905, p.24, Pl.XXXVI, figs.7, 8); but the apices are not very much narrower than the base of the semicells and the cells are smaller. Cells small, about 2.1-2.2 times longer than broad, deeply constricted, sinus narrowly linear; semicells truncate-pyramidate, basal angles rounded; upper part of lateral margins somewhat concave; apex convex with a narrow median incision. Cell wall smooth. Length 36.5-38.0 μm ; breadth 16.5-18.0 μm ; breadth of isthmus 7.5-8.0 μm ; breadth of apex 12.0 μm (Claassen 1961).

175. EUASTRUM DUBIUM NÄG.

- VAR. **DUBIUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

- VAR. **TRANSVAALENSE** CHOLNOKY

Illustrations. Fig.145 (Cholnoky 1955).

Samples. RSA: 229.

Note. Eine durch ihre Abmessungen von dem Typus abweichende Form, die eine Länge von 29.0-30.0 μm , eine Breite von 18.0 μm und eine Isthmusbreite von 6.0-7.0 μm aufweist (Cholnoky 1955).

176. EUASTRUM ELEGANS (BRÉB.) KÜTZING

- VAR. **ELEGANS**

Illustrations. Fig.5, *D, E* (Fritsch, Rich 1938).

Sample. RSA: 198, 199, 200. – NAM: 307.

Note. *Forma apice fere truncato, angulis basalibus retundatis.* Long. cell., 28.0-30.0 μm ; lat., 17.0-20.0 μm ; isthm., 5.5-6.7 μm .

The form of this variable species found in the present collection is not exactly like any that has hitherto been described, though approaching var. *madagascariense* W. et G.S. West and var. *symmetricum* Fritsch et Rich. The side-view is practically identical with that of the type as figured in British Desmidiaceae (West, West 1905, Pl.XXXVIII, fig.17 c). The markings on the semicell could not be clearly deciphered. Somewhat similar forms were found in the Welttevreden West Pan (Rich 1932) and in Natal (Fritsch, Rich 1938).

Forma (Grönblad, Croasdale 1971).

- VAR. **COMPACTUM** (WOLLE) KRIEG.

- F. **COMPACTUM**

Illustrations. Pl.10, Fig.4 (Williamson 1994).

Sample. RSA: 338.

Note. Length 31.0 μm ; breadth 23.0 μm ; isthmus 4.0-4.5 μm ; ratio of length to breadth 1.34; thickness 14.0 μm . Somewhat more compressed and more deeply retuse above the lateral lobes than usually illustrated (Williamson 1994).

- F. **MIRIFORME** CROASD.

Illustrations. Fig.25 (Grönblad, Croasdale 1971).

Sample. NAM: 305, 307.

Note. Long., 26.0-27.0 μm ; lat., 19.0-20.0 μm (1.35-1.42x); isthm., 4.5-6.0 μm . A form differing from Wolle's original (*E. compactum* Wolle 1884, p.107, 27: 28, 29) and the figure given by Krieger (1937, 82: 1, 2), in the flat base of the semicell, but very similar to plants figured by various authors from the tropics, except that the central ornamentation is regularly asymmetrical in manner of *E. mirum* Behre (1956, p.79, 9:1). Bourrelly and Manguin (1952, p.226, 30: 571, 572) show a plant with a slight asymmetry (Grönblad, Croasdale 1971).

- VAR. **MADAGASCARIENSE** W. ET G.S. WEST

Illustrations. Fig.6, C, D (Rich 1932).

Sample. RSA: 192 (very rare), **299.**

Note. *Formae* (Rich 1932).

Long. cell., 25.0 μm ; lat., 19.0 μm . Somewhat similar to the specimens found in Belfast Pan, but more closely resembling those in Old Ngamo (Rich 1935, Contributions to our Knowledge of the Freshwater Algae of Africa. 11. Algae from a Pan in Southern Rhodesia. *Trans. Roy. Soc. S. Africa*, **23** (Pt.II): p.131).

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.9, fig.18 (Claassen 1961).

Samples. RSA: 254.

Note. *Affinis E. eleganti var. madagascariensi* W. et G.S. West, *sed forma apicis, incisura apicali multo angustiore, et tumore supra isthmum granulis 4 ornato bene distincta.*

This is near *E. elegans var. madagascariense* W. et G.S. West (West, West 1895, Pl.6, fig.18); but differs in the shape of the apex, the apical incision is narrower and the protuberance above the isthmus contains four granules; the cells are slightly smaller than in Messrs. West's variety. Length 23.0-24.0 μm ; breadth 16.0 μm ; breadth of isthmus 3.0-4.0 μm ; breadth of apex 6.5-8.0 μm (Claassen 1961).

- VAR. **SYMMETRICUM** FRITSCH ET RICH

Illustrations. Fig.10 (Fritsch, Rich 1924).

Samples. RSA: 91 (rare).

Note. *E. subparvum, circiter 1.5 plo longius quam latum, profunde constrictum, sinu angusto-lineari, extus non ampliato. Semicellulae ovato-pyramidatae, angulis basalibus subrectangularibus, marginibus lateralibus crenis duabus ab apice et basi et inter se fere aequidistantibus, partibus interpositis late concavis; apicibus incisura profunda aperta plus quam tertiam partem longitudinis semicellulae; tumore granulato in medio semicellularum supra isthmum et granulis parvis singulis intra excavationem quamque marginum lateralium. A latere visae ovatae, apice rotundato, et tumore emarginato utrobique paullo supra isthmum. A vertice visae ellipticae granulo parvo in utroque polo et granulis 4 fere aequidistantibus in utraque margine. Zygosporae globosae, aureo-fuscae, spinis acuminatis densis munitae. Long. cell., 35.0-41.0 μm ; lat. cell., 21.0-26.0 μm ; lat. isthm., 7.0-8.0 μm ; crass., 12.0-13.0 μm ; lat. zygosp. (sine spin.), 28.0 μm .*

The distinguishing features of this variety are the symmetrical distribution of the two crests on the lateral margins and of the three intramarginal granules in front-view, and the symmetrical outline in end-view. The apical incision is also much deeper than is the rule in the type. On the other hand the side-view is very much like that of a typical *E. elegans* (West, West 1905, p.48, Pl.XXXVIII, figs.16-21). In Fig.17 in Messrs. West's monograph the crests on the lateral margins show

an approximation to the symmetrical arrangement characteristic of the variety here described.

Only a limited number of individuals were observed, and we are consequently unable to say whether the ornamentation of the semicells is always exactly like that shown in the figure. The zygospore was unfortunately lost before it could be drawn (Fritsch, Rich 1924).

177. EUASTRUM EVOLUTUM (NORDST.) W. ET G.S. WEST

- VAR. **INTEGRIVUS** W. ET G.S. WEST

Illustrations. Fig.5, K, L (Fritsch, Rich 1938); Figs.17, 18 (Grönblad, Croasdale 1971).

Sample. RSA: 202, 204. – NAM: 304, 307.

Note. *Forma lobo polari longiore, spinis lateralibus bene evolutis.* Long. cell., 48.0-52.0 μm ; lat. sine spin., 28.0 μm ; isthm., circa 7.0 μm .

Specimens of this variety have been recorded by Nygaard (1932, p.140, fig.38) from the Zambezi River which have a proportionally shorter polar lobe. The individuals are slightly smaller than those described by the Wests from North America ("On Some North American Desmidiaceae", Trans. Linn. Soc. (Bot.), v, 2 ser., 1896, p.244) and have longer spines. The surface markings were not clearly seen (Fritsch, Rich 1938).

In (Fritsch, Rich 1938) indicated as *Eu. evolutum* W. et G.S. West var. *integrius* W. et G.S. West.

Long., 45.0-47.0 μm ; lat. without spines 28.0-31.0 μm (1.5-1.6x); isthm., 7.0-9.0 μm ; lat. apic., 19.0-22.0 μm (Grönblad, Croasdale 1971).

178. EUASTRUM FRITSCHII COESEL ET VAN GEEST (SYN: *EUASTRUM BRASILIENSE* ORGE VAR. *AFRICANUM* F.E. FRITSCH ET F. RICH; *EUASTRUM SOLUM* (NORDST.) GRÖNBL. ET SCOTT VAR. *AFRICANUM* (FRITSCH ET RICH) GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE ET SCOTT; *EUASTRUM BRASILIENSE* BORGE VAR. *THERONII* CLAASSEN)

Illustrations. Fig.9, A-C (Fritsch, Rich 1924); Tab.9, figs.6, 7 (Claassen 1961); Pl.12, Fig.2 (Williamson 1994); Pl.4, 7 (Williamson 2000); Figs.8-10 (Coesel, van Geest 2008).

Samples. RSA: 91 (not uncommon), **271, 341, 392. – BOT: (?) 400-418. – SWA: 377.**

Note. *E. magnum, longior et pro rata angustior quam typo, profunde constrictum, sinu angusto-lineari, membrana crassa. Semicellulae subpyramidatae, apice lato et truncato; marginibus lateralibus inferioribus saepe leviter convergentibus, raro subparallelis, obscure undulatis; marginibus lateralibus superioribus convergentibus et leviter concavis; incisura apicali non profunda, angustissima et membrana incrassata; in media semicellula supra isthmum tumore magno truncato membrana incrassata, tumorem alterius semicellulae contingenti et ca. Eiusdem latitudinis quam isthmo; membrana semicellulae vulgo obscure et irregulariter punctata. A latere visae pyramidatae, apice rotundato, tumoribus supra isthmum sitis a parte superiore incisura lata concava disjunctis. A vertice visae ellipticae, polis rotundatis, tumore utrobique saepe manifesto. Long. cell., 120-138 μm ; lat. cell., 42-43 μm ; lat isthm., 16 μm ; lat. tumor., 16-17 μm ; crass., 21 μm .*

This variety, in the shape of its semicells in front view (Fig.9, A), has a greater resemblance to a form of the species figured by Borge (cf. Arkiv f. Bot., xv, 1918, p.60, Pl.V, fig.5) than to the type itself. It however differs from all described

forms of *E. brasiliense* in the relatively greater length, the square character of the rather wide central protuberances (which resemble those of *E. gnathophorum* W. et G.S. West), and the truncate apices. The type and the variety differ from all the other species of the *ansatum*-group in possessing but a single median protuberance on either side of the semicell. Compare also with *E. huillense* W. et G.S. West (Fritsch, Rich 1924).

Affinis E. brasiliense var. *africano* Fritsch et Rich, *sed cellularum a latere visarum forma differt quoniam semicellulae gradatim a basi apicem versus in cuneum deplanantur, neque tuberculi apparent.*

This variety closely resembles *E. brasiliense* var. *africanum* Fritsch et Rich (F.E. Fritsch and F. Rich, Trans. Roy. Soc. of S.A., Vol.XI, Part 4, 1924, p.330, fig.9); but the shape of its semicells differs in being gradually attenuated from base to apex when seen in lateral view and the cells are slightly smaller. Cells of medium size, about 3-3.4 times longer than broad, deeply constricted; sinus narrowly linear, open towards the extremity; semicells pyramidate, basal angles rounded, lower part of lateral margins convex, upper part slightly concave; apex truncate with rounded angles, median incision not very deep; semicells tumid above the isthmus. Side view of semicell elongate-pyramidate; cell wall punctate. Length 107-108 μm ; breadth 32-35 μm ; breadth of isthmus 16-18 μm ; breadth of apex 22-23 μm . Named after Mr. J.E. Theron of Rietfontein 288, Nylstroom (Claassen 1961).

Length 114.0-124.0 μm ; breadth 38.5-41.5 μm ; isthmus 18.5 μm ; ratio of length to breadth 2.74-3.22; thickness 37.0 μm . All specimens found at both samples (341 and 377) had the square protuberance mentioned and figured by Fritsch and Rich (1924). Claassen (1961) also illustrates it correctly in front view whilst proposing a new variety solely on the basis of a gradual attenuation from base to apex when seen in lateral view. This would surely have been better assigned to *E. brasiliense* var. *africanum* Fritsch et Rich (Williamson 1994).

The recombination of *Eu. brasiliense* var. *africanum* by Grönblad and al. (1958) to *Eu. solum* var. *africanum* is understandable in view of its elongate cell shape fitting that of *Eu. solum* rather than that of *Eu. brasiliense*. In our opinion, however, var. *africanum* deserves the status of a separate species as it differs from *Eu. solum* by lateral semicell sides that, from base to apex, are not fluently concave but more or less bulgy in the middle part. We decided to name the species after Felix Eugen Fritsch, one of the original describers of the taxon under discussion. As is shown in our figures, cell outline is pretty variable. Most likely, *Eu. solum* var. *angustum* Grönblad et A.M. Scott described by Grönblad and al. (1958) from the same region as where they encountered *Eu. solum* var. *africanum* is within that wide morphological range, so does not deserve the status of a separate variety.

So far, *Eu. fritschii* – as *Eu. brasiliense* var. *africanum*, or *Eu. solum* var. *africanum* – was only recorded from South Africa and Sudan. In Okavango Delta it was locally rather common on the sites of Chief's Island and Moremi (Coesel, van Geest 2008).

179. EUASTRUM GALPINII CLAASSEN

Illustrations. Tab.29, fig.1 (Claassen 1961).

Samples. RSA: 296.

Note. *Affinis E. bidentato* Näg., *sed lobo infirmo infimo laterali latiore quam lobo laterali supremo et margine apicali recto bene distincta.*

Near *E. bidentatum* Näg. (West, West 1905, p.39, Pl.XXXVII, figs.16-19); but the semicells are broader at the lower lateral lobule than at the upper lateral lobule; apical margin straight. The protuberance in the centre above the isthmus has four granules, and there are a few granules within the lateral lobules and the apex. Length 38 μm ; breadth 27 μm ; breadth of isthmus 8 μm ; breadth of apex 16 μm (Claassen 1961).

180. EUASTRUM GAYANUM DE TONI

Illustrations. Tab.7, Fig.3 (Huber-Pestalozzi 1930).

Samples. RSA: 329 (often).

Note. *Forma* (Huber-Pestalozzi 1930).

181. EUASTRUM HIERONYMUSII SCHMIDLE

Illustrations. Fig.28 (Coesel, van Geest 2008).

Samples. BOT: 400.

Note. *Eu. hieronymusii*, described by Schmidle (1898) from Zanzibar, was recombined to *Eu. sphyroides* Nordst. var. *hieronymusii* by Krieger (1937). However, when comparing *Eu. hieronymusii* with *Eu. sphyroides* distinction on species level seems to be justified. *Eu. hieronymusii*, as compared to *Eu. sphyroides*, is distinctly larger in cell size. In addition to that, its cell wall spines are much stouter and less equal in distribution than in *Eu. sphyroides*. In view of that, affiliation of *Eu. hieronymusii* to *Eu. subhypochondrum* is more plausible.

Of *Eu. hieronymusii* only a few reliable records are known, i.e., from Tanzania (Schmidle 1898), Zambia (Thomasson 1965) and Chad (Compère 1967) (Coesel, van Geest 2008).

182. EUASTRUM HYPOCHONDROIDES W. ET G.S. WEST

Illustrations. Figs.36, 37 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Forma*. A more compact form with the lateral lobes thicker, more sloping, and slightly bilobulate, the isthmus broader, the polar lobe broader and shorter, and with subapical denticulation in one or two horizontal rows. Long., 44-48 μm ; lat., 38-40 μm (1.2x); isthm., 12-14 μm ; lat. apic., 13-15 μm (Grönblad, Croasdale 1971).

183. EUASTRUM INCERTUM FRITSCH ET RICH

Illustrations. Fig.11 (Fritsch, Rich 1924); Pl.10, Fig.1 (Williamson 1994).

Samples. RSA: 91 (very rare).

Note. *E. mediocre, circiter 1.5 plo longius quam latum, profunde constrictum, sinu lineari paullum aperto. Semicellulae a fronte visae subpyramidatae, partibus lateralibus inferioribus convexis dentibus parvis in margine vel intra merginem munitis; lobo polari subbrevis, a parte inferiore semicellulae incisura lata vadosa discreto, marginibus lateralibus subparallelis dentibus munitis, dente prominenti in angulo apicali utroque, apice truncato incisura profunda angustissima; tumore magno granulato in media semicellularum supra isthmum et tumoribus minoribus granulatis 3 intra marginem lateralem utramque, granulis varie dispositis in superficie reliqua. A latere visae (?) plus minus ovatae, marginibus fere deplanatis, apice truncato exserto. A vertice visae ellipticae tumore granulato prominenti utroque, polis dentatis. Long. cell., 60 μm ; lat. cell., 44-46 μm ; lat. isthm., 9-10 μm ; crass., 28 μm .*

This species comes nearest to *E. bidentatum* Näg., of which it is possibly only a variety. In the form of the front-view (Fig.11, A) there is considerable resemblance to fig.17 on Pl. XXXVII of Messrs. West's monograph (West, West 1905), but the lower lateral margins are not bilobulate, the apex is flat and truncate, and the apical teeth are horizontal; moreover, the ornamentation of the cell is of a much more elaborate type. Apart from the median granulated tumour, there are three other smaller ones situated on either side of the semicell, one within the basal angle, another within the apical angle, and a third opposite the incision separating the polar lobe from the lower part of the semicell. We do not feel altogether sure of the characters of the side- and end-views, as very few specimens were seen. It seems, that the central granulated protuberance projects far more pronouncedly than in *E. bidentatum*, and we have also obtained the impression that the side-view has more flattened edges. The new species may also be compared with some forms of *E. evolutum* W. et G.S. West (Fritsch, Rich 1924).

Length 57.4 μm ; breadth 44.8 μm ; isthmus 11.2 μm ; ratio of length to breadth 1.28. Very rare in the sample but a completely empty cell revealed considerable detail which as Fritsch and Rich (1924) comment is "elaborate". The ornamentation of this specimen is slightly different from that portrayed by Fritsch and Rich and more specimens of what appears to be a rare desmid in South Africa need to be found so that further investigations can be made (Williamson 1994). In (Williamson 1994) was not indicate sample in which species was found.

184. EUASTRUM INCRASSATUM NORDST.

Illustrations. Tab.3, Figs.4a-e (Huber-Pestalozzi 1930).

Sample. RSA: 327.

Note. Long., 28.6-40.0 μm ; lat., 20.8 μm ; isthmus, 7.5 μm , *forma* (Huber-Pestalozzi 1930).

185. EUASTRUM INERME (RALFS) LUND

- F. AFRICANA CHOLNOKY

Illustrations. Fig.146 (Cholnoky 1955).

Sample. RSA: 232.

Note. Die hier gesehenen 52.0-56.0 μm langen, 31.0 μm breiten Exemplare stimmen habituell gut mit der Zeichnung von W. und G.S. West (1908) auf der Taf. XXXVI, Fig. 10 überein, da sie aber kleiner sind, halte ich es für zweckmässig; die hier gesehenen Exemplare als neue Form abzusondern, desto mehr, da hier von einem Übergang keine Sprache ist (Cholnoky 1955).

186. EUASTRUM INSULARE (WITTR.) ROY

Illustrations. Fig.41 (Cholnoky 1954b); Fig.147 (Cholnoky 1955); Tab.9, figs.10-12 (Claassen 1961).

Sample. RSA: 198 (rare), 199, 203, 211, 228, 241, 258, 270, 300.

Note. Long. cell., 22.0-28.0 μm ; lat., 15.0-17.0 μm ; isthm., 4.0 μm ; crass., 10.0-11.0 μm (Fritsch, Rich 1938).

Long. cell., 28.0-30.0 μm ; lat., 18.0-20.0 μm . Precisely similar to the individuals found in Belfast Pan. Also in sample **299** was recorded *forma* W. et G.S. West (West, West 1905, p.69, pl.xl, fig.14). Long. cell., 21.0-23.0 μm ; lat., 15.0-16.0 μm ; isthm., 4.0-5.0 μm . In outline exactly like the form found by Messrs. West in Cambridgeshire (Rich 1940).

Studied specimen were usually smaller than type (only 13.5 μm long and 11.0 μm wide). This small specimen shown on Fig.41 (Cholnoky 1954b).

Da die gesehenen keinesfalls als vollkommen typische Exemplare betrachtet werden können, habe ich von denen eins auf der Fig.147 dargestellt (Cholnoky 1955).

Fig.11 shows a cell during normal cell division and fig.12 shows an abnormal one (Claassen 1961).

Western Cape, Magaliesberg, North-West Province, KwaZulu Natal (orig.).

187. EUASTRUM KNYSANUM HUBER-PESTALOZZI

Illustrations. Tab.3, Figs.1 a-c (Huber-Pestalozzi 1930).

Sample. RSA: 327.

Note. Measurements: Long., 44.2 μm , lat., 26.0 μm ; long., 46.8 μm , lat. 24.7 μm and 26.0 μm (lat. apex, 20.8 μm , isthmus, 5.2-6.5 μm); long., 48.1 μm , lat., 25.0 μm ; long., 49.0 μm , lat., 26.0 μm ; long., 50.7 μm , lat., 26.0 μm (isthmus, 6.5 μm) (Huber-Pestalozzi 1930).

188. EUASTRUM LUETKEMUELLERI DUCEL.

- VAR. **CARNIOLICUM** (LÜTKEM.) KRIEG.

Illustrations. Fig.29 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. Forma. A form differing in smaller size and less flat base of the semicell. Long., 22.5 μm ; lat., 14.5 μm (1.6x); isthm., 4.5 μm (Grönblad, Croasdale 1971).

189. EUASTRUM MONONCYLUM (NORDST.) RACIB. (SYN.: EUASTRUM GEMMATUM BRÉB. VAR. MONONCYLUM NORDSTEDT)

- VAR. **MONONCYLUM**

Illustrations. Fig.30 (Coesel, van Geest 2008).

Sample. NAM: 424 (in small cell number).

Note. Coesel (2000) rendered this species a central position in a hypothetical scheme of radiating evolution lines resulting in clusters of closely affiliated *Euastrum* species. This so-called *Eu. mononcyllum* group of species displays its highest diversity in tropical Africa. Whereas, from that region, related species such as *Eu. spinulosum*, *Eu. devergens* and *Eu. platycerum* are commonly reported, of *Eu. mononcyllum* itself only a very few records are known. The impression that *Eu. mononcyllum* is a relatively rare species was confirmed by our collections, for it was only encountered in one sample from Caprivi Strip (Coesel, van Geest 2008).

- VAR. **ABBREVIATA** FRITSCH ET RICH

Illustrations. Fig.8, A-C (Fritsch, Rich 1938).

Sample. RSA: 199 (rare), **202, 204, 205.**

Note. *Differt a typo in aspectu frontali lobo polari brevior apice truncato, lobis lateralibus superioribus fere horizontalibus, tumore centrali majore cum granulis numerosis periphericis et granulis centralis 6, spinis marginalibus bene evolutis, spinis bifidis intra marginem apicalem in utroque latere; semicellulae a vertice visae ellipticae cum tumore magno fere truncato utrobique.* Long. cell., 70.0-80.0 μm ; lat., 60.0-65.0 μm ; lat. lob. pol., 26.0 μm ; isthm., 14.0-15.0 μm ; crass., 37.0-38.0 μm .

The original figure of the type as published by Nordstedt ("De Algis nonnullis, praecipue Desmidicis, etc.", Acta Univers. Lund, xvi, 1880, p.8, fig.13)

shows only the front-view. The variety here described differs from other forms varieties of *E. mononcyllum* in the short, almost truncate, polar lobe, and the practically horizontal disposition of the upper lateral lobes. The median tumour is also exceptionally large and possesses a peripheral series of granules as well as six central ones; a similar arrangement has been recorded in var. *germanicum* Schmidle; cf. also var. *aequilobum* W. et G.S. West, Another special feature of the new variety is the presence of a bifid intramarginal spine within each apical angle (Fig.8, A). The large size and prominence of the median tumour is also apparent in the end-view (Fig.8, C). The side-view shows a characteristic broadening of the semicell towards the apex.

E. mononcyllum is closely related to *E. spinulosum* Delponte ("Specimen Desmidiacearum subalpinarum", Mem. Acad. Sci, Torino, Ser.2, vol.xxx, 1876, p.97, Tab.VI, figs.17, 18), the original form of which – distinguished by the possession of numerous series of pointed spines – has apparently not been found again. Grönblad ("New Desmids from Finland and N. Russia", Acta Soc. pro Fauna et Flora Fennica, xlix, No.7, 1921, p.16) has tabulated the essential differences between two species (Fritsch, Rich 1938).

- VAR. **GERMANICUM** SCHMIDLE (SYN.: *EUASTRUM GERMANICUM* (SCHMIDLE) KRIEG.)

Illustrations. Figs.38, 39 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long. without spines, 54.0-57.0 μm ; lat. without spines, 47.0-48.0 μm (1.12-1.21x); isthm., 12.0-13.0 μm . R. Grönblad (1960, p.35) gives his reasons for preferring to retain the species *E. mononcyllum* (Grönblad, Croasdale 1971).

190. EUASTRUM OBESUM JOSH.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 235, 278.

191. EUASTRUM OKAVANGICUM COESEL ET VAN GEEST

Illustrations. Figs.32, 33 (Coesel, van Geest 2008).

Samples. BOT: (?) 400, 401, (?) 402-418.

Note. Cells about as long as broad. Sinus deep, closed for the greater part. Semicells in frontal view approximately truncate-pyramidal, five-lobed. Invagination between the broad apical lobe and the lateral lobes deeper than that between the lateral lobes and the basal lobes. Semicells with a flat protuberance in the centre, decorated with a circle of granules enclosing a large verruca. Semicell lobes with some scattered granules, those in the midregion of the basal lobes tubercle-like enlarged. Cell length 34.0-40.0 μm , cell breadth 32.0-38.0 μm , cell thickness circa 20.0 μm , breadth of isthmus 5.0-6.0 μm .

Unmistakably, also *Eu. okavangicum* belongs to the *Eu. mononcyllum*-allied species group. Of the species generally accounted this group, *Eu. spinulosum* Delponte is near to our newly described *Eu. okavangicum*. Actually, *Eu. okavangicum* can be characterized as a smaller-sized form of *Eu. spinulosum*, with a relatively broad apical lobe and only a shallow invagination between lateral and basal lobes. A suchlike form has been described much earlier from Bulgaria, i.e., by Petkoff (1925) as *Eu. bulgaricum*, recombined to *Eu. spinulosum* var. *bulgaricum* by Krieger (1937). Remarkably enough, this taxon has never been recorded for a second time. Although our *Eu. okavangicum* resembles *Eu. bulgaricum* we prefer to render it the status of a separate species. Invaginations between the semicell lobes in *Eu. bulgaricum* are deeper than those in *Eu.*

okavangicum and, more relevant, the ornamentation pattern of granules on the face of the semicell is distinctly different.

In the Okavango Delta *Eu. okavangicum* appeared to be a widely distributed and locally common species on the sites of Chief's Island and Moremi (Coesel, van Geest 2008).

192. EUASTRUM OSMONDII COUTE ET ROUSSELIN

Illustrations. Fig.35 (Coesel, van Geest 2008).

Samples. BOT: 410.

Note. *Eu. osmondii*, with its diverging, broadly rounded apical lobes marked by a deep, narrow apical incision, is a characteristically shaped species that hardly can be confused with any other *Euastrum* species. After its description by Couté and Rousselin (1975) from Mali it has never been reported again. However, there can be no doubt that the alga labeled *Eu. turneri* in Gerrath and John (1988, Pl.8-10) from Ghana refers to this same species (Coesel, van Geest 2008).

193. EUASTRUM PLATYCERUM REINSCH

- VAR. PLATYCERUM

Illustrations. Pl.12, Fig.3 (Williamson 1994).

Samples. RSA: 338.

Note. Length 54.0 μm ; breadth 51.6 μm ; isthmus 11.5 μm ; ratio of length to breadth 1.04 (Williamson 1994).

- VAR. EXIMIUM GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE ET SCOTT

Illustrations. Fig.41 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Forma. A form differing in being more angular, in having a longer polar lobe and in having paired spines on the lower margin of the basal lobe. Long. without spines, 64.0 μm ; lat. without spines 55.0 μm (1.16x); isthm., 13.0 μm ; lob. pol. long. without spines, 17.0 μm ; lat. without spines, 14.0 μm (Grönblad, Croasdale 1971).

- VAR. OBTUSIUS GRÖNBL. ET CROASD.

Illustrations. Fig.40, 135 (Grönblad, Croasdale 1971); Pl.10, Fig.2 (Williamson 1994).

Samples. RSA: 358, 376. - NAM: 304, 305.

Note. A variety differing in having its lateral lobes stouter and bilobulate, in having the sinus linear and closed throughout, and in having its central ornamentation showing up to three circles of granules. Long. without spines, 53.0-55.0 μm ; lat. without spines, 49.0-50.0 μm (1.1x); isthm., 12.0 μm ; lat. pol. lob., 18.0-19.0 μm (Grönblad, Croasdale 1971).

Length 45.0-54.6 μm ; breadth 38.0-47.0 μm ; isthmus 11.0 μm ; ratio of length to breadth 10.0-11.0; thickness 22.0 μm (Williamson 1994).

194. EUASTRUM PRAEMORSUM (NORDST.) SCHMIDLE (SYN.: EUASTRUM ROSTRATUM RALFS VAR. PRAEMORSUM NORDSTEDT)

- VAR. PRAEMORSUM

Illustrations. Fig.16 (Grönblad, Croasdale 1971).

Sample. RSA: 198, 200. - NAM: 301.

Note. Long. cell., 63.0-73.0 μm ; lat., 33.0-37.0 μm ; lat. lob. pol., 22.0-24.0 μm ; isthm., 8.0-9.0 μm ; crass., 26.0-28.0 μm .

Some of the individuals observed closely resembled those figured by Nordstedt ("Freshwater Algae collected in New Zealand and Australia", K. Sv. Vet.-Akad. Handl., 22, No.8, 1888, p.34, Tab.III, fig.7). Others, however, possessed a more elongate polar lobe (*cf.* Fig.6, A-C) in all of them the notch of the lower part of the lateral margins of the semicells was well marked (Fritsch, Rich 1938).

Forma. Differing from the original (*E. rostratum* var. *praemorsum* Nordst.) in being much smaller, relatively shorter, and showing a different facial ornamentation. Long., 50.0 μm ; lat., 35.0 μm (1.43x); isthm., 9.0 μm . This plant might nearly as well be considered a form of *E. umbonatum* West et West, which was an early suggestion of R. Grönblad, or of *E. rostratum* Ralfs, which is H. Croasdale's preference. Perhaps these three species should never have been separated (Grönblad, Croasdale 1971).

- VAR. **AFRICANUM** FRITSCH ET RICH

Illustrations. Fig.6, D-G (Fritsch, Rich 1938).

Sample. RSA: 200.

Note. Differt a typo semicellulis paullo brevioribus, marginibus lateralibus inferioribus solum leviter concavis, tumoribus 3 infra incisionem medianam in parte apicali; zygosporis globosis spinis acutis bene evolutis munitis. Long. cell., 60.0-63.0 μm ; lat. med., 32.0-36.0 μm ; lat. lob. pol., 21.0-24.0 μm ; isthm., 8.0-10.0 μm ; diam. zygosp. sine spin., 42.0 μm ; long. spin., circa 10.0 μm .

The variety differs from the type in the fact that the lateral notch in the lower part of the lateral margins is not nearly so well defined, being merely indicated by slight concavity. The ornamentation of the surface of the semicell is also different, inasmuch as there are three tumours symmetrically disposed just beneath the apical incision. In some of the individuals seen the sinus was widely open at the outer extremity. The side- and end-views resemble those of the type except in the different disposition of the tumours in the end-view (*cf.* Fig.6, G) (Fritsch, Rich 1938).

195. **EUASTRUM PSEUDOCORALLOIDES** FRITSCH

Illustrations. Fig.25, A-D (Fritsch 1918).

Samples. RSA: 46 (rare).

Note. *E. minutum*, circiter $1\frac{1}{3}$ plo longius quam latum, profunde constrictum, sinu angusto-lineari extremo vix ampliato. Semicellulae sub quadratae, trilobae, incisuris lateralibus subprofundis subampliatis; lobo polari lato, apice complanato et plus minus distincte undulato, incisura mediana extrorsum ampilata non profunda, angulis apicalibus in lobulo acuto membrana leviter incrassata productis; lobis lateralibus bilobulatis, iis superioribus eadem forma quam iis lobi polaris, iis interioribus oblique truncatis; semicellulis granulatis et tumore centrali destitutis, membrana laevi. A latere visae ovatae, inflatione mediana (ubi membrana incrassata) distincta, marginibus superioribus concavis, apicibus rotundatis incrassatis. A vertice visae ellipticae, inflatione mediana valde distincta. Long. cell., 24.0-25.0 μm ; lat. cell., 18.0-21.0 μm ; lat. isthm., 5.0-6.0 μm ; crass., 9.0-10.0 μm .

This species, of which only few individuals were seen, evidently belongs to the group of species comprising *E. coralloides* Joshua, *E. plesiocoralloides* W. et G.S. West, *E. trigibberum* W. et G.S. West, and *E. geometricum* W. et G.S. West. All of these are characterized by the deep incisions between the polar and the lateral lobes, often accompanied by a rather deep apical incision, rendering the

semicells more or less markedly 4-lobbed, a feature which is not so well seen in the present species. The differences between *E. pseudocoralloides* and the other species just enumerated are sufficiently obvious without special mention, in particular the smooth membrane and the characteristic side- and end-views are very distinctive. Another very marked feature is the shape of the upper lateral and apical lobules; the lower lateral lobules appear to be merely truncated. The semicell shown in Fig.25, *D* either represent a simplified form of *E. pseudocoralloides* or, more probably, an immature stage. The extent of development of the apical undulations is, however, certainly subject to some slight degree of variation (Fritsch 1918).

196. EUASTRUM PSEUDOVALIDUM CLAASSEN

Illustrations. Tab.9, figs.15-17 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis E. valido* W. et G.S. West, *sed forma cellulae (praecipue ad basin semicellulae) haud multum sed plane differt. Dentes desunt.*

Near *E. validum* W. et G.S. West (West, West 1905, p.75, Pl.XL, figs.21, 22); but differs in the shape of the basal part of the semicells, and in the absence of teeth. Cells small, about 1.5-1.6 times longer than broad, very deeply constricted, sinus narrowly linear; semicells truncate-pyramidate, lateral margins retuse, inferior angles inflated, superior angles somewhat acutely-rounded; apex broad, truncate-convex, emarginate. Semicells ovate in lateral view, and elliptic in vertical view. Cell wall smooth. Length 36.0-36.6 μm ; breadth 22.0-23.0 μm ; breadth of isthmus 8.0-9.5 μm ; breadth of apex 14.0-16.0 μm ; thickness 14.0 μm (Claassen 1961).

197. EUASTRUM PULCHERRIMUM W. ET G.S. WEST

- VAR. **ORNATUM** FRITSCH ET RICH

Illustrations. Fig.7, A-C (Fritsch, Rich 1938); Figs.21, 22 (Grönblad, Croasdale 1971).

Sample. RSA: 198, 200. – NAM: 307.

Note. *Differt a typo incisuris lateralibus indistinctis, spinis lateralibus vel apicalibus obtusus, tumore majore supra isthmum cum granulis 3-4 centralibus et granulis 7-9 periphericis, granulis parvis in totam superficiem semicellulae dispositis; semicellulae a latere visae trilobatae, lobo polari rotundato granulis rotundatis in marginem; semicellulae a vertice visae tumore mediano bene evoluto, polis rotundatis granulatis.* Long. cell., 41.0-54.0 μm ; lat., 27.0-33.0 μm ; isthm., 6.0-8.0 μm ; crass., 22.0-26.0 μm .

This is a more ornate form with a less marked incision of the lateral margins in the front-view. The disposition of the tumours on the semicells in front-view as almost exactly as in the type, but the tumour above the isthmus is larger and bears central, as well as peripheral, granules. The remaining tumours also bear a few granules, and other granules occur scattered over the whole surface of the semicell. The more ornate character, and the stronger development of the median tumour, are also perfectly apparent in the side- and end-views (Fig.7, *B, C*). In the side-view the polar lobe is markedly rounded, which rather alters the shape of the semicell as compared with the type when seen in this position. The polar incision is narrow in the middle and increases in width towards each face of the semicell (*cf.* Fig.7, *C*) (Fritsch, Rich 1938).

Long., 40.0-45.0 μm ; lat., 27.0-30.0 μm (1.47-1.55x); isthm., 7.0-9.0 μm ; lat. apic., 18.0-19.0 μm . Our plants have less surface ornamentation than Fritsch

and Rich's, but agree well in general outline and smaller size. Very similar to this plant is *E. incertum* Fritsch et Rich f. *minus* Compère (1967, p.229, fig.208) (Grönblad, Croasdale 1971).

198. EUASTRUM QUADRICEPS NORDSTEDT

- VAR. **MINOR** FRITSCH ET RICH

Illustrations. Fig.7, D-G (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200 (rare).

Note. *Differt a typo magnitudine minore, lobo polari pro ratione latiore, marginibus lateralibus seny cellululae in aspectu frontali et laterali evidenter lobulatis; aspectus verticalis quam in typo. Zygosporae globosae, luteo-fuscae, papi; is brevibus obtusis leviter curvatis numerosis munitae.* Long. cell., 75.0-87.0 μm ; lat., 36.0-41.0 μm ; lat. lob. pol., 22.0-23.0 μm ; isthm., 9.0-12.0 μm ; crass., 24.0-29.0 μm ; diam. zygosp. sine papill., 36.0 μm ; long. papill., 3.0-4.0 μm .

The variety differs from the type as described by Nordstedt ("Desmidiaceae", in E. Warming, Symbolae ad Floram Brasiliae centralis cognoscendam, Copenhagen, 1887, p.216) and as subsequently recorded by G.S. West ("A Contribution to our Knowledge of the Freshwater Algae of Columbia", Mem. de la Soc. neuchâteloise, v, 1914, p.1034, Pl.XXII, fig.40) from Columbia, in its decidedly smaller dimensions. It is a more squat form with a relatively broader polar lobe and with the lobing of the lateral margins of the semicells more pronounced. This is also marked in the side-view, while the end-view does not differ appreciably from the type, especially as figured by West. The zygospore of *E. quadriceps* is unknown; that of the variety is spherical, yellowish brown, and densely covered with short, blunt, somewhat curved papillae. The type has hitherto been recorded only from S. America, although a form has been described by Raciborski ("Desmidija zebране pozez Dr. E. Ciastonia", Rozpr. Ak. Umiej. Krakow, ser.2, ii, 192, p.379, Pl.VII, fig.30) from Australia (Fritsch, Rich 1938).

199. EUASTRUM RECTANGULARE FRITSCH ET RICH

Illustrations. Fig.5, M, N (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 201.

Note. *E. minimum, fere tam lat. quam long., profunde constrictum, sinu lineari aperto; demicellulae a fronte visae subrectangularibus, angulis inferioribus rotundatis vel subrectangularibus, marginibus lateralibus in media parte concavis, angulis superioribus cum spina brevi divergenti, apice late truncato incisura mediana vadosa, membrana cum tumore parvo supra isthmum; semicellulae a latere visae ovatae apice rotundato, prominentia in latere utroque; semicellulae a vertice visae late ellipticae, tumore rotundato utrobique; polie cum spinis brevibus 3 (?).* Long. cell., 10.0-11.0 μm ; lat., 9.0-10.0 μm ; isthm., 3.0-4.0 μm ; crass. 6.0-7.0 μm .

This *Euastrum* in its rectangular shape somewhat recalls *Cosmarium regnesi* Reinsch. It has not been possible to obtain a clear view of the cell from the end, but such evidence as has been obtained indicates that apart from the small spines at the apical angles in front-view, there is another intamarginal spine near the apical angles on each side of the semicell (Fritsch, Rich 1938).

200. EUASTRUM ROSTRATUM RALFS

- SUBSP. ROSTRATUM

- VAR. ROSTRATUM

Illustrations. Fig.7, *H (forma major)* (Fritsch, Rich 1938).

Samples. RSA: 198 (together typical form with *forma major*), **200, 202, 204.**

Note. Long. cell., 52.0-56.0 μm ; lat., 27.0-32.0 μm ; isthm., 9.0-10.0 μm .

Forma major. Long. cell., 60.0-62.0 μm ; lat., 27.0 μm ; isthm., 8.0 μm (Fig.7, *H*). The general outline of the semicell is very similar to that usually found in *E. rostratum*, but the individuals are appreciably larger, and there also appears to be some difference in the surface markings. These were, however, never seen clearly in the few specimens that were found (Fritsch, Rich 1938).

- VAR. TRANSVAALENSIS CHOLNOKY

Illustrations. Fig.42 (Cholnoky 1954b).

Samples. RSA: 214.

Note. The variety differs in their outlines from the type, as the central markings of the semicells are poorly developed. All protrusions, not just the polar are unavailable with long, blunt or sharp, thorn-like projections that are quite unevenly distributed. The proportions are consistent with those of the typical form, cells are 45.0 μm long and 27.0 μm wide, isthmus is about 7.0 μm (Cholnoky 1954b).

- SUBSP. UMBONATUM W. ET G.S. WEST

- VAR. KRANSKOPENSE CLAASSEN

Illustrations. Tab.9, figs.4, 5 (Claassen 1961).

Samples. RSA: 286.

Note. *Affinis E. rostrato subsp. umbonato* W. et G.S. West, *sed sculptura membranae omnino diversa facile distinguenda.*

The shape of the cells agrees with that of *E. rostratum* subsp. *umbonatum* W. et G.S. West (West, West 1895, Pl.6, fig.16); but the cell wall sculpture differs. Apex of polar lobe convex, slightly undulate, with a deep and slightly open median notch, a short spine at each outer angle, and a thickening of the cell wall at each angle and below the apical notch. Cell wall punctate, punctae in rows. Length 50.0-54.0 μm ; breadth 30.5-32.0 μm ; breadth of isthmus 9.0-10.0 μm ; breadth of apex (without spines) 19.0-20.0 μm (Claassen 1961).

201. EUASTRUM SCHWEICKERDTHI CLAASSEN

Illustrations. Tab.9, figs.19-21 (Claassen 1961).

Samples. RSA: 268.

Note. *Ab omnibus generis speciebus distincta. Cehulae plus minusve tam longae quam laetae. Semicellulae latae et obtuse pyramidales, margine apicali hūd penitus inciso, supra isthmm dentes magno munitae; a latere visae plantae et ovatae, a vertice ellipticae. Incisura apicali non profunda.*

Cells small; about as long as broad, deeply constricted, sinus narrowly linear; semicells broad and flat, apical margin with a shallow median incision; with a tooth in the centre of each semicell above the isthmus. Side view of semicell flattened-ovate and oval in vertical view. Length 27.0 μm ; breadth 27.0-28.0 μm ; breadth of isthmus 7.0 μm ; thickness 12.5-13.0 μm (with teeth 18.0 μm). Named after Prof. Dr. H.G. Schweickerdth, Head of the Department of General Botany, University of Pretoria (Claassen 1961).

202. EUASTRUM SCOTTII COESEL ET VAN GEEST (SYN.: *EUASTRUM PRAEMORSUM* (NORDST.) SCHMIDLE VAR. *SIMPLICIUS* GRÖNBLAD ET A.M. SCOTT)

Illustrations. Fig.18 (Coesel, van Geest 2008).

Samples. NAM: (?) **419-420.** – **BOT:** (?) **400-418.**

Note. Although, objectively considered, there are only a number of minor differences between the nominate variety of *Eu. praemorsum* and its var. *simplicius*, their appearance is quite distinct. In our samples both taxa occurred next to each other, without transitional forms. In our opinion, this findings justifies raising in rank of var. *simplicius* to species level. The name of *Eu. simplicius* already having been used by Turner (1892), *Eu. scottii* is chosen as new species name.

Up to then *Eu. scottii* (as. *Eu. praemorsum* var. *simplicius*) was only known from Sudan (Grönblad and al. 1958) and Zambia (Thomasson 1960). *Eu. praemorsum* var. *simplicius* reported from Madagascar (Bourrelly, Couté 1991, Pl.14-6) and from Uganda (Grönblad and al. 1964, pl.2-19) do not refer to our taxon under discussion but to the nominate variety of *Eu. praemorsum*.

On the sites of Chief's Island, Moremi and Mohango *Eu. scottii* appeared to be widely distributed and locally rather common (Coesel, van Geest 2008).

203. EUASTRUM SIBIRICUM BOLDT

- VAR. **SIBIRICUM**

- F. **SIBIRICUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 199, 200, 356.

Note. Long. cell., 16.0-17.0 μm ; lat., 14.0-16.0 μm ; isthm., ca. 3.0 μm ; cross., ca. 8.0-9.0 μm (Fritsch, Rich 1938).

Length 19.2 μm ; breadth 17.7 μm ; isthmus 4.5 μm (Williamson 1994).

- F. **AFRICANUM** GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE ET SCOTT

Illustrations. Fig.26 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 165.0 μm ; lat., 13.5 μm ; isthm., 4.5 μm . Our plant has its lobes somewhat less rounded and its ornamentation even more reduced (Grönblad, Croasdale 1971).

- VAR. **CAPENSE** HUBER-PESTALOZZI

Illustrations. Tab.7, Fig.1 (Huber-Pestalozzi 1930).

Samples. RSA: 328, 329.

Note. Long., 15.6 μm ; lat., 13.2 μm ; apex 10.4 μm ; isthmus, 3.0 μm . In sample **329** mistakenly indicated as *St. sibiricum* Boldt. f. nova *capense* (Huber-Pestalozzi 1930).

204. EUASTRUM SIMPLICIFORME F.E. FRITSCH

Illustrations. Fig.9 (Fritsch, Stephens 1921).

Samples. RSA: 74 (very rare).

Note. *E. subparvum, circiter 2plo longius quam latum, subprofunde constrictum sinu subangusto-lineari extus paullo ampliato. Semicellulae trapeziformes, apice leniter concavo vel interdum triundulato, lateribus leniter convergentibus tricenatis (angulis apicalibus inclusis), crenis superioribus prope apice, crenis inferioribus ca. in media parte marginis lateralis; angulis basalibus subrectangulari-rotundatis. Membrana in tota superficie semicellulae glabra. A latere visae ellipticae, apice subrotundato, intra marginem lateralem lineis duabus cum crenis lateralibus in aspectu frontale congruentibus. A vertice*

visae subellipticae, polis deplanatis retusis, inflatione mediana subdistincta, Long. cell., 40.0-42.0 μm; lat. cell., 21.0-24.0 μm; lat. isthm., 9.0 μm; crass., 15.0-16.0 μm.

This species might almost equally well be regarded as belonging to the genus *Cosmarium*, the chief reasons for referring it to *Euastrum* lying in the character of the side-view and the usual concavity of the apex of semi-cell. As a matter of fact it shows considerable resemblance to *Cosmarium angulatum* Perty, a species which is not at all well known. It differs from the latter in having a narrower isthmus and in the character of the lateral margins; the end-view, which is not known in the case of *Cosmarium angulatum*, also appears distinctive (Fritsch, Stephens 1921)

205. EUASTRUM SINUOSUM LENORM.

- VAR. SINUOSUM

Illustrations. Fig.14 (Grönblad, Croasdale 1971); Pl.12, Fig.1 (Williamson 1994).

Samples. RSA: 368. - NAM: 307.

Note. Long., 60.0 μm; lat., 33.0 μm (1.8x); isthm., 10.0 μm; lat. apic. max., 14.0-16.0 μm; min., 12.0-13.0 μm. In its relatively long polar lobe our plant somewhat resembles forms described by Skuja (1949, p.114, 24: 5, 7) from Burma, but seems to lack all pores. It also resembles *var. dideltoides* Krieger (1932, p.214, 22:2) from Sunda. R. Grönblad also suggested "*E. ansatum* Ehrenb. f.", but in outline the cell much more closely resembles *E. sinuosum* (Grönblad, Croasdale 1971).

Length 88.0-89.0 μm; breadth 39.0-41.0 μm; isthmus 14.0 μm; ratio of length to breadth 2.14-2.25; thickness 27.7 μm. These specimens differ from typical *E. sinuosum* in being much narrower and the facial swellings which correspond exactly with the position of the pores can only be seen, and then only with some difficulty when the desmid is at an oblique angle. There is also a difference in the side and vertical views. However *E. sinuosum* certainly seems the nearest taxon. Comparison should be made with *E. ansatum* Ralfs, some forms of which in front view have a close resemblance, but they lack the facial swellings penetrated by prominent pores (Williamson 1994).

In (Williamson 1994) indicated as *Euastrum sinuosum* Lenorm. ex Arch.

- VAR. REDUCTUM W. ET G.S. WEST

Illustrations. Fig.1, A (Rich 1940).

Samples. RSA: 230, 300.

Note. Forma. Long. cell., 52.0-58.0 μm; lat., 32.0-34.0 μm. It shows the slight indentation on the lateral lobes indicated in the drawings by Prescott and a few other observers (Rich 1940).

206. EUASTRUM SPHYROIDES NORDST.

Illustrations. Fig.31 (Coesel, van Geest 2008).

Samples. BOT: 401.

Note. *Eu. sphyroides* was originally described by Nordstedt (1888) from bogs in New Zealand. Later on it was reported also from the African and the Asian continent. Most of the records originate from tropical Africa and all of them make mention of somewhat larger cell dimensions than in Nordstedt (1888). Whether this is ground for distinguishing a separate intraspecific taxon, like forma *lata* Schmidle (1898), however, is questionable (Coesel, van Geest 2008).

207. EUASTRUM SPICATUM W.B. TURNER

Illustrations. Fig.1, B, C (Rich 1940).

Samples. RSA: 299.

Note. *Forma* W. et G.S. West. Long cell., 46.0 μm ; lat., 40.0 μm ; crass., 23.0-24.0 μm . A little smaller than the form observed by Messrs. West in Ceylon ("A Contribution to the Freshwater Algae of Ceylon", Trans. Linn. Soc. (Bot.), vol.vi, pt.3, 1902, p.150) (Rich 1940).

208. EUASTRUM SPINULOSUM DELPONTE

- SUBSP. **SPINULOSUM**

- VAR. **SPINULOSUM**

Illustrations. Fig.26 (Coesel, van Geest 2008).

Samples. BOT: (?) 400-418.

Note. *Eu. spinulosum* is the most common and widely distributed representative of the *Eu. mononcyllum*-allied species complex, occurring in (sub)tropical regions on all continents (Krieger 1937). *Eu. spinulosum* is a polymorphic species of which quite a number of intraspecific taxa have been described. No doubt, some of those taxa have to be attributed only little significance (e.g. *Eu. spinulosum* subsp. *africanum* Nordst.) while others rather deserve the status of a separate species (e.g. *Eu. spinulosum* var. *orbiculare* (G.C. Wall.) De Wild.).

The nominate variety was commonly distributed on the sites of Chief's Island and Moremi (Coesel, van Geest 2008).

- VAR. **BURMENSE** W. ET G.S. WEST

Illustrations. Fig.46 (Grönblad, Croasdale 1971).

Samples. NAM: 306.

Note. Long., 60.0 μm ; lat., 48.0 μm (1.25x); isthm., 14.0 μm . Differs from type in presence of two small lateral tumors bearing granules, at base of semicell (Grönblad, Croasdale 1971).

- VAR. **BORGEI** WILLIAMSON

Illustrations. Pl.11, Fig.3 (Williamson 1994), Figs.9, 10 (Williamson 1996).

Samples. RSA: 373, 381.

Note. Similar to the nominal variety except for a blunt rectangular tubercle close to and on each side of the isthmus and below the central arrangement of prominent verrucae. At first the tubercle escaped notice on specimens with intact cell contents but eventually proved to be present on all specimens examined in this large population Length 55.0-64.0 μm ; breadth 56.0-65.0 μm ; crass. 31.0 μm .

An identical plant has been portrayed by Borge (1899) as *E. spinulosum* Delp. subsp. *africanum* Nordst. f. *borge* and by Jao (1949). Gerrath and Lobban (1991) have drawn similar plants (Figs.37-39) but placed them under var. *inermius*.

E. panamense Coesel (Coesel 1987) also has some affinity with this plant but differs in its shape and marginal spines (Williamson 1994).

A new illustration from the considerable population found in the roadside pond near Warburton is shown. *Dimensiones: latitudo cum processibus* 63.0 μm , *sine processibus* 46.0 μm . The zygospore illustrated for the first time is globular with many bifurcate projections of moderate length (c. 10 μm) (Williamson 1996).

- VAR. **INERMUS** (NORDST.) C. BERNARD

Illustrations. Fig.27 (Coesel, van Geest 2008).

Samples. BOT: 400.

Note. Differing from the nominate variety by a broader and more flattened apex. As well as by a more elaborate cell wall sculpturing. Less common (e.g. in sample **400**) (Coesel, van Geest 2008).

- VAR. **LINDAE** GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE AND SCOTT

Illustrations. Pl.12, Fig.4 (Williamson 1994).

Samples. RSA: 341, 343, 350, 355, 358, 362, 392.

Note. Length 69.0-100.0 μm ; breadth 59.0-96.0 μm ; isthmus 15.5-20.0 μm ; ratio of length to breadth 1.0-1.2; thickness 35.0-42.0 μm . Specimens from sample **341** had central arrangements in each semicell consisting mostly of emarginate verrucae (Williamson 1994).

- SUBSP. **AFRICANUM** NORDST.

- VAR. **AFRICANUM**

Illustrations. Fig.6, *E*, *F* (Rich 1932); Tab.9, fig.1; Tab.29, fig.2 (Claassen 1961); Figs.42, 137 (Grönblad, Croasdale 1971).

Samples. RSA: 192 (not uncommon), **254, 292, 296, 328.** – **NAM: 307.**

Note. Long., 62.4 μm ; lat., 59.8 μm ; long., 59.8 μm , lat., 57.2 μm ; long., 67.6 μm , lat., 57.2 μm ; isthmus, 13.0 μm (Huber-Pestalozzi 1930).

The length agrees rather nearly with that of var. minus Nordst., but the breadth is greater than in this variety. Here length and breadth are about equal. Long., 58.0-80.0 (plerum 60.0 μm); lat., 54.0-70.0 μm ; crass., 32.0-34.0 μm ; lat. lob. pol., 23.0 μm ; isth., 11.0-12.0 μm . *Euastrum spinulosum* is an exceptionally variable species; two extreme forms her observed are shown in Fig.6, *E*, *F* (Rich 1932).

Interlobular incision slightly deeper than in the typical form. The Doornfontein specimens are considerably larger than the Mosdene specimens (Claassen 1961).

	Doornfontein	Mosdene
Length	78.0-84.0 μm	60.0 μm
Breadth	68.0-72.0 μm	56.0-60.0 μm
Breadth of isthmus	16.0-18.0 μm	16.0 μm

Long., 86.0 μm ; lat., 82.0 μm ; isthm., 22.5 μm . Cell large, with notch at apex, rounded lobes and elaborate central ornamentation. Krieger (1937, p.633) includes this with the species type, but H. Croasdale agrees with the many authors who prefer to keep it separate (Grönblad, Croasdale 1971).

- VAR. **MINUS** NORDST.

Illustrations. Figs.44-45, 138 (Grönblad, Croasdale 1971).

Samples. NAM: 304, 305, 307.

Note. Long., 49.0-60.0 μm ; lat., 43.0-52.0 μm (1.0-1.7x); isthm., 11.0-14.0 μm . Similar to var. *africanum* but smaller, with ornamentation somewhat reduced and apical notch sometimes less definite (Grönblad, Croasdale 1971).

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.9, fig.2 (Claassen 1961).

Samples. RSA: 243.

Note. *Affinis* var. *duplo-minori* W. et G.S. West, *sed forma lobi polaris et incisuris interlobularibus minus profundis distinguenda.*

This differs from var. *duplo-minor* W. et G.S. West (West, West 1895, Pl.6, fig.13) in the shape of the polar lobe, and in having shallower interlobular incisions and larger cells. Lobes more or less semicircular. Length 81.0-82.0 μm ; breadth 62.5-64.0 μm ; breadth of isthmus 15.0-15.5 μm (Claassen 1961).

- SUBSP. **INERMIVUS** NORDST.

- VAR. **INERMIVUS**

Illustrations.

Samples. RSA: 185 (very rare).

209. EUASTRUM SPLENDENS FRITSCH ET RICH

Illustrations. Fig.9, A-C (Fritsch, Rich 1938).

Samples. RSA: 198.

Note. *E. mediocre*, circa $1\frac{1}{5}$ plo longius quam latius, profunde constrictum, sinu valde ampliato acuto; semicellulae a fronte visae trilobatae sine incisura mediana, lobo polari valde evoluto subcylindrico apicem versus ampliato, vertice leviter convexo crenato, membrana glabra, lobis lateralibus divergentibus bilobulatis lobulis emarginatis, in superficiem partis basalis semicellularum jugis 3 symmetrice dispositis, lateralibus emarginatis mediano trilobulato; in aspectu laterali lobeus polaris imilis est, marginibus lateralibus partis basalis semicellulae tricrenatis, in superficiem jugis 3, lateralibus emarginatis mediano profunde bilobulato; aspectu verticali elliptico, lobis 3 rotundatis valde evolutis utrobique, lobo polari a vertice viso circulari cum granulibus pluribus seriatis. Long. cell., 62.0-75.0 μm ; lat., 50.0-51.0 μm ; lat. lob. pol., 12.0-16.0 μm ; isthm., 11.0-12.0 μm ; crass. (max.) 32.0-43.0 μm .

The striking form shows a tendency to radial symmetry and therefore an approach to the genus *Euastridium* (W. and G.S. West, "Freshwater Algae from Burma, including a few from Bengal and Madras", Ann. Roy. Bot. Garden, Calcutta, 6, 1907, p. 199, Pl.XIV, fig.11). The end-view (Fig.9, C) is elliptic in general outline, but shows on each side three prominent rounded lobes, which in the front-view (Fig.9, A) appear as three ridges on the basal part of the semicell. The median ridge is tricrenate (cf. Fig.9, B), while the lateral ones are emarginate. The conspicuous polar lobe is without an apical incision and widens towards the apex, which appears crenate (Fig.9, A, B). In the end-view the polar lobe is seen to be cylindrical, and the crenate appearance of its apex to be due to several series of marginal and intramarginal granules. Elsewhere the membrane is smooth.

The new species shows resemblances to *E. attenuatum* Wolle as described and figured by W. and G.S. West ("On Some North American Desmidiaceae", Trans. Linn. Soc. (Bot.), v, 2 ser., 1896), as well as with *E. pectinatus* Bréb. var. *porrectum* Borge ("Süßwasseralgen aus Süd-Patagonien", Bih. K. Svensk. Vet.-Akad., Handl.27, Afd.3, No.10, 1901), which G.S. West ("A Contribution to our Knowledge of the Freshwater Algae of Columbia", Mem. de la Soc. neuchâteloise, v, 1914, p.1032) identifies with the former. As compared with *E. attenuatum* the new species is broader, has a widely open isthmus, a somewhat different polar lobe, and a more elaborate development of the rounded ridges on the basal part of the semicell. Borge's form agrees with *E. splendens* in dimensions and in the widely open isthmus, but, judging by the front-view of which details alone are available, it would seem to be less complex and with rather shorter lateral lobes. We do not agree with the reference of this form to *E. attenuatum* Wolle, since it shows manifest differences; it should be regarded either as a variety of *E. attenuatum*, or perhaps, better, as a variety of *E. splendens* (Fritsch, Rich 1938).

210. EUASTRUM SUBALPINUM MESSIKOMMER

Illustrations. Fig.1, D (Rich 1940).

Samples. RSA: 300.

Note. Long. cell., 18.0-20.0 μm ; lat., 13.0-14.0 μm ; isthm., 4.5 μm . A very small *Euastrum* resembling *E. insulare*, but characterized by its slightly dilated apex, and a minute papilla terminating the upper angle on each side in the front view (Rich 1940).

211. EUASTRUM SUBINCISUM REINSCH

Illustrations. Pl.VI, fig.12 (Reinsch 1878).

Sample. RSA: 4.

Note. *E. e minoribus, in sciagraphia rectangulari oncisura acutangula divisum; semicellulis a fronte visis rectangularibus, trilobulatis, lobulis basalibus subrotundatis, in quoque latere gibberulo rotundato instructis, lobulo terminali lato a lobulis basalibus incisura rotundata disjuncto, margine terminali subrecto, in medio levissime inciso diametrum transversalem cellulae subaequante, angulis rotundatis; semicellulis e latere et e vertice visis rectangularibus, marginibus leviter emarginatis in quoque angulo gibberulo rotundato instructis; cytiodermate laevi; isthmi latitudo et corporis crassitudo dimidium diametri transversalis. Longit. 0.0224 mm, latit. 0.0178 mm. In speciminibus singulis* (Reinsch 1878).

212. EUASTRUM SUBINTEGRUM NORDST.

- VAR. **BRASILIENSE GRÖNBL.**

Illustrations. Pl.11, Fig.1 (Williamson 1994).

Sample. SWA: 377.

Note. Cells medium sized, more or less elliptical in general outline. Cells 1.3-1.5 times longer than broad. Sinus very deep, linear, closed. Basal angles rounded with two marginal granules. Above the basal angles the margins are retuse to a rounded lateral lobe and a superior to this a widely open acute-angled incision separating the lateral lobe from the apical lobe. The apical lobe is convex with a slight median invagination the apical angles being sharply rounded and often thickened.

Cell wall with a small protrusion within the basal angle and two small depressions horizontally disposed immediately below the apical invagination. Cell wall scrobiculate. Semicells in lateral view ovate with smooth convex margins near the semicell base and at the apices. In vertical view semicells elliptical with two low swellings on each margin.

Careful observation of the specimen is necessary to ascertain whether there are any depressions disposed horizontally on the upper part of the polar lobe, for otherwise the desmid could be confused with some forms of *E. truncatiforme* G.S. West or *E. pectinatum* (Bréb.) ex Ralfs. Length 47.0-61.0 μm ; breadth 36.0-41.0 μm ; isthmus 7.0-8.0 μm ; thickness 17.5-21.5 μm (Williamson 1994).

213. EUASTRUM SUBHYPOHONDRUM FRITSCH ET RICH

Illustrations. Fig.10 (Fritsch, Rich 1938), Fig.25 (Coesel, van Geest 2008).

Samples. RSA: 200, 201, 204. – BOT: 400, 401, 409.

Note. *E. submagnum, tam longum quam latum, profundissime constrictum, sinu acuto valde ampliato dente obtuso in media parte; semicellulae a fronte visae trilobatae sine incisura mediana, lobo polari brevi cylindrico apice truncato angulis apicalibus cum spinis pluribus, lobis lateralibus plus minus divergentibus margine superiore fere recta margine inferiore leviter convexa angulis externis rotundatis cum spinis pluribus, in superficiem semicellulae tumore centrali magno cum granulis in series tres (10-*

12:5-6:1), *tumore laterali obscuro utrobique cum granulis 3-5, et granulis aliis sparsis; semicellulae a latere visae trilobatae, angulis apicalibus sinuses, marginibus lateralibus in parte basali cum tumore magno; semicellulae a vertice visae ellipticae polis spinosis tumore magno utrobique, lobo polari subrectangulari; zygosporae globosae spinis acutis basin versus dilatatis mutinae*. Long. cell., 83.0-97.0 μm ; lat., 83.0-97.0 μm ; lat. lob. pol., 21.0-25.0 μm ; isthm., 14.0-16.0 μm ; crass., 41.0-42.0 μm ; zygosp. sine spin., circa 60.0 μm .

This species, as the name suggests, stands nearest to *E. hypochondrum* Nordst., especially in the character of the end- and side-views. *E. subhypochondrum* is, however, considerable larger, and the front-view is rather different. The upper margin of the lateral lobes is almost a straight line (Fig.10, A), while the lower margin is more or less convex. The sinus is thus widely open, although a projecting tooth situated as about the middle of the lower margin of each lateral lobe may almost its vis-à-vis. There may also be a second tooth near isthmus. The median tumour is more strongly developed than in *E. hypochondrum* (evident also in side- and end-views, Fig.10, B, C) and bears a central granule apart from the two peripheral series. The single granule just above the isthmus is lacking, but on either side of the central tumour are faint 3-5 granulated tumours; the remaining granules show no very definite arrangement. The spines at the angles of the semicells are better developed than in *E. hypochondrium*. Other species with which *E. subhypochondrium* can be compared are *E. bellum* Nordst., *E. hierohymusii* Schmidle, and *E. stellatum* Nordst.

The zygospore was not found by us, but we reproduce a drawing of it sent us by Dr. Doidge many years ago (Fritsch, Rich 1938).

Eu. subhypochondrum, belonging to the *Eu. mononcyllum*-allied group of species (Coesel 2000) is rather close to *Eu. platycerum* Reinsch, *Eu. platycerum* var. *eximium* Grönblad et A.M. Scott even may be considered a bit intermediate between these two species. For that matter, in our opinion, the transfer of var. *eximium* to *Eu. subhypochondrum* by Bourrelly and Couté (in Couté and Rousselin 1975) is less desirable. For, var. *eximium* is marked by lateral lobes that are broadly rounded and slightly inflated at their end whereas *Eu. subhypochondrum* as originally described by Fritsch and Rich (1938) is characterized by attenuating lateral lobes. Actually, typical *Eu. subhypochondrum* is only known from a few African countries, i.e. South Africa (Fritsch and Rich 1938), Mali (Bourrelly 1957) and Zambia (Thomasson 1960) (Coesel, van Geest 2008).

214. EUASTRUM SUBLOBULATUM BRÉB.

Illustrations. Fig.148 (Cholnoky 1955).

Samples. RSA: 230, 233.

Note. In both materials, only were 20.0 μm long and 12.5 μm wide specimens (Cholnoky 1955).

215. EUASTRUM SUBMONTANUM F.E. FRITSCH

Illustrations. Fig.8 (Fritsch, Stephens 1921).

Samples. RSA: 62 (rather rare).

Note. *E. parvum, 1½plo longius quam latum, profunde constrictum sinu subangusto-lineari extus gradatim ampliato. Semicellulae obscure trilobae, sinu late aperto inter lobos; lobo polari lato, apice deplanato vel raro leniter convexo, incisura mediana subprofunda extus ampliata, cum granulis 2 in utroque latere incisurae, angulis apicalibus dente parvo munitis, marginibus*

lateralibus lobi polaris subparallelis; lobis lateralibus bilobulatis, iis superioribus rotundatis vel subtruncatis vel dente parvo munitis, iis interioribus late rotundatis; semicellulis plerumque granulis ca. 4 intra lobum lateralem utrumque et granulis 5-6 intra angulum apicalem utrumque, membrana in media parte glabra. A latere visae elongato-ovatae apice rotundato dente parvo munito, tumore distincto prope basin utrobique. A vertice visae ellipticae, polis rotundatis, inflatione mediana (ubi membrana incrassata) distincta. Zygosporis globosis processibus crassis basi auctis ca. 15 munitis.

Long. cell., 29.0-31.0 µm; lat. cell., 19.0-22.0 µm; lat. lob. pol., 15.0-17.0 µm; lat. isthm., 6.0-7.0 µm; crass., 14.0-16.0 µm; lat. zygosp. sine proc., 20.0-21.0 µm; long. proc. zygosp., 5.0-7.0 µm.

This species shows considerable resemblance to *E. montanum* W. et G.S. West, especially as regards the side- and end-views. The front-view is, however, rather different. The zygosporangium of *E. montanum*, which has been figured by Luetkemüller ("Desm. Boehmens," Verh. k. k. zool.-bot. Ges. Wien, 1910, p.483, fig.2), also differs from that of *E. submontanum*, having more numerous and falcate processes (Fritsch, Stephens 1921).

216. EUASTRUM SUBPRAEMORSUM FRITSCH ET RICH

Illustrations. Fig.9, D-F (Fritsch, Rich 1938).

Samples. RSA: 202, 205.

Note. *E. mediocre*, ca. 1½ plo longiore quam latiore, profunde constrictum, sinu anguste lineari; semicellulae a fronte visae subquadratae, incisura mediana subprofunda aperta, angulis basalibus subquadratis, marginibus lateralibus in parte inferiore lobulo emarginato, in parte mediana spina acuta praeditis, in parte superiore concavis, angulis superioribus cum spina acuta, lobo polari paulo evoluto, apice fere recto, spinis brevibus 3 intra marginem in utroque latere lobi polaris et spina brevi 1 intra marginem lateralem semicellulae unamquamque, tumoribus rotundatis pluribus in superficiem semicellulae, unum supra isthmum; semicellulae a vertice non visae. Zygosporae globosae, spinis obtusis circa 8.0 µm longis munitae. Long. cell., 44.0-50.0 µm; lat., 27.0-32.0 µm; isthm., 9.0 µm; crass., 23.0-26.0 µm; diam. zygosp. sine spine, circa 40.0 µm.

We have had considerable difficulty in determining the status of this *Euastrum*, which shows some characteristics of *E. praemorsum* (Nordst.) Schmidle, but differs from it altogether in the poor development of the polar lobe, as well as in relative dimensions; the intramarginal spines are, moreover, peculiar, and the disposition of the rounded tumours different. The appearance of the side-view is very characteristic, the trifid apices being due to the apical (marginal) spine and the adjacent intramarginal spine on either side. As far as the front-view is concerned there is some resemblance in general outline to a form of *E. rostratum* figured by Borge ("De Algen der erstern Regnellschen Expedition: II. Desmidiaceen", Arkiv för Bot., 1, 1903, Tab.IV, fig.28) (Fritsch, Rich 1938).

217. EUASTRUM SUDANENSE COESEL ET VAN GEEST

Illustrations. Figs.15 (after Grönblad and al. 1958), 16 (Coesel, van Geest 2008).

Samples. BOT: 415 (only a few cells).

Note. Cells slightly longer than broad. Sinus deep, closed for the greater part. Semicells in frontal view trapeziform with retuse lateral sides. Apex truncate with a wide, shallow, median indentation. Apical angles narrowly rounded or

papillate. Basal angles broadly rounded. Semicells in apical view ellipsoid with a broad median inflation. Cell wall smooth. Cell length 38.0-44.0 μm , cell breadth 30.0-33.0 μm , cell thickness circa 24.0 μm , breadth of isthmus 9.0-12.0 μm .

Originally, algal form was labeled *Eu. gessneri* Willi Krieg. et Bourr. (Grönblad and al. 1958). It should, however, be clear that *Eu. gessneri* as recorded by Grönblad and al. (1958) from Sudan refers to another species than *Eu. gessneri* as originally described by Krieger and Bourrelly (1956) from the Venezuelan Andes. Semicells of *Eu. gessneri* are characterized by a big, globose, central tumour that is lacking in *Eu. sudanense*. In addition to that, cell wall in *Eu. gesneri* is distinctly scrobiculate versus perfectly smooth in *Eu. sudanense*. Finally, apical angles in *Eu. gessneri* cells are broadly rounded as against acute in *Eu. sudanense*. In some of cells from Okavango Delta a couple of minute papillae were observed, positioned at the base of the semicells, about half-way the sinus incision (Coesel, van Geest 2008).

218. EUASTRUM SYMPAGEUM W. ET G.S. WEST

- VAR. **SYMPAGEUM** (SYN.: *EUASTRUM SUBCRASSUM* FRITSCH ET RICH)

Illustrations. Fig.8, D-F (Fritsch, Rich 1938).

Samples. RSA: 198, 200, 201.

Note. *E. submagnum*, ca. duplo longius quam latis, elliptico-oblongum, profunde constrictum, sinu angusto lineari interdum subaperto, membrana crassa minute scrobiculata; semicellulae a fronte visae trilobate, incisura inter lobum polarem et lobos laterales angusta vel subaperta, lobo polari late cuneato sine incisura mediana apice distincte convexo, marginibus lateralibus leviter concavis, angulis basalibus rotundatis; semicellulae a latere visae subrectangulares, lobo polari apice truncato dente obtuso in parte basali, lobis lteralibus leviter cuneatis; semicellulae a vertice non satis visae, quadratae (?). Long. cell., 75.0-86.0 μm ; lat., 40.0-44.0 μm ; isthm., 7.5-9.0 μm ; crass. (max.), 24.0-30.0 μm .

This *Euastrum* is characterized by its thick minutely scrobiculate membrane, its entire polar lobe appearing as a convex hump in the front-view, and by the side-view (Fig.8, E). In general outline there is resemblance to *E. crassum* (Bréb.) Kütz., a much larger form with a smaller polar lobe showing the usual median incision. Other somewhat similar species are *E. truncatum* Joshua ("Burmese Desmidiaceae", Journ. Linn. Soc. (Bot.), xxi, 1885) and *E. capitatum* Huber-Pestalozzi ("Algae aus dem Knysnawalde in Südafrika", Zeitschr. für Botanik., 23, 1930, p.462, fig.72). In the former the apex of the polar lobe is concave, while in both there is no appreciable thickening of the membrane, and the side-view is altogether different. Forms like *E. subcrassum* in their entire polar lobe form a link between *Micrasterias* and *Euastrum* (cf. Huber-Pestalozzi, "Algae aus dem Knysnawalde in Südafrika", Zeitschr. für Botanik., 23, 1930, p.463) and in this connection attention may specially be directed to *Micrasterias suboblonga* Nordstedt ("Freshwater Algae collected in New Zealand and Australia", K. Sv. Vet.-Akad. Handl., 22, No.8, 1888) (Fritsch, Rich 1938),

- VAR. **ELABORATUM** (GRÖNBLAD ET A.M. SCOTT) COESEL (SYN.: *EUASTRUM SUBCRASSUM* FRITSCH ET RICH VAE. *ELABORATUM* GRÖNBLAD ET A.M. SCOTT)

Illustrations. Figs.20, 21 (Coesel, van Geest 2008).

Samples. NAM: (?) 400, 401, (?) 402-418.

Note. As argued earlier (Coesel 2002), *Eu. subcrassum* described by Fritsch and Rich (1938) from Transvaal should be considered identical to *Eu. sympageum* described by West and West (1895) from Madagascar. Both taxa are

only known from Africa. *Eu. sympageum* var. *elaboratum*, differing from the nominate variety by a more elaborate cell wall sculpturing has been recorded (as *Eu. subcrassum* var. *elaboratum*) from Sudan (Grönblad and al. 1958), Kenya (Lind 1967), Mozambique (Rino 1971) and Madagascar (Bourrelly and Couté 1991).

In Okavango Delta it was widely distributed and locally rather common on the sites of Chief's Island and Moremi. Zygospores (which up to then have not been described) were encountered in sample **401** (Coesel, van Geest 2008).

219. EUASTRUM THERONII CHOLNOKY

Illustrations. Fig.43 (Cholnoky 1954b).

Samples. RSA: 211.

Note. This species is close to *E. verrucosum* Ehr. but different from it in shape of the cells. The polar notch is also striking. The resulting large lobes are covered with short, sharp spines, as a fairly large rounded protuberance near the isthmus, that is in the middle of the semicells. The uneven distribution of spines is more pronounced than in *E. verrucosum*, the length of the spines is a very different. The cell walls are finely grained and indistinct. The length of the observed specimen is 77.0-80.0 μm , their width is 68.0-70.0 μm , isthmus is 10.0 μm . Chloroplast as in *E. verrucosum*. This species is named after Dr. J.J. Theron from Pretoria (Cholnoky 1954b).

220. EUASTRUM TRUNCATIFORME G.S. WEST

Illustrations. Figs.31-33 (Grönblad, Croasdale 1971); Fig.17 (Coesel, van Geest 2008).

Samples. NAM: 305, 306, 307. - NAM: 420, 421, 424. - BOT: 400, 401, 411, 415.

Note. Long., 48.0-49.0 μm ; lat., 35.0-36.0 μm (1.36-1.37x); isthm., 7.0-9.0 μm ; apex 23.0-24.0 μm . Very close to the type but at the large end of the size range and varying in ornamentation. Note the different position of the central pore in each of the three figures (Grönblad, Croasdale 1971).

Eu. truncatiforme is a characteristically shaped desmid taxon that cannot be readily confused with any other *Euastrum* species. It has only been recorded from tropical African countries, i.e., Tanzania (West 1907, Lenzenweger 1980), Sudan (Grönblad and al. 1958), Uganda (Grönblad and al. 1964), Chad (Compère 1967), Namibia (Grönblad and Croasdale 1971) and Sierra Leone (Gerrath and Denny 1988) (Coesel, van Geest 2008).

221. EUASTRUM TURNERI W. WEST

- VAR. TURNERI

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 215, 327.

Note. In (Huber-Pestalozzi 1930) indicated as *Euastrum turnerii* West.

- VAR. SIMPLEX FÖRSTER 1964, TAF.I, FIGS.1-2, TAF.II, FIGS.1-2

Illustrations. Pl.12, Fig.5 (Williamson 1994).

Samples. RSA: 338.

Note. Length 42.0-44.0 μm ; breadth 27.5-28.5 μm ; isthmus 6.0-7.0 μm ; ratio of length to breadth ca. 1.5. Central protrusion without surrounding verrucae (Williamson 1994).

222. EUASTRUM UMBONATUM (W. ET G.S. WEST) SCHMIDLE

Illustrations. Figs.23, 24 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 51.0-59.0 μm ; lat., 29.0-35.0 μm (1.68-1.76x); isthm., 8.0-13.0 μm . Our plants agree quite well with Wests' original (*E. rostratum* Ralfs subsp. *umbonatum* West et West (1895, p.51, 6: 16)), particularly in the wide sinus between the two lateral lobes which later authors use to help separate it from *E. praemorsum* (Nordst.) Schmidle, although the Wests do not mention this. For Fig.23 R. Grönblad changed his identification from *E. praemorsum* to *E. umbonatum*, for Fig.24 he gave only name *E. praemorsum*. H. Croasdale believes that these are essentially the same plant and closer to *E. umbonatum* (Grönblad, Croasdale 1971).

223. EUASTRUM VENUSTUM HANTZSCH

Illustrations. Absent in literature on Southern African desmids.

Samples. ? (Reinsch 1878).

Note. *Paulo majus persimile, differt margine terminali inciso, lobulis basalibus se adtingentibus* (Reinsch 1878). Sample place not indicated.

Members of this genus which were not identified to the species level occurred in following samples: **RSA: 430, 434.**

MICRASTERIAS C.A. AG. EX RALFS

224. MICRASTERIAS AMBADIENSIS (GRÖNBLAD ET A.M. SCOTT) THOMASSON EX KURT FÖRST.

Illustrations. Figs.37, 38 (Coesel, van Geest 2008).

Samples. NAM: 424. – BOT: 415, 417.

Note. *M. ambadiensis* was originally described as *M. radians* var. *ambadiensis* (Grönblad and al. 1958), raised to species level by Thomasson (1960) and nomenclaturally validated by Förster (1981). It is only known from a series of African countries (Förster 1982) (Coesel, van Geest 2008).

225. MICRASTERIAS AMERICANA (EHRENB.) RALFS

- VAR. **TRANSVAALENSIS** CLAASSEN

Illustrations. Tab.16, fig.4 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis typo speciei, sed lobo polari bifido et minore differt.*

This differs from the typical form (West, West 1905, p.117, Pl.LIII, figs.4, 5; Pl.LIV, figs.1-3) in the shape of the polar lobe. Polar lobe smaller than in the typical form, divided into two equal parts near the base (lateral view of semicell); apical margin with a slight median depression, angles produced into small divergent processes, each with a truncate-denticulate apex. Length 104.0-108.0 μm ; breadth 80.0-82.5 μm ; breadth of isthmus 17.5-18.0 μm ; maximum breadth of polar lobe 34.0-35.0 μm (Claassen 1961).

226. MICRASTERIAS APICULATA (EHRENB.) MENEGH.

- VAR. **APICULATA**

Illustrations. Tab.10, figs.1-4 (Claassen 1961).

Samples. RSA: 198 (very rare), **259, 260, 268, 269.**

Note. *Forma* Borge ("Die in São Paulo gesammelten Süßwasseralgen," Arkiv för Bot., 15, No.13, 1918, p.68, Tab.V, fig.34). Long. cell., 330 μm ; lat., 255 μm (Fritsch, Rich 1938).

Polar lobe less exerted than in the typical form, apical angles with one spine and in some specimens without spines (the typical form has a pair of diverging spines). Some specimens slightly smaller than in the type. Length 210.0-236.0 μm (with spines 238.0-252.0 μm); breadth 173.0-196.0 μm (with spines 186.0-217.0 μm); breadth of isthmus 30.0-35.0 μm ; maximum breadth of polar lobe 64.0-80.0 μm (Claassen 1961).

Western Cape, Magaliesberg, Drakensberg (orig.).

- VAR. **LACERATA** TURN.

- F. **ORNATA** WILLIAMSON

Illustrations. Pl.13, Fig.5 (Williamson 1994).

Sample. RSA: 358.

Note. Cells large in size, elliptical in general outline, inner part of sinus narrowly open. Semicells with five lobes, the interlobular incisions moderately deep. Upper part of polar lobe cuneate, the lower part narrower with subparallel margins; the apex strongly retuse in the middle with about 4 pointed spines on each side of the median notch and with the lateral angles downwardly uncinat. Lateral lobes approximately equal in size, divided by a moderately deep narrow acute-angled incision, the secondary division of the lobes being shallow and acute-angled. The margins of all lobes bearing pointed spines. Length 140.0-145.0 μm ; breadth 118.0-123.0 μm ; crass., 46.0-50.0 μm .

Cell wall with blunt stalk-like projections surrounded by a few short spines near the base of each lobule and with two similar projections horizontally disposed about midway along the polar lobe. Each lobule with a number of short, pointed spines, arranged between the basal projection and the outer margin. Each semicell with a large verruca about 20.0 μm across, with a peripheral crown of round or conical granules.

Side view of cells narrowly elliptic with large flat or convex verruca on either side and with prominent blunt projections about midway along each semicell margin; the apices with sharp spines. Vertical view of cell narrowly elliptic with a large convex verruca in the median position. This verruca may also have a median concavity whilst its angles may bend downwards. Blunt, stalk-like projections on each side of the median verruca and with pointed spines at the poles.

Differs from the var. *lacerata* in having two side-by-side projections on the polar lobe with similar single projections near the base of each lobule. *Micrasterias apiculata* var. *lacerata* f. *elaborata* Scott et Prescott (1961) is similar but the ornamentation of the cell wall is quite different and it is much larger (Williamson 1994).

227. **MICRASTERIAS BEWSII** FRITSCH ET RICH

Illustrations. Fig.12 (Fritsch, Rich 1924).

Sample. RSA: 91 (very rare).

Note. *M. medioccris*, circiter $1\frac{1}{3}$ plo longior quam lata, profunde constricta, sinu aperto acutangulo, extremo paullum contracto, interdum dente parvo munito. Semicellulae a fronte visae pyramidato-trapeziformes, angulis basalibus acuto-rotundatis, dentibus 3-4 instructis, marginibus lateralibus inferioribus valde convergentibus et dentibus acutis plus minus numerosis praeditis; lobo polari dilatato, lateribus late concavis glabris, apice

subtruncato dentibus acutis, prope angulos apicales exsertos densioribus, munito. In superficie semicellularum costis duabus paullum curvatis dentatis, a margine isthmi primordiam lobi polari attingentibus, et costis minus effiguratis intra marginem partis basalis semicellulae. A laterevisae ovatae marginibus convexis, apice acuto, dentibus diverse dispositis munitae, A vertice non visae. Long. cell., 114.0-120.0 μm ; lat. cell., 87.0-90.0 μm ; lat. lob. pol. ad apic., 65.0 μm ; lat. isthm., 21.0-23.0 μm ; crass., 22.0 μm .

Although we have seen very few specimens of this form, and cannot pronounce quite certainly on some of the details, we have no hesitation in describing it as a new species, since it appears quite distinct from any other *Micrasterias*. The only species at all resembling it is *M. uniformis* W. et G.S. West (Trans. Linn. Soc., Bot., vi, 1901, p.157, Pl.XX, fig.19), in which, however, the shape of the semicells is decidedly different, there are no superficial to the ridges, the number of teeth is far less, and the dimensions are about one-half. There is also some resemblance to a form figured by Borge (Arkiv. f. Bot., xv, 1918, p.69, Tab.VI, fig.1) under the name of *M. tropica* Nordst. var. *indivisum* (Nordst.) Eichl. et Racib. This, however, appears to differ rather markedly from *M. euastroides* Joshua var. *indivisa* Nordst. (K. Sv. Vet.-Akad. Handl., xxii, 1888, No.8, p.31, Tab.II, fig.17) in the more marked production of the polar lobe, the truncate apex, and the absence of the central tumour, and should probably be regarded as a distinct variety.

We have not able to make out quite clearly the details of ornamentation of the surface of the semicels of *M. bewsii*. It appears, however, that, apart from the two prominent toothed ridges extending from the outer edge of the isthmus to the base of the polar lobe, there are several other similar, though less developed, ridges situated between the principal ones and the basal angles. There would also appear to be a number of teeth, on either side, within the apex of the semicell (cf. Fig.12) (Fritsch, Rich 1924).

228. MICRASTERIAS CRUX-MELITENSIS (EHRENB.) HASS.

- VAR. **CRUX-MELITENSIS**

Illustrations. Tab.18, figs.1-14; Tab.19, figs.1-11; Tab.20, figs.1-6; Tab.21, figs.1-4; Tab.22, figs.1-6; Tab.23, fig.1 (Claassen 1961).

Sample. RSA: 186, 214, 216, 217, 290, 297, 298.

Note. Individuals were found scarcely differing from Turner's figure of *forma typica* (W.B. Turner, The Freshwater Algae (principally Desmidiaceae) of East India, 1892, Tab.V, fig.4a), and agreeing with it in dimensions (Rich 1932).

In sample **214** cells of a small size were observed (130.0 μm long and 122.0 μm wide) (Cholnoky 1954b).

The shape of the polar and lateral lobes differs slightly from those in the type. Cells slightly larger than in the typical form. Length 116.0-148.0 μm (with processes 128.0-168.0 μm); breadth 118.0-126.0 μm (with spines 128.0-140.0 μm); breadth of isthmus 20.0-23.0 μm ; maximum breadth of polar lobe 60.0-80.0 μm (Claassen 1961).

In different regions of Southern Africa (orig.)

- VAR. **AEQUALIS** RICH

Illustrations. Fig.6, A (Rich 1932).

Sample. RSA: 192 (May, July), **198** (rare).

Note. *Cellulis fere tam longis quam latis, incisionibus inter lobulos laterales inferiores et superiores fere tam profundis quam iis interlobum*

polarem et lobos laterales, lobulis lateralibus profundiore furcatis quam in typo; membrana delicate punctata. Long., 126.0-144.0 µm; lat., 126.0-144.0 µm.

In this very rich pan individuals were found larger than type, and with a deeper incision between the lateral lobes; they recalled *M. radiata* Hass. in these respects, but the long diverging processes of the polar lobe, characteristic of *M. radiata*, were lacking. Bernard (Sur quelques Algues unicellulaires d'eau douce récoltées dans le domaine Malais, 1909, Pl.V, fig.114) figures a form of *M. crux-melitensis* which he considers more or less typical, and that, though smaller, is similar to the present form. Turner (W.B. Turner, The Freshwater Algae (principally Desmidiaceae) of East India, 1892, Tab.V, fig.4b) figures a form *compressa* with lobulations apparently just as deep as they are here, but all the dimensions he gives are smaller. Joshua (Burmese Desmidiaceae, 1885, Pl.XXII, figs.10, 11) depicts a similar form which he refers to a *variety*. All the forms hitherto figured are longer than broad, though often the difference is but slight (Rich 1932).

Long. (max.), 129.0 µm; lat., 126.0 µm; isthm., circa 14.0 µm. The cell-wall is delicately punctate. This variety, already recorded from the Transvaal, shows some resemblance to *M. radiata* Hass., but it is more robust, and the median lobe is less extended (Fritsch, Rich 1938).

- VAR. *EVOLUTA* W.B. TURNER

Illustrations. Fig.6, *B* (Rich 1932); Tab.16, fig.3; Tab.17, fig.1 (Claassen 1961).

Sample. RSA: 191, 192, 284, 298, 299, 328, 329.

Note. In sample **328**: long., 101.4 µm; lat., 96.2 µm; isthmus, 13.0 µm. Indicated as *Micrasterias crux-melitensis* (Ehr.) Ralfs f. *evoluta* Turner (Huber-Pestalozzi 1930).

Forma. The present form has two small teeth at the apex of the polar polar lobe, but is larger than var. *evoluta*, and the incisions are deeper. In Weltevreden West Pan individuals were seen with the two small teeth at one end and not at the other. This transitional form is figured (Fig.6, *B*) (Rich 1932).

Long. cell. (max.), 88.0-90.0 µm; lat., 84.0 µm; isthm., 15.0 µm (Rich 1940).

Apical margin of the polar lobe with four small teeth; the lateral lobes with more subdivisions than in the typical form. Length 98.0-124.0 µm (with processes 113.0-144.0 µm); breadth 101.0-116.0 µm (with teeth 111.0-128.0 µm); breadth of isthmus 17.0-22.0 µm; maximum breadth of polar lobe 36.5-45.0 µm (Claassen 1961).

- VAR. *TRANSVAALENSIS* CLAASSEN

Illustrations. Tab.16, figs.1, 2 (Claassen 1961).

Samples. RSA: 258, 269.

Note. *Typo speciei affinis, sed forma lobi polaris distincta et margine apicali paene recto quippe cui pars media leviter sit depressa.*

This differs from the typical form in the shape of the polar lobe and in having an almost straight apical margin. Fig.2 shows a cell shortly after division. Length 98.0-104.0 µm (with processes 110.0-113.0 µm); breadth 86.0-98.0 µm (with spines 96.0-105.0 µm); breadth of isthmus 16.0-19.0 µm; maximum breadth of polar lobe 40.0-44.0 µm (Claassen 1961).

229. MICRASTERIAS DECEMDENTATA (NÄG.) ARCH.

- VAR. DECEMDENTATA

Illustrations. Fig.13 (Fritsch, Rich 1924), Fig.11, *B, C* (Fritsch, Rich 1938); Tab.16, figs.5-7 (Claassen 1961); Fig.47 (Grönblad, Croasdale 1971); Pl.3, 6 (Williamson 2000).

Sample. RSA: 91 (very rare), **198, 203, 258, 269, 300, 382, 385, 392.**

- **NAM: 305.**

Note. *Formae diversae* (Fig.13). *Long. cell.*, 83.0-93.0 μm ; *lat. cell.*, 93.0-105.0 μm .

The individuals present varied much among one another with respect to the number of teeth developed at the margins of the lobes; moreover, there was often asymmetry as regards this feature between the two sides of the semicell (*cf.* Fig.13, *A, C, E*). The figures will suffice to illustrate these points. In the individual shown in Fig.13, *F*, there was a tendency towards the differentiation of further teeth of the apices of the semicells. Attention should also be drawn to the fact that the apices were more markedly rounded than in Nägeli's original figure (Gatt. einzell. Algen, 1849, p.123, Tab.VI, H, fig.2) or in most of those that have been published subsequently. Moreover, the cells were always shorter than they were broad (Fritsch, Rich 1924).

Forma lobis lateralibus minus dissectis. *Long. cell.*, 40-44 μm ; *lat. cum spin.*, 52-57 μm ; *isthm.*, 10-11 μm . The polar lobe in these specimens is almost exactly like that of the type, figured by Nägeli (Gattungen einzelliger Algen, Zurich, 1849, Tab.VI, H, fig.2), the apex being rather faintly convex and the spines at the apical angles being directed upwards. Most of the subsequently published figures of *M. decemdentata* show a much more markedly convex polar lobe, and horizontally directed spines. In Nägeli's figures the lateral lobes are more deeply dissected than in our specimens, in some of which, in fact, the lateral lobes were merely bidentate with a broad concavity between them (Fig.11, C) (Fritsch, Rich 1938).

Forma. Similar to some of the forms found in Natal (Fritsch, Rich, "Contributions to our Knowledge of the Freshwater Algae of Africa. 4. Freshwater and Subaerial Algae from Natal". *Trans. Roy. Soc. S. Afr.* **11**: 337) (Rich 1940).

Cell wall smooth or punctate. Length 76.5-80.0 μm ; breadth 71.5-75.5 μm (with teeth 79.0-87.0 μm); breadth of isthmus 15.0-17.0 μm ; maximum breadth of polar lobe 54.0-60.5 μm (Claassen 1961).

Long., 68.0 μm ; *lat.* without spines 62.0 μm ; *isthm.*, 15.0 μm ; *lat. lob. pol.* without spines, 49.0 μm . R. Grönblad called this plant "*M. zeylanica*" Fritsch (1907, p.246), but it differs in having the lateral lobe divided, the extremity of each division being emarginate, and bearing two spines. Also the incision between the polar and lateral lobe open than in *M. zeylanica* (Grönblad, Croasdale 1971).

In (Williamson 2000) indicated as *M. decemdentata* (Näg.) var. *decemdentata* Arch.

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, North-West Province, KwaZulu Natal (orig.).

- VAR. GALPINII CLAASSEN

Illustrations. Tab.17, figs.4-7 (Claassen 1961).

Samples. RSA: 289, 290, 292, 294, 295, 298.

Note. *A typo speciei cellulis multo minoribus distincta. Formae intermediae haud visae.*

Cells smaller than in the typical form; lateral angles of polar lobe acuminate. Length 48.5-52.0 μm ; breadth 47.0-51.0 μm (with teeth 56.0-63.0 μm); breadth of isthmus 14.0-17.0 μm ; maximum breadth of polar lobe 40.0-44.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

230. MICRASTERIAS DENTICULATA BRÉB.

- VAR. DENTICULATA

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 91 (very rare), **228, 392.**

Note. *Long. semicell.*, 126.0 μm ; *lat. cell.*, 212.0 μm (Fritsch, Rich 1924).

Indicated as *Micrasterias denticulata* Bréb. ex Ralfs (Williamson 2000).

- VAR. AFRICANA CLAASSEN

Illustrations. Tab.11, figs.1-4; Tab.12, fig.1 (Claassen 1961).

Samples. RSA: 198 (very rare), **258, 259, 266, 269.**

Note. *Affinis M. denticulatae* Bréb. *var. angustosinuatae* Gay, *sed lobulo polari latiore et brevioris incisuris minus altis bene distinguenda.*

This variety is near *M. denticulata* *var. angustosinuata* Gay (W. and G.S. West, Monogr. Brit. Desm., Vol.II, 1905, p.108, Pl.L, fig.5); but differs in having a shorter and broader polar lobe and shallower interlobular incisions. Some specimens with slightly excreted polar lobes (fig.3). Length 234.0-248.0 μm ; breadth 196.0-220.0 μm ; breadth of isthmus 32.0-40.0 μm ; maximum breadth of polar lobe 74.0-95.0 μm (Claassen 1961).

- VAR. ANGULOSA (HANTZSCH) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 195.

Note. The specimens observed differed from this variety only in their smaller dimensions. *Long.*, 178.0 μm ; *lat.*, 140.0 μm (Rich 1932).

- VAR. ANGUSTA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 221.

Note. Ausser den typischen habe ich in diesem Materiale auch nur 150.0 μm breite Exemplare gesehen, die aber mit allmählichen Übergängen zu der typischen Variation gebunden sind (Cholnoky 1955).

- VAR. ANGUSTO-SINUATA GAY

Illustrations. Fig.14, A (Fritsch, Rich, 1924).

Sample. RSA: 91 (not uncommon).

Note. *Forma incisuris inter lobulis principalibus minus profundis. Long. cell.*, 210.0-270.0 μm ; *lat. cell.*, 138.0-156.0 μm ; *lat. isthm.*, 24.0-30.0 μm (Fritsch, Rich 1924).

- VAR. NOTATA NORDST. (SYN.: MICRASTERIAS ANGULOSA HANTZSCH VAR. NOTATA NORDST.)

Illustrations. Fig.1, E (Rich 1940).

Samples. RSA: 299, 300, 329.

Note. *Long. and lat.*, 260.0 μm . One cell: *long.*, 312.0 μm ; *lat.*, 286.0 μm ; *isthmus*, 26.0 μm (Huber-Pestalozzi 1930).

Long. cell., 228.0-240.0 μm ; *lat.*, 190.0-204.0 μm ; *isthm.*, 25.0-26.0 μm . Cell wall coarsely punctate (Rich 1940).

- VAR. SUBNOTATA WEST

- F. CORNUTA CLAASSEN

Illustrations. Tab.12, fig.2; Tab.13, figs.1-3 (Claassen 1961).

Samples. RSA: 265, 268.

Note. *Affinis* var. *subnotatae* West, *sed differt quod in lobis polaribus ad incisuram media utrimque bini sunt processus, quibus singuli denticuli insunt.*

This differs from West's variety (West, West 1905, p.108, Pl.L, fig.7) in the polar lobe possessing a pair of processes on each side of the median notch; each process furnishes with a small tooth. Cells slightly larger than var. *subnotata* West, and some lobules with more subdivisions. Length 208.0-256.0 μm ; breadth 180.0-216.0 μm (fig.3, 156.0 μm); breadth of isthmus 26.0-34.0 μm ; maximum breadth of polar lobe 44.0-52.0 μm (Claassen 1961).

231. MICRASTERIAS FOLIACEA BAIL. EX RALFS

- VAR. *ORNATA* NORDST.

Illustrations. Pl.13, Fig.2 (Williamson 1994).

Samples. SWA: 378.

Note. Length 77.0-80.0 μm (+processes); 61.0-63.0 μm (without processes); breadth 88.0-91.0 μm ; isthmus 14.0-16.5 μm (Williamson 1994).

232. MICRASTERIAS FURCATA RALFS

Illustrations. Pl.13, Fig.3 (Williamson 1994).

Samples. RSA: 356.

Note. Length 162.0 μm ; breadth 130.0 μm ; isthmus 18.5 μm ; ratio of length to breadth 1.24 (Williamson 1994).

233. MICRASTERIAS GROENEWALDII CLAASSEN

Illustrations. Tab.14, figs.1-4 (Claassen 1961).

Samples. RSA: 274.

Note. *Affinis* *M. confertae* Lund., *sed lobi polaris forma differt et membranae tres processus supra isthmum sunt conspicui.*

This species is near *M. conferta* Lund. (West, West 1905, p.88-89, Pl.XLIII, figs.4-9); but differs in the shape of the polar lobe and each semicell has three processes above the isthmus. Cells fairly large, a little longer than broad, sub-elliptic, deeply constricted, sinus and interlobular incisions open outwards; semicells 5-lobed; polar lobe with convex sides in its lower half, upper half cuneate, apex with a median notch, apical margin with 4-5 spines on each side of the median hollow; superior lateral lobes slightly larger than inferior lateral lobes, each divided into two lobules, lobules again divided, for four ultimate divisions of each lobe being emarginate (or sometimes tridenticulate); the small lobule adjoining the polar lobe usually tridenticulate. Semicells with three projections across the base, the middle one immediately above the isthmus larger than the lateral ones. Cell wall furnished with numerous minute spines, arranged in subquadrate rows. Cell in vertical view fusiform, poles acute, with three projections on each side towards the middle. Length 184.0-190.0 μm (with spines 197.0-203.0 μm); breadth 162.0-166.0 μm (with spines 170.0-174.0 μm); breadth of isthmus 29.0-33.0 μm ; maximum breadth of polar lobe 61.0-68.0 μm (Claassen 1961).

234. MICRASTERIAS MAHABULESHWARENSIS HOBSON

- VAR. *MAHABULESHWARENSIS*

Illustrations. Pl.13, Figs.6, 6a (Williamson 1994).

Sample. RSA: 192 (May), **338, 358.**

Note. Length 130.0-146.0 μm ; breadth 87.0-133.0 μm ; isthmus 21.0-26.0 μm ; ratio of length to breadth 1.09-1.5; thickness 43.0-45.0 μm (Williamson 1994).

Magaliesberg, Drakensberg, Orange Free State, North-West Province (orig.).

- VAR. **TRANSVALENSIS** CLAASSEN

Illustrations. Tab.17, fig.2 (Claassen 1961).

Samples. RSA: 289, 295.

Note. *Affinis M. mahabuleshwariensis* var. *tetracero* W. et. G.S. West, *sed et forma lobi lateralis summi et dispositione dentium distincta. Margo lobi polaris duobus tantum processibus accessoriis est muniyis, qui processibus M. mahabuleshwariensis similes sed multo breviores sunt.*

Near *M. mahabuleshwariensis* var. *tetracerum* W. et G.S. West (West, West 1895, Pl.6, figs.2-4); but differs in the shape of the upper lateral lobule, and in the arrangement of the small spines; polar lobe with only two accessory denticulate processes like those in var. *wallichii* (Grun.) W. et G.S. West (West, West 1905, p.122, Pl.LIV, figs.7, 8; Pl.LV, figs.1-3); but the processes are considerably shorter. Apical margin of polar lobe furnished with four 3-pointed spines; each lobule of the lateral lobes furnished with singular or branched teeth; cell wall with a series of small teeth within the lateral lobes, across the lateral sides of the polar lobe and a few denticulations above the isthmus. Length 128.0 μm (with apical processes 148.0 μm); breadth 112.0 μm ; breadth of isthmus 28.0 μm ; maximum breadth of polar lobe 84.0 μm (Claassen 1961).

In Orange Free State pan (orig.)

235. MICRASTERIAS NYLSTROMICA CLAASSEN

Illustrations. Tab.12, fig.3; Tab.13, fig.4 (Claassen 1961).

Samples. RSA: 260, 269.

Note. *Ex affinitate M. confertae* Lund., *sed et forma lobi polaris et laborum superiorum-lateralium differt et quod dentibus est ornata.*

This species somewhat resembles *M. conferta* Lund. (West, West 1905, p.88-89, Pl.XLIII, figs.4-9); but differs in the shape of the polar and superior lateral lobes; cell wall furnished with small spines. Cells large, broadly elliptic, deeply constricted, sinus narrowly linear; semicells 5-lobed, the interlobular incisions being narrowly linear and not very deep; polar lobe sub-cuneate, lateral angles downwardly curved, apex concave with a median notch, with three spines on each side of the median notch, and a large curved spine on the apical margin close to each angle, and a smaller spine near the extremity; lateral lobes unequal, superior lateral lobes considerably larger than the inferior lateral lobes, each lateral lobe divided into two more or less similar lobules and each lobule furnished with four marginal spines except the lobule adjoining the polar lobe; this lobule consists of a lower part with four marginal spines, and an upper part which consists of a two-spined lower half and a tree-spined upper half, the latter with the top spine upwardly curved to overlap the apical angle of the polar lobe. Cell wall strongly punctate and furnished with numerous minute spines, arranged in subradiate rows within the polar and lateral lobes. Length 264.0-276.0 μm (with spines 278.0-292.0 μm); breadth 221.0-226.0 μm (with spines 233.0-241.0 μm); breadth of isthmus 42.0-43.0 μm ; maximum breadth of polar lobe 102.5-108.0 μm (Claassen 1961).

236. MICRASTERIAS OSCITANS RALFS

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 238.

Note. Rarely observed species but very big number of typical specimens were observed in our sample (Cholnoky 1955).

237. MICRASTERIAS PAPILLIFERA BRÉB.

- VAR. **GLABRA** NORDST.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 237.

Note. One of the most common desmids. It is strange that I did not find it in other locations (Cholnoky 1955).

238. MICRASTERIAS PINNATIFIDA (KÜTZ.) RALFS

- VAR. **INCUDIFORMIS** W. ET G.S. WEST

Illustrations. Fig.49 (Grönblad, Croasdale 1971).

Sample. RSA: 211-213. - NAM: 307.

Note. *Forma.* A large form. Much broader than long, with one spine on the polar lobe and two spines on the lateral lobes. Long., 68.0 μm ; lat. without spines 87.0 μm ; with spines, 91.0 μm ; isthm., 14.0 μm ; lat. lob. pol. without spines 67.0 μm ; with spines, 70.0 μm . This is very like a form shown by Bourrelly (1957, p.1065, 5:43) from French Sudan (Grönblad, Croasdale 1971).

- VAR. **TRANSVAALENSIS** CLAASSEN

Illustrations. Tab.23, figs.2, 3 (Claassen 1961).

Sample. RSA: 296, 298.

Note. *Affinis* *M. pinnatifida* var. *divisae* W. West *formae majori* Schmidle, *sed differt et forma lobi polaris et quod tuberculi iuxta supra isthmum semicellulae desunt.*

This differs from var. *divisa* W. West *forma major* Schmidle (W. Schmidle, Engler Botan Jahrb., XXXII Bd., 1903, p.73, Taf.II, fig.7) in the shape of the polar lobes and in absence of tubercles above the isthmus in each semicell. Length 108.0-116.0 μm ; breadth 104.0-116.0 μm (with teeth 114.0-124.0 μm); breadth of isthmus 16.0-18.0 μm ; maximum breadth of polar lobe 74.0-92.0 μm (Claassen 1961).

239. MICRASTERIAS RADIANS TURN.

- VAR. **RADIANS**

Illustrations. Pl.13, Fig.1 (Williamson 1994).

Sample. RSA: 350, 351, 375.

Note. This was originally assigned to *M. crux-melitensis* (Ehr.) Hass. ex Ralfs, the close resemblance of which to *M. radians* Turn. had been remarked upon by Prescott and al. (1977). In the collections made by the author both species occur sparsely, so it is not proposed to amalgamate them until denser populations are found. Length 106.0-117.0 μm ; breadth 100.0-113.0 μm ; isthmus 15.0-17.0 μm ; ratio of length to breadth 1.03-1.06 (Williamson 1994).

- VAR. **EVOLUTA** (TURNER) KRIEG.

Illustrations. Pl.13, Fig.4 (Williamson 1994).

Sample. RSA: 345.

Note. Length 100.0 μm ; breadth 93.0 μm ; isthmus 16.5 μm ; ratio of length to breadth 1.07 (Williamson 1994).

240. MICRASTERIAS RADIATA HASS.

Illustrations. Fig. nostr.11, *D* (Fritsch, Rich 1938).

Sample. RSA: 198, 199, 202, 204, 214.

Note. Long. cell. cum proc., 165.0-182.0 μm ; lat., 156.0-180.0 μm ; isthm., 18.0-24.0 μm ; lat. lob. pol., 20.0 μm ; crass., 35.0 μm .

The incision between the polar and lateral lobes is much deeper than that between the two divisions of the lateral lobes, as in the figures of West cited (West, West 1905, p.113, Pl.LII, fig.2). The teeth at the ends of the processes of the polar lobe are long and curved, those of each pair in opposite directions. The end-view (Fig.11, *D*) shows a more marked median inflation than the figure in British Desmidiaceae (Fritsch, Rich 1938).

241. MICRASTERIAS ROTATA (GREV.) RALFS

- VAR. *PULCHRA* LEMM.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 195.

Note. Dimensions slightly greater than those given by Lemmermann (Forschungsber. Biol. Stat. Plön, iv, 1896, p.173, fig.7), but showing the four teeth in the middle of the polar lobe. Long., 306.0 μm ; lat., 265.0 μm (Rich 1932).

242. MICRASTERIAS SCHMIDLEANA COESEL AT VAN GEEST (SYN.: MICRASTERIAS PINNATIFIDA RALFS VAR. DIVISA W. WEST FORMA MAJOR SCHMIDLE)

Illustrations. Fig.6 (Coesel, van Geest 2008).

Sample. BOT: 414 (in low cell numbers), **415** (in low cell numbers), **417** (in low cell numbers).

Note. When Krieger (1937: 21) distinguished *M. divisa* (W. West) Willi Krieg., he created a nomenclatural chaos. For, as type of that species not *M. pinnatifida* var. *divisa* W. West was indicated, but *M. pinnatifida* var. *divisa* W. West forma *major* Schmidle. To add to this confusion he renamed *M. pinnatifida* var. *divisa* W. West to *M. pinnatifida* var. *furcata* Willi Krieg. Apart from this confusing nomenclature, however, he was right in considering West's taxon and Schmidle's taxon to belong to different species. *M. pinnatifida* var. *divisa* W. West, originally described from the USA (West 1891) differs from the nominate variety of *M. pinnatifida* by furcate (instead of simple) lateral lobes. In view of the fact that not seldom janus forms may be encountered that combine a semicell with simple and semicell with furcate lobes (e.g., Krieger 1937, Pl.99-12), only little taxonomic significance should be attributed to this morphological difference. *M. pinnatifida* var. *divisa* forma *major* Schmidle described from Tanzania (Schmidle 1902), on the contrary, is not only characterized by furcate lateral lobes but also by an upward curve of those lobes, longer cell dimensions and a couple of supraisthmial tubercles at the base of the semicell. Such a cell wall sculpturing is unknown in any other intraspecific taxon of *M. pinnatifida* and may justify its raising in rank to species level (see also Růžička 1981: 572).

M. schmidleana seems to be endemic to Africa. Although it is only known with certainty from Tanzania (Schmidle 1902) and Botswana (our results), most likely it has been found also in a number of other African countries. *M. pinnatifida* var. *polymorpha* described from Madagascar (Bourrelly and Manguin 1949) and afterwards also recorded from Sudan (Grönblad and al. 1958), Uganda (Lind 1971), Sierra Leone (Gerrath, Denny 1989) and Nigeria (Opute 1992), as well as *M. pinnatifida* var. *transvaalensis* described from South Africa (Claassen 1961) much resemble *M. schmidleana*, except for the absence of the supraisthmial tubercles. Actually, our Okavango material showed supraisthmial acute granules rather than tubercles. As it is imaginable that those

granules or tubercles, particularly in chloroplast-filled cells, are overlooked, at least part of the above-mentioned records might refer to *M. schmidleana* (Coesel, van Geest 2008).

243. MICRASTERIAS SOL (EHRENB.) KÜTZ.

Illustrations. Tab.15, fig.6 (Claassen 1961).

Sample. RSA: 258, 259, 269.

Note. These specimens are slightly smaller than in the typical form. Length 146.0-152.0 μm ; breadth 146.0-152.0 μm ; breadth of isthmus 18.0-20.0 μm ; maximum breadth of polar lobe 32.0-36.0 μm (Claassen 1961).

244. MICRASTERIAS THOMASIANA ARCH.

- VAR. THOMASIANA

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

- VAR. NOTATA (NORDST.) GRÖNBL.

Illustrations. Pl.14, Fig.5 (Williamson 1994).

Sample. RSA: 362.

Note. Length 246.0 μm ; breadth 211.0 μm ; isthmus 28.0 μm ; ratio of length to breadth 1.16 (Williamson 1994).

245. MICRASTERIAS TROPICA NORDST.

- VAR. TROPICA (SYN.: *MICRASTERIAS EXPANSA* BAILEY VAR. γ WALLICH)

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 196.

Note. A form with the two processes of the polar lobe inclined upwards, forming angles of about 120° with the apex (Rich 1932).

- VAR. ELEGANS W. ET G.S. SMITH

Illustrations. Fig.40 (Coesel, van Geest 2008).

Sample. BOT: (?) 400-418.

Note. Var. *elegans*, originally described by West and West (1897) from Angola, has mainly been recorded from African countries (e.g., Thomasson 1960, Grönblad and al. 1964, Lind 1971, Comperé 1977) but also from India (Agarkar and al. 1983). In the Okavango Delta. *M. tropica* var. *elegans* appeared to be commonly distributed on the sites of Chief's Island and Moremi (Coesel, van Geest 2008).

- VAR. ELONGATA SCHMIDLE

Illustrations. Fig.41 (Coesel, van Geest 2008).

Sample. RSA: 192 (July). – **BOT: 402.**

Note. *Forma.* This is wider than Schmidle's variety. Long., 110 μm ; lat., 70 μm (Rich 1932).

Var. *elongata*, described by Schmidle (1898) from Tanzania, is exclusively known from the African continent (e.g., Grönblad and al. 1958; Thomasson 1960; Lind 1971; Gerrath, Denny 1988). In the Okavango Delta, *M. tropica* var. *elongata* was much more rarer than var. *elegans* (e.g., sample **402**) (Coesel, van Geest 2008).

- VAR. ELONGATISSIMA CLAASSEN

Illustrations. Tab.17, fig.3 (Claassen 1961).

Sample. RSA: 297.

Note. *Affinis* *M. tropicae* var. *elongatae* Schmidle, *sed forma lobi polaris et dispositione dentium valde distincta. Cellula non duplo longior quam latior.*

Near var. *elongata* Schmidle (W. Schmidle, Engler Botan. Jahrb., Vol.26, 1899, p.48, Taf.III, fig.13); but the proportion of length to breadth is not 2:1, and the shape of the polar lobe and the arrangement of the spines differ. Cells longer than in var. *elongata* Schmidle, polar lobes shorter and with a distinct constriction below the apex, apical margin concave, with the angles produced into short processes. Cell wall furnished with seven series of small spines within the lateral lobes, and with a number of spines within the lateral margins of the polar lobe. Length 112.0-128.0 μm ; breadth 76.0-80.0 μm ; breadth of isthmus 16.0 μm ; maximum breadth of polar lobe 22.0-24.0 μm (Claassen 1961).

- VAR. **TENUIOR** FRITSH ET RICH

Illustrations. Fig.11, A (Fritsch, Rich 1938).

Sample. RSA: 198, 199.

Note. *Differt a typo lobis lateralibus leviter divergentibus tenuioribus marginibus superioribus et inferioribus fere rectis, processibus lobi polaris longioribus.* Long. cell. cum proc. apic., 138.0-146.0 μm ; long. cell. sine proc., 81.0-100.0 μm ; lat., 130.0-160.0 μm ; isthm., 13.0-16.0 μm .

This variety differs from the type as described by Wallich ("Descriptions of Desmidiaceae from Lower Bengal", Ann. and Mag. Nat. Hist., ser.3, 5, 1860, p.5, Tab.XIII, fig.9) and Nordstedt ("Desmidiaceae", in E. Warming, Symbolae ad Floram Brasiliae centralis cognoscendam, Copenhagen, 1887, p.219, Tab.II, fig.15 b) in the apical processes being longer, in the lateral processes being longer, thinner, and upwardly divergent, and in their having practically straight margins. All this results in a form giving a more slender impression than any that has hitherto been described, apart from the f. *gracilior* of Schmidle ("Die ... in Ost-Africa gesammelten Desmidiaceen", Eng. Bot. Jahrb., xxvi, p.1, 1899, p.48, Tab.III, fig.12) which differs in several other respects. The apex in our specimens is furnished with a crown of eight small spines with an inflated base, and the intramarginal granules on the rest of the semicell seem to have a somewhat similar shape, although the spine is very minute. The degree of divergence of the lateral processes varies; sometimes they are almost horizontal, sometimes they diverge more than in Fig.11, A.

A form and two varieties of this species were described by the Wests from Welwitsch's collection, and another form was recorded from the Weltevreden West Pan (Fritsch, Rich 1938).

246. MICRASTERIAS TRUNCATA (CORDA) BRÉB.

- VAR. **TRUNCATA**

Illustrations. Tab.15, figs.1-3 (Claassen 1961).

Sample. RSA: 230, 258, 259, 269, 383, 386, 389.

Note. These specimens are usually slightly shorter than broad. Length 124.0-132.0 μm ; breadth 124.0-138.0 μm ; breadth of isthmus 22.5-27.0 μm ; maximum breadth of polar lobe 82.0-100.0 μm (without spines 76.0-94.0 μm) (Claassen 1961).

In (Hancock 1973) information about sampling place absent.

4.09.1987. Indicated as *Micrasterias truncata* Corda ex Bréb. (Williamson 2000).

Orange Free State (orig.).

- VAR. **AFRICANA** FRITSCH ET RICH

Illustrations. Fig.14, B and C (Fritsch, Rich 1924); Tab.15, figs.4, 5 (Claassen 1961); Pl.14, Fig.6 (Williamson 1994).

Sample. RSA: 91 (not uncommon), **92** (rather rare), **258, 269, 361** (abundant), **396**.

Note. *Differ a typo incisuris inter lobum polarem et lobos laterales superiores praeurtioribus, incisuris per totam semicellulam plerumque profundioribus, marginibus lateralibus convexioribus ita ut in aspectu varticali series plures lobulorum manifestae sunt. Lobus polaris late cuneatus, lobi laterales diverse divisi, membrana punctata. Long. cell., 125.0-158.0 μm ; lat. cell., 100.0-144.0 μm ; lat. isthm., 18.0-30.0 μm ; lat. lob. pol. ad apic., 66.0-75.0 μm ; crass., 46.0-47.0 μm .*

This form is sharply distinguished from the type as figured in Messrs. West's monograph (West, West 1905, p.82, Pl.XLII, figs.1-8). The angle formed by the incisions between the polar and upper lateral lobes with the transverse plane varies somewhat, and extreme cases show a trend in the direction of *M. rotata* (Grev.) Ralfs, which, however, differs in several other striking respects. Great diversity was noticed among the different individuals in the form of the apical margin of the polar lobe and in the degree of incision and the teething of the lateral lobes, in which respects the new variety shows a tendency parallel to that of the type (cf. G.S. West, Journ. Linn. Soc., Bot., xxvii, 1899, p.383, Pl.IX, figs.9-16; and Grönblad, Acta Soc. Fauna et Flora Fennica, xlix, 1921, No.7, p.21, Pl.I, figs.4, 5, 8, 11) (Fritsch, Rich 1924).

Polar lobe somewhat variable in shape, cuneate or with subparallel sides in the lower portion and dilated in the upper portion. Length 134.0-152.0 μm ; breadth 124.0-136.0 μm (without spines 120.0-131.0 μm); breadth of isthmus 25.5-26.0 μm ; maximum breadth of polar lobe 62.0-67.0 μm (Claassen 1961).

Length 126.0 μm ; breadth 103.0 μm ; isthmus 22.0 μm ; ratio of length to breadth 1.22. Identical to the figure in Fritsch and Rich (1924) (Williamson 1994).

In (Williamson 1994) indicated as *Micrasterias truncata* Corda ex Bréb. var. *africana* Fritsch et Rich.

- VAR. **MINOR** CLAASSEN

Illustrations. Tab.17, fig.8 (Claassen 1961).

Sample. RSA: 298.

Note. *Cellulae varietatis quam typi speciei aliquanto minores sunt. Formae intermediae haud visae.*

These specimens are considerably smaller than in the type. Lateral angles of polar lobe acuminate; cell wall punctate. Length 57.5-60.0 μm ; breadth 56.0-60.0 μm (with spines 62.0-66.0 μm); breadth of isthmus 12.5-13.0 μm ; maximum breadth of polar lobe 44.0-50.0 μm (Claassen 1961).

- VAR. **SEMI-RADIATA** (KÜTZ.) CLEVE

Illustrations. Fig.1, F (Rich 1940).

Samples. RSA: 300.

Note. *Forma.* Long. cell., 130.0-134.0 μm ; lat., 140.0 μm . The cells are usually a little wider than long. This form resembles var. *africanum* Fritsch et Rich in its deep incision on either side of the polar lobe (Rich 1940).

247. MICRASTERIAS ZEYLANICA FRITSCH

Illustrations. Fig.48 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. *Forma.* A form approaching *M. decemdentata* (Näg.) Arch. Long., 50.0 μm ; lat. without spines, 53.0 μm ; isthm., 15.0 μm ; lat. lob. pol., 42.0 μm . R. Grönblad called this plant "*M. zeylanica*" but it seems to fall midway between this and *M. decemdentata*, having 8 spines per semicell, rather than the 6 of *M.*

zeylanica or the 10 of *M. decemdentata*. The sinus openings are also intermediate. This plant closely resembles one from Uganda which R. Grönblad called *M. zeylanica* and H. Croasdale only reluctantly accepted (Grönblad, Scott and Croasdale 1964, p.16, 2: 34). Both plants might perhaps as well be classified as *M. decemdentata* var. *upsaliensis* Cleve in Lundell (1871, p.16, 1: 7) (Grönblad, Croasdale 1971).

COSMARIUM CORDA EX RALFS

248. COSMARIUM ABBREVIATUM RACIB.

- VAR. ABBREVIATUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 201, 214, 216, 217.

Note. Long. cell., 21.0 μm ; lat., 18.0-22.0 μm ; isthm., 5.0 μm ; crass., 10.0 μm ; diam. zygosp., 21.0 μm . Only one immature zygospore was observed; this was spherical and possessed a smooth membrane. The zygospore of this species has not previously been described (Fritsch, Rich 1938).

North-West Province (orig.).

- VAR. MINUS (G.S. WEST) KRIEG. ET GERL.

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

- VAR. PLANCTONICUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 201.

Note. Long. cell., 20.0 μm ; isthm., 4.0 μm . The superior angles are more rounded than in type (Fritsch, Rich 1938).

249. COSMARIUM ABNORME NORDSTEDT

- VAR. TRIQUETRUM REINSCH

Illustrations. Pl.VI, figs.5, 6 (Reinsch 1878).

Sample. RSA: 4.

Note. Longit. 0.0363 mm. Latit. 0.0278 mm. Specimina a fronte visa in dimensionibus ac in forma maxime consentiunt cum icone Nordstedtiana (Desmid. Spetsberg. et Beerens Eiland. Akad. Förhandl. Stokholm. N.6, p.32, Tab.vi, fig.15); speciminum Africanorum e vertice visorum anguli minus rotundati marginesque laterales in medio subrecti aut levissime tumidi (Reinsch 1878).

250. COSMARIUM ADOXUM W. ET G.S. WEST

- VAR. ADOXUM

- F. ADOXUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 199, 200.

Note. Forma papillis minoribus. Long. cell., 9.5-10.5 μm ; lat., 9.5-10.0 μm ; isthm., 2.5 μm (Fritsch, Rich 1938).

- F. MINOR HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids (Huber-Pestalozzi 1930).

Sample. RSA: 328 (rarely).

Note. Long., 8.1 μm ; lat., 7.8 μm (Huber-Pestalozzi 1930).

251. COSMARIUM ALATUM KIRCHN.

- VAR. *AEQUATORIENSE* NORDST. IN WITTR. & NORDST.

Illustrations. Fig.41 (West 1912).

Sample. RSA: 5.

Note. *Forma angulis basalibus semicellularum majoribus et levissime bilobulatis, lobuli superiori minori.* Long. 58.0 μm ; lat. 47.0-49.0 μm ; lat. isthm. 13.5 μm (West 1912).

252. COSMARIUM AMOENUM BRÉB.

- VAR. *AMOENUM*

Illustrations. Fig.2, A (Rich 1940).

Sample. RSA: 299, 328, 329.

Note. In sample **328**: long., 60.0 μm ; lat., 26.0-28.6 μm ; isthmus, 20.8 μm ; bubbled on the ends. In sample **329**: long., 52.0 μm ; lat., 28.6 μm ; isthmus, 20.8 μm (Huber-Pestalozzi 1930).

Long. cell., 50.0-56.0 μm ; lat., 28.0-30.0 μm ; isthm., 19.0 μm ; crass., 26.0 μm . There are about 9 vertical series of granules visible across the face of the semicell; two pyrenoids in each semicell. The sinus is variable. This is a widely distributed desmid, though not a common one (Rich 1940).

- VAR. *MEDIOLAEVE* NORDST.

Illustrations. Fig.136 (Cholnoky 1955).

Sample. RSA: 237, 238.

Note. Da diese Form, die hier ziemlich häufig ist, bisher nur selten gesehen wurde, habe ich ein Exemplar auf der Fig.136 dargestellt (Cholnoky 1955).

253. COSMARIUM ANAX W. ET G.S. WEST

- F. *CAPENSIS* HUBER-PESTALOZZI

Illustrations. Tab.8 (Huber-Pestalozzi 1930); Pl.15, Fig.2 (Williamson 1994).

Sample. RSA: 328, 329, 342, 343, 371.

Note. Long., 145.6-166.4 μm ; lat., 135.8-137.8 μm ; isthmus, 36.4-39.0 μm (Huber-Pestalozzi 1930).

Length 147.0-183.0 μm ; breadth 129.0-160.0 μm ; isthmus 43.0-50.0 μm ; ratio of length to breadth 1.1-1.27; thickness 76.0-80.0 μm .

Under good optical conditions using the o.i. objective the central pores of the specimens from sample **342** appeared to be made up of 2-3 minute pores. Between all the larger pores over the complete cell surface is a much fainter scattering of punctae (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium anax* W. et G.S. West var. *capense* Huber-Pestalozzi.

254. COSMARIUM ANCEPS LUND.

- VAR. *ANCEPS*

- F. *CRISPULUM* NORDST.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 223.

Note. In soils of Mpumalanga (orig.).

- VAR. *MINUMUM* GUTW.

Illustrations. Pl.14, Fig.3 (Williamson 1994).

Sample. RSA: 336.

Note. Length 17.5 μm ; breadth 11.2 μm ; isthmus 7.0 μm ; ratio of length to breadth 1.5 (Williamson 1994).

255. COSMARIUM ANGULOSUM BRÉB.

- VAR. ANGULOSUM

Illustrations. Fig.85 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 14.0 μm ; lat., 10.0 μm ; isthm., 3.0 μm (Grönblad, Croasdale 1971).

- VAR. CONCINNUM (RABENH.) W. ET G.S. WEST

Illustrations. Fig.10, *D, E* (Hodgetts 1926).

Samples. RSA: 122 (very rare, see note), **124** (very rare), **164** (very rare).

Note. *Forma angulis superioribus retusis.* Long. cell., 12.0 μm ; lat., 10.6-11.0 μm ; lat. isthm., 4.0 μm . μ This resembles the form figured by Borge (Algenfl. des Tåkernsees, 1921, p.18, t.1, fig.14), and also by Printz (Chloroph. Norwegen, 1915, p.26, t.3, figs.56, 57).

The following is another form which occurred in sample **122**: - *Forma apicibus in medio leviter retusis* (Fig.10, *E*). Long. cell., 12.0 μm ; lat., 10.0 μm ; lat. isthm., 3.5 μm . It differs from the typical var. *concinnum* only in the truncate apex, being slightly retuse in the middle (Hodgetts 1926).

Long., 13.0-14.0 μm ; lat., 11.0 μm ; ist., 3.0 μm (Fritsch, Rich 1930).

256. COSMARIUM ASKENASYI SCHMIDLE

Illustrations. Figs.62, 139 (Grönblad, Croasdale 1971); Pl.14, Fig.2 (Williamson 1994).

Samples. NAM: 307.

Note. *Forma.* A large form. Long., 186.0 μm ; lat., 148.0 μm (1.25x); isthm., 58.0 μm (Grönblad, Croasdale 1971).

Forma. Length 100.0-107.0 μm ; breadth 80.0-87.0 μm ; isthmus 35.0 μm ; ratio of length to breadth 1.25; thickness 57.0 μm . Intermediate in size between the species and the f. *minus* Vinyard. The dimensions and somewhat compressed semicells probably place it near to the var. *americana* Carter 1935 (Williamson 1994).

In (Williamson 1994) was not pointed sampling place.

In Swaziland streams (orig.).

257. COSMARIUM ASPERULUM REINSCH

Illustrations. Pl.VI, fig.9 (Reinsch 1878).

Sample. RSA: 4.

Note. *C. e minoribus, diametro transversali $\frac{3}{5}$ diametri longitudinalis, semicellulis subtrapezicis, nucleo amylaceo singulo, marginibus lateralibus obtusangule subincisis, margine terminali subrecto, lobulis basalibus rotundatis introrsum se adtingentibus, extrorsum aculeolis brevioribus (sicut margine terminali) armatis.* Longit. 0.0224 mm, latit. 0.0116 mm.

Cum Cosmario protumido Nordstedt (Desmid. Spetsberg. et Beerens Eiland, p.34, tab.vii, fig.18), in forma semicellularum aliqua similitudine consentit, ad contra margine terminali undato-inciso aculeolis marginum lobulorum crassioribus subregulariter positis (Reinsch 1877).

258. COSMARIUM ASYMMETRICUM RICH

Illustrations. Pl.16, Fig.3 (Williamson 1994).

Sample. RSA: 200 (rare), **299, 300, 374.**

Note. Long. cell. 18.0 μm ; lat., 16.0 μm (Fritsch, Rich 1938).

Long. cell., 19.0-22.0 μm ; lat., 16.0-20.0 μm ; isthm., 4-5 μm . A little larger than the specimens found in Southern Rhodesia (Rich F., 1935, Contributions to our Knowledge of the Freshwater Algae of Africa. 11. Algae from a Pan in Southern Rhodesia. *Trans. Roy. Soc. S. Africa*, **23** (Pt.II): 107-160), but very similar indeed to those in Belfast Pan (Fritsch, Rich 1938) (Rich 1940).

Length (max.) 18.0-22.0 μm ; breadth 16.0-19.5 μm ; isthmus 5.0-6.0 μm ; thickness 9.5-11.0 μm . These specimens have a close resemblance to *C. dolabriforme* Brandham (1967) except that in vertical view a small protrusion is visible on each side. When viewed laterally from both sides the pairs of semicells present a different appearance (Williamson 1994).

259. COSMARIUM BARBARICUM CLAASSEN

Illustrations. Tab.26, fig.16 (Claassen 1961).

Sample. RSA: 258.

Note. *Affinis C. entochondro* W. et G.S. West, *sed membrana cellulae glabra, sinu undulato et marginibus lateralibus magis undulatis facile distinguenda.*

Near *C. entochondrum* W. et G.S. West (West, West 1908, p.193, Pl.LXXXVII, fig.17); but the sides have more undulations, the sinus is undulate and cell wall is smooth. Cells small, about as long as broad, deeply constricted, sinus narrow and slightly crenate; semicells semicircular, apex truncate, basal angles furnished with a spine, sides convex and with 3-5 undulations, apical margin smooth. Chloroplasts axile, each with two pyrenoids. Length 20.0-28.0 μm ; breadth 19.0-28.0 μm ; breadth of isthmus 9.0-9.5 μm ; breadth of apex 10.0-14.0 μm (Claassen 1961).

260. COSMARIUM BEATUM W. ET G.S. WEST

Illustrations. Fig.91, 92 (Grönblad, Croasdale 1971); Pl.14, Fig1 (Williamson 1994).

Samples. RSA: 376. - NAM: 305.

Note. *Forma.* Long., 36.0 μm ; lat., 34.0 μm ; isthm., 11.0-14.0 μm ; crass. including protuberances 16.0 μm . A little larger and relatively broader than West's species (1895, p.60, 7: 8), with a single median truncate protuberance, and a larger verruca at each basal angle (Grönblad, Croasdale 1971).

Length 31.0-32.0 μm ; breadth 31.0 μm ; isthmus 10.0 μm ; ratio of length to breadth ca. 1.0. Has an affinity with *C. monomazum* var. *polymazym* although the sinus and shape of semicells are different (Williamson 1994).

261. COSMARIUM BELLUM W. ET G.S. WEST

Illustrations. Fig.1 (Coesel, van Geest 2009).

Samples. BOT: 408, 409.

Note. *Cosmarium bellum* belongs to a group of *Cosmaria* characterized by a series of broad, emarginate, flattened warts at the cell outline. It is affiliated with *C. monomazum* P. Lundell, *C. submonomazum* F. Rich, *C. beatum* W. et G.S. West and *C. eximium* W. et G.S. West. In particular *C. bellum*, *C. beatum* and *C. eximium*, all three described by West & West (1895) from Madagascar, seem to be closely related but, judging from Bourrelly & Couté (1991), also transitional forms to *C. monomazum* can be encountered.

C. bellum, in its characteristic form, is marked by a huge supraisthmial inflation rendering the semicell in apical view a rhomboid outline. Cell wall sculpturing at the inflation is in the form of a big, sharply bordered, circular

protuberance with on either side a much smaller wart-like elevation. Our Okavango material well agrees with the original description in West & West (1895). The cell sinus may be linear and closed for the greater part, but usually it is already narrowly open at the apex to open widely towards the extremity.

As far as could be traced, after the original description by West & West (1895), the only other record of *C. bellum* is by Bourrelly & Couté (1991) referring to a slightly different, larger form, also from Madagascar. In the Okavango Delta we found it regularly in samples **408** and **409** (Coesel, van Geest 2009).

262. COSMARIUM BEWSII FRITSCH ET RICH

Illustrations. Fig.15 (Fritsch, Rich 1924).

Sample. RSA: 91 (rare).

Note. *C. mediocre, circiter 1.5 plo longius quam latum, profunde constrictum, sinu angusto-lineari introrsum leviter dilatato, membrana crassa. Semicellulae ovato-pyramidatae e basi lata, angulis basalibus subrectangularibus, lateribus convexis tuberculis rotundatis 3-4 supra basim (ubi membrana praecipue incrassata est) et ulterius undulationibus exiguis paucis, apice subtruncato, angulis apicalibus rotundatis; intra apicem tuberculis rotundatis solidis vel leviter cavis in seriebus 2-3 transversis, et intra marginem lateralem tuberculis similibus in serie inica (?). Tota superficies semi cellulae granulis (poris ?) parvis rotundatis aequidistantibus munita. A vertice et a latere non visae. Chromatophorae axillares pyrenoidibus duabus in quaque semicellula. Long. cell., 59.0-60.0 µm; lat. cell., 40.0-45.0 µm; lat. isthm., 13.0 µm.*

We have describes this as a new species, in spite of not having seen either end- or side-views, since it is unlike any *Cosmarium* that has hitherto become known. The tubercles, which are solid or slightly hollow rounded projections of the thick cell-wall, show a peculiar and very characteristic disposition. The only species with which this one might be compared is *C. askenasyi* Schmidle (Hedwigia, xxxiv, 1895, p.304, Tab.IV, fig.7), which, however, shows many points of difference (Fritsch, Rich 1924).

263. COSMARIUM BINUM NORDST.

Illustrations. Fig.101 (type), Fig. 102 (*forma*) (Grönblad, Croasdale 1971); Pl.15, Fig.5 (Williamson 1994).

Sample. RSA: 90 (rather rare), **91** (rather rare), **185, 186, 192, 212, 214, 219, 244, 245, 248, 253, 254, 255, 257, 262, 265, 271, 272, 274, 275, 276, 277, 278, 279, 280, 282, 283, 289, 290, 296, 299, 300, 332, 336, 352.** – **NAM: 305** (*forma*), **307.** – **SWA: 377.**

Note. *Long. cell., 60.0-66.0 µm; lat. cell., 42.0-48.0 µm; lat. isthm., 13.0-15.0 µm; crass., 30.0-33.0 µm.*

Whilst the shape of the front- and end-views quite agreed with those of *C. binum*, the granulation of the central region of the semicells was not quite typical. The median tumour bore vertical rows of rather small granules, thus resembling more that of *C. subspeciosum* Nordst. var. *validius* than that of *C. binum*; moreover, the series of rounded granules above the isthmus was not always clearly recognizable, though quite distinct in some specimens (**cf.** the form described and figured by Borge, Arkiv. f. Bot., xv, No.13, 1918, p.38, Tab.III, fig.19). It is obvious that, in discriminating between *C. binum* and the forms of *C. subspeciosum*, the shape of the front-view must play as important a role as the nature of the central tumour (Fritsch, Rich 1924).

Long. cell., 54.0-64.0 μm ; lat., 40.0-48.0 μm ; isthm., 15.0-16.0 μm ; crass., 29.0 μm . In most individuals there was a single series of rounded granules just beneath the central tumour, in others there was a double series (Rich 1940).

Some specimens with two horizontal series of granules below the conspicuous tumour immediately adjacent to the isthmus (Claassen 1961).

Long., 52.0 μm ; lat., 39.0 μm (1.33x); isthm., 15.0 μm (Grönblad, Croasdale 1971).

Forma. Long., 73.0 μm ; lat., 53.0 μm (1.37x); isthm., 20.0 μm . Differs in having the vertical ridges smooth, also shown by Compère (1967, p.218, fig.172) from Lake Chad, Africa, and in having the cell relatively long, also shown by Lind (1967, p.373, 4: 4, 4a) from East Africa (Grönblad, Croasdale 1971).

Length 57.0-70.0 μm ; breadth 43.0-50.0 μm ; isthmus 15.5-19.5 μm ; ratio of length to breadth 1.2-1.4 (Williamson 1994).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal, Swaziland (orig.).

264. COSMARIUM BIOCULATUM BRÉB.

- VAR. BIOCULATUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. *Forma minor* (Huber-Pestalozzi 1930).

- VAR. HIANUS W. ET G.S. WEST

Illustrations. Pl.15, Fig.4 (Williamson 1994).

Sample. RSA: 121, 130 (very rare), **188** (July, September, November), **207, 212, 349.** – **NAM: 302.**

Note. *Forma*. This form differs from var. *hians* in possessing a lateral inflation in end-view. Cell-wall distinctly punctate, apices slightly retuse. Very few individuals seen. Long., 11.0-12.0 μm ; lat., 12.0-13.0 μm (Rich 1932).

Forma. Found to be present only from July to September, and then it was very rare (Schuurman 1932). Mistake in name of variety, in article (Schuurman 1932) indicated as *Cosmarium bioculatum* Bréb. var. *bians* W. et G.S. West.

The pores (or very minute granules) were arranged obliquely across the semicell, the rows showing convergence towards the apices (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium bioculatum* Bréb. in Ralfs 1848 var. *hians* W. et G.S. West.

265. COSMARIUM BIPUNCTATUM BÖRG.

Illustrations. Fig.137 (Cholnoky 1955).

Sample. RSA: 233.

Note. On Fig.137 are rarely observed shape (Cholnoky 1955).

266. COSMARIUM BIREME NORDSTEDT

- VAR. BIREME

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 200.

Note. Long. cell., 12.0 μm ; lat., 10.0 μm ; isthm., 2.5 μm (Fritsch, Rich 1938).

- VAR. CRASSUM W. ET G.S. WEST

Illustrations. Fig. 39 (West 1912).

Sample. RSA: 6, 200.

Note. *Forma papilla centrali semicellularum minori.* Long. 20.0-21.5 μm ; lat. 16.0-18.0 μm ; lat. isthm. 4.8-5.5 μm ; crass. 13.0 μm (West 1912).

Forma marginibus lateralibus inferioribus divergentibus, iis superioribus convergentibus, latitudine maxima semicellulae in media parte. Long. cell., 14.0-16.0 μm ; lat., 14.0 μm ; isthm., 3.5-4.5 μm . Cf. var. *crassum* forma G.S. West ("Freshwater Algae, Percy Sladen Memorial Expedit.", Ann. S. Afr. Mus., ix, 1912, p.85, fig.39).

The lower parts of the sides diverge, but upper parts converge to about the same degree, the greatest width of the semicell being at the middle. The end- and side-views show the papillae characteristic of the type. The dimensions are a little greater than those given by the Wests for the type (West, West 1908, p.77, Pl.LXXI, fig.37) (Fritsch, Rich 1938).

267. COSMARIUM BLYTHI WILLE

Illustrations. Fig.7, J (Rich 1932).

Sample. RSA: 145, 146 (common), **153** (rare), **159** (rather common), **164** (rather rare), **168** (rather common), **172** (rare), **192, 198, 200, 201, 299.** – **NAM: 302, 305.**

Note. *Forma papilla centrali semicellularum minori.* Long. 20-21.5 μm ; lat. 16.0-18.0 μm ; lat. isthm. 4.8-5.5 μm ; crass. 13.0 μm (West 1912).

Dimensions of the cells in studied samples: **146** (long., 19.0-21.0 μm ; lat., 14.0-17.0 μm ; ist., 5.0-6.0 μm ; crass., 11.0 μm), **153** (18.0x15.0 μm ; crass., 10.0 μm), **159** (*forma crenis marginalibus 2 plus minus emarginatis vel truncatis*; long., 20.0-21.0 μm ; lat., 16.0-17.5 μm ; ist., 3.5 μm ; crass., 10.0 μm), **168** (long., 19.0-20.0 μm ; lat., 16.0-19.0 μm ; ist., 6.0-7.0 μm ; crass., 12.0-13.0 μm) (Fritsch, Rich 1930).

Forma. A form intermediate between that of Lütkemüller from Central China (1900) and var. *novae-sylvae* W. et G.S. West. The central nodule bears six granules surrounding a central one, as in Lütkemüller's form, but there is only one row of granules round the semicell as in var. *novae-sylvae*. Long., 20.0 μm ; lat., 17.0-18.0 μm ; ist., 4.0-5.0 μm (Rich 1932).

Long. cell., 12.0-16.0 μm ; lat., 13.0-15.0 μm ; isthm., 4.0 μm . Apex truncate, or with 4 faint undulations; upper part of sides retuse, the lower and longer part convex with three crenations. The side- and end-views show a median papilla (Fritsch, Rich 1938).

Long. cell., 16.0 μm ; lat., 14.0 μm (Rich 1940).

268. COSMARIUM BOECKII WILLE

- VAR. BOECKII

- F. BOECKII

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 89, 97, 98, 103 (rare).

Note. Long. cell., 24.0-30.0 μm ; lat. cell., 21.0-27.0 μm ; lat. isthm., 8.0 μm . In the view of our having seen no empty specimens this determination is a little uncertain (Fritsch, Rich 1924).

- F. MINOR HODGETTS

Illustrations. Fig.11, C, D (Hodgetts 1926).

Sample. RSA: 112, 113.

Note. Long. cell., 19.0-20.6 μm ; lat. cell., 16.0-17.5 μm ; lat. isthm., 4.7-5.5 μm . Diam. zygosp. sine spin., 24.0 μm ; diam. zygosp. cum spin., 43.0-44.0 μm .

The granules of the central tumour were rather variable. A frequent arrangement, however, was that shown in Fig.11, C, two granules being placed transversely just above the isthmus, and above these a circle of six granules round a central one. Some of these granules of the central tumour were often duplicated. The individuals were always decidedly smaller than the dimensions given by W. and G.S. West (West, West 1908, p.234, t.86, figs.26-32), but the semicells had the incised crenate margins and the undulate-nodulose apex characteristic of the species. In sample **112**, zygospores of the desmid, often with the four empty semicells attached, were not uncommon. There appears to be no previous record of the zygospore of *C. boeckii*. They were globose, black in color, and furnished with long spines, the latter arising from low mammillate projections, and forked at the ends, each branch of the fork usually again dividing at the tip into two very short branches, as shown in Fig.11, D (Hodgetts 1926).

269. COSMARIUM BOTESII CLAASSEN

Illustrations. Tab.27, figs.3, 4 (Claassen 1961).

Sample. RSA: 258, 259.

Note. *Affinis C. praemorso* Bréb., *sed et dispositione granularum omnino dissimili et membrana cellulae leviter undulata differt.*

This species differs from *C. praemorsum* Bréb. (West, West 1908, p.196, Pl.LXXXIV, figs.1-5) in the cell wall sculpture and in having slightly undulate margins. Cells of medium size, about 1.1-1.3 times as long as broad, deeply constricted, sinus narrowly linear; semicells semicircular, apex truncate, sides with 3-6 distinct and a number of obscure undulations, apical margin smooth or with about 3-4 undulations. Cell wall minutely punctate and with a number of large scattered granules in the upper part of the semicell. Each chloroplast contains two pyrenoids. Length 46.0-49.0 μm ; breadth 39.0-41.0 μm ; breadth of isthmus 11.0-12.5 μm . Named after Mr. P.W. Botes of Moddernek, Nylstroom (Claassen 1961).

270. COSMARIUM BOTRYTIS MENEGHINI

- VAR. **BOTRYTIS**

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 6, 22, 34, 36, 38 (here in part approaching var. *depressum* W. et G.S. West), **41, 69** (very rare), **228, 238.**

Note. *Long.*, 62.0-73.0 μm ; *lat.*, 55.0-63.0 μm ; *lat. isthm.*, 17.0-18.0 μm (Fritsch 1918).

Long. cell., 63.0-68.0 μm ; *lat.*, 57.0 μm ; *lat. isthm.*, 18.0-21.0 μm (Fritsch, Stephens 1921).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

- VAR. **DEPRESSUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 5, 132, 153, 155, 156, 157, 162, 163, 164 (common).

Note. *Long cell.*, 51.0-66.0 μm ; *lat.*, 45.0-59.0 μm ; *ist.*, 13.0-16.0 μm ; *crass.*, 21.0-22.0 μm . A large majority of the individuals seen quite agreed with Messrs. West's figures (West, West 1912, p.7, Pl.XCVII, fig.6) in general outline, but many were proportionally rather longer than broad. The side-view was quite circular; in end-view a very faint median protuberance was evident in some specimens, but not in all. Messrs. West (West, West 1912, p.7) suggest that *C. hyacinthi* Gutwinski (Sprawozd. kom. fiz. Ak. Umiej. Krakowie, ześz ii, xxvii,

1892, p.70, Tab.II, fig.30) is closely related to this variety, although it is very much smaller. *C. hyacinthi* has a median protuberance in end-view, but it is more marked than any seen in our specimens (Fritsch, Rich 1930).

- VAR. **TUMIDUM** WOLLE (SYN.: *COSMARIUM SUBBOTRYTIS* SCHMIDLE)

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 36, 37, 39.

Note. *Long.*, 63.0-72.0 μm ; *lat.*, 54.0-60.0 μm ; *lat. isthm.*, 15.0-16.0 μm (Fritsch 1918).

- VAR. **PEGLERI** F.E. FRITSCH

Illustrations. Fig17 (Fritsch, Stephens 1921).

Sample. RSA: 74 (rare).

Note. *Cellulis granulis majoribus frequentioribus, apicibus evidenter truncatis vel etiam retusis, a vertice visis polis subdeplaatis, a latere visis marginibus lateralibus minus convexis.* *Long.*, 85.0-96.0 μm ; *lat.*, 66.0-72.0 μm ; *lat. isthm.*, 18.0-21.0 μm ; *crass.*, 41.0-42.0 μm .

This variety is distinguished by the possession of larger and more numerous granules, by the truncate or even retuse apex, by the flattening of the poles in end-view, and the shape of the semicell in side-view. It approaches somewhat to var. *emarginatum* Hansgirg (Prodr. Algenfl. Boehmen, I, 1888, p.199, fig.116), in which, however, the apex is much narrower. There is also some resemblance to *C. deltoideum* Delp., although end- and side-views markedly different (Fritsch, Stephens 1921).

271. COSMARIUM BREBISSONII MENEGH.

Illustrations. Absent in literature on Southern African desmids

Sample. RSA: 328.

Note. *Forma.* *Long.*, 72.8 μm ; *lat.*, 57.2 μm ; *isthmus*, 15.6 μm (Huber-Pestalozzi 1930).

272. COSMARIUM CAFFRORUM CLAASSEN

Illustrations. Tab.25, figs.7, 8 (Claassen 1961).

Sample. RSA: 258.

Note. *Affinis C. subundulato* Wille, *sed semicellulis paulo applanatis, membranibus lateralibus solum undulatis, ore sinus denticulato, distinguitur.*

This comes near *C. subundulatum* Wille (West, West 1905, p.151, Pl.LIX, figs.13-15); but the semicells are slightly flattened, only the lateral margins are undulate and there is a small spine at each basal angle. Cells small, 1.2-1.3 times longer than broad, deeply constricted, sinus narrow, linear or slightly undulate; semicells truncate-pyramidate, basal angles furnished with a spine, sides convex with 3-4 undulations. Cell wall slightly thickened at the apex; chloroplasts axile, with two pyrenoids each. Length 33.0-42.5 μm ; breadth 26.0-33.0 μm ; breadth of isthmus 8.5-10.5 μm (Claassen 1961).

273. COSMARIUM CALCAREUM WITTR.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 70, 71, 73, 322.

Note. *Long. cell.*, 24.0 μm ; *lat. cell.*, 18.0-20.0 μm ; *lat. isthm.*, 6.0 μm (Fritsch, Stephens 1921).

274. COSMARIUM CAPENSE (NORDST.) DE TONI

- VAR. **CAPENSE** (= *COSMARIUM PYRAMIDATUM* BRÉB. SUBSP. *CAPENSE* NORDSTEDT)

- F. **CAPENSE**

Illustrations. Pl.15, Fig.1 (Williamson 1994); Pl.4, 8', 8" (Williamson 2000).

Samples. RSA: 67, 68, 74, 341, 343, 366, 390, 392.

Note. *Long cell.*, 90.0-117.0 μm ; *lat. cell.*, 69.0-84.0 μm ; *lat. isthm.*, 20.0-24.0 μm ; *crass.*, 60.0 μm . In all cases the specimens were quite typical, the basal angles in front view being broadly rounded, the end-view broadly elliptical, and the membrane strongly punctate. This species has been recorded from the Cape by Nordstedt (Fritsch, Stephens 1921).

In (Fritsch, Stephens 1921) indicated as *Cosmarium capense* De Toni.

Length 92.0-102.0 μm ; breadth 66.0-71.0 μm ; isthmus 20.0-24.0 μm ; ratio of length to breadth 1.4; thickness 49.0 μm (Williamson 1994).

Western Cape (orig.).

- F. **MINOR** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 112.

Note. *Long cell.*, 54.0-66.0 μm ; *lat. cell.*, 35.0-45.0 μm ; *lat. isthm.*, 14.0-16.0 μm . Two small forms of *C. capense* have been described, namely (1) the above forma *minor* W. et G.S. West ("*long.*, 64.0 μm ; *lat.*, 46.0 μm ; *lat. isthm.*, 16.0 μm "), and (2) a var. *minor* Fritsch (Ann. of the S. Afr. Mus., ix, pt.7, 1918, p.550, fig.26), the size of the latter being given as *long.*, 45.0-54.0 μm ; *lat.*, 33.0-36.0 μm ; *lat. isthm.*, 11.0-12.0 μm .

The dimensions of the present individuals tend to lie between these two forms, although including the size given by W. and G.S. West for their "forma *minor*". A few individuals were seen which might be placed in the var. *minor* Fritsch, except that they had a rather wider isthmus. It is obvious, therefore, that the forma *minor* W. et G.S. West, and the var. *minor* Fritsch merge into each other, and should be considered as a single variety of *C. capense*. The present form had the characteristic shape of the var. *minor* Fritsch, the semicells in side view having almost parallel sides, while the end view was elliptic. The cell-wall was densely scrobiculate-punctate (Hodgetts 1926).

In (Hodgetts 1926) indicated as *Cosmarium capense* De Toni. f. *minor* W. et G.S. West.

- VAR. **MINOR** FRITSCH

Illustrations. Fig.26 (Fritsch 1918).

Samples. RSA: 18, 24, 25, 31, 91 (very rare).

Note. *Long.*, 45.0-54.0 μm ; *lat.*, 33.0-36.0 μm ; *lat. isthm.*, 11.0-12.0 μm ; *crass.*, 24.0-27.0 μm . *Semicellulae a vertice visae ellipticae, axis major ca. Triplo longior quam axis minor; a latere visae elliptico-oblongae, lateribus fere parallelis, polis leviter rotundatis.*

This species is evidently of common occurrence in the Cape Peninsula. The characteristic features are the rounded basal angles, the convex sides which gradually converge more and more markedly from the base to the apex, and the slightly flattened and retuse apex. There are two pyrenoids in each semicell. The flattened apex varies considerably in width and the retuse character is sometimes more sometimes less pronounced.

The specimens are appreciably smaller than those originally described by Nordstedt (De Alg. nonnul., praecipue Desm., etc., Act. Univ. Lund., xvi, 1880, p.6, Tab.I, fig.8), although Messrs. West (On some Desm. of the United States,

Journ. Linn. Sc., Bot., xxxiii, 1897, p.301, Pl.XVII, fig.3) have already recorded a forma *minor*, whose dimensions approximate more closely to those of the specimens found in the present collections. The most important differences as compared with Nordstedt's specimens, however, lie in the shape of the side- and end-views. The end-view is narrower and more elongated ellipse, whose ends are not so markedly rounded, whilst in side-view the almost parallel sides of the semicells are noteworthy. In the latter respect our specimens are like a form described by Borge (Ueb. trop. u. subtrop. Suesswasser-chlorophyc., Bih. K. Sv. Vet.-Ak. Handl., xxiv, Afd. Iii, No.12, p.22, Tab.II, fig.50), which is, however, considerably larger and has an end-view like that of Nordstedt's specimens. Borge's form has a punctate membrane, and in this connection it may be mentioned that the individuals in the present samples in some cases had a very obscurely punctate membrane, although generally nothing of the kind could be discerned (Fritsch 1918).

Forma ad var. minor Fritsch valde accedens, sed marginibus lateralibus vel in aspectu frontali vel in aspectu laterali plus rotundatis. Long. cell., 35.0-39.0 µm; lat. cell., 27.0 µm; lat. isthm., 7.0 µm.

Also see notes of Hodgetts (1926) for *C. capense* De Toni f. *minor* W. et G.S. West.

- VAR. NYASSAE SCHMIDLE

Illustrations. Fig.60 (type), Fig.61 (*forma*) (Grönblad, Croasdale 1971).

Samples. NAM: 302 (*forma*), **304**.

Note. Long., 160.0 µm; lat., 122.0 µm (1.3x); isthm., circa 45.0 µm. Our form differs from Schmidle's original (1902, p.70, 2: 1) only in greater roundness of its semicells and very slight apical depression (Grönblad, Croasdale 1971).

Forma. Long., 163.0 µm; lat., 142.0 µm (1.14x); isthm., 50.0 µm. Differing in many scattered pyrenoids. R. Grönblad describes the chloroplasts as "4 parietal plates" (Grönblad, Croasdale 1971).

In (Grönblad, Croasdale 1971) indicated as *Cosmarium capense* De Toni var. *nyassae* Schmidle.

275. COSMARIUM CAPITULUM ROY ET BISS.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (common).

Note. The thickness here (12.0 µm) is a little greater than in the type, but the other dimensions agree (Rich 1932).

276. COSMARIUM CISKEIUM WILLIAMSON

Illustrations. Pl.16, Fig.5 (Williamson 1994).

Samples. RSA: 376 (abundant).

Note. The cells are of medium size, 1.1-1.23 times longer than broad and deeply constricted, the inner part of the sinus closed with a slight inflation, the outer part opening widely and acutely. The semicells are elliptical, the lateral margins convex with large rounded granules. Immediately below the apices there is a large emarginate crenation. The apices are somewhat variable but seem always to be slightly truncate and usually 4-crenate, the two outer crenations being larger than the inner. Length 62.0-66.0 µm; breadth 53.0-57.0 µm; crass. 35.0-38.0 µm.

The side view of the semicell is ovate, the base being swollen with about 5 rounded granules standing out at the margin. The vertical view is elliptic with broadly rounded granulate poles and a 5 granulate tumour on each side.

Cell wall with a prominent central tumour bearing a ring of about 12 granules surrounding an inner arrangement of 4-6. Within the margins there are 3-4 series of granules, often paired, with a noticeably clear space between them and the central tumour. Chloroplasts axile with 2 pyrenoids in each semicell. Zygospores were not seen (Williamson 1994).

277. COSMARIUM CLAASSENII LEVANETS, NOM. NOV. (BASIONYM: *COSMARIUM TRANSVAALENSE* CLAASSEN 1961, BOTHALIA 7, P.597, TAB.25, FIG.11; NON *COSMARIUM TRANSVAALENSE* FRITSCH ET RICH 1938, PP.198-199, FIG.13, F-H)

Illustrations. Tab.25, fig.11 (Claassen 1961).

Samples. RSA: 259.

Note. *Affinis C. trachypleuro* Lund., *sed semicellulis minus applantis, margine apicali spinis munito, ore sinus spinoso, et omni spinarum dispositione valde distincta.*

This species is near *C. trachypleurum* Lund. (West, West 1908, p.172, Pl.LXXXI, figs.2, 3); but the semicells are less flattened, there are spines on the apical margin, there is a spine at each basal angle, and the cell wall sculpture is different. Cells of medium size, about 1.1-1.3 times longer than broad, deeply constricted, sinus narrowly linear; semicells semicircular, apex somewhat flattened. Cell wall punctate and furnished with a number of irregularly disposed spines. Length 48.0-50.5 μm ; breadth 36.0-37.5 μm ; breadth of isthmus 15.0-16.0 μm (Claassen 1961).

278. COSMARIUM CLEPSYDRA NORDST

- VAR. **BICARDIA** (REINSCH) CROASD.

Illustrations. Pl.15, Fig.3 (Williamson 1994).

Samples. RSA: 343.

Note. Length 19.2 μm ; breadth 17.7 μm ; isthmus 5.4 μm ; ratio of length to breadth 1.08; thickness 10.7 μm (Williamson 1994).

279. COSMARIUM CONNATUM BRÉB.

- VAR. **CONNATUM**

Illustrations. Fig.13, E (Fritsch, Rich 1938); Fig.83 (Grönblad, Croasdale 1971); Pl.16, Fig.1 (Williamson 1994).

Samples. RSA: 198, 201, 214, 217, 295, 328, 329, 336, 382, 386, 388.

- **NAM: 305.**

Note. Long., 65.0 μm ; lat., 52.0 μm ; isthmus, 39.0 μm (Huber-Pestalozzi 1930).

Forma cellulis a fronte visis constrictione vadosa, forma Krieger ("Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiologie, Suppl. Bd.xi, 1932, Tab.VIII, figs.14, 15), *proxime accessit*. Long. cell., 90.0-94.0 μm ; lat., 70.0 μm ; isthm., 68.0 μm .

The cells are very slightly constricted, and have a faintly flattened apex. The cell-wall is finely scrobiculate, and densely but minutely punctate between the scrobiculations. There is some resemblance to *C. alpestre* Roy et Biss., which differs in the proportion of length to breadth, and in the markings on the cell-wall (Fritsch, Rich 1938).

Long., 70.0 μm ; lat., 54.0 μm (1.3x); isthm., 42.0 μm . "In vertical view oval" (R. Grönblad). It is regrettable that the chloroplast and wall detail are not shown, but this is R. Grönblad's determination, and seems correct (Grönblad, Croasdale 1971).

Length 67.0-69.0 μm ; breadth 52.0-55.0 μm ; isthmus 42.0-43.0 μm ; ratio of length to breadth 1.2-1.3 (Williamson 1994).

Indicated as *C. connatum* Bréb. in Ralfs (Williamson 2000).

- VAR. **AFRICANUM** FRITSCH ET RICH

Illustrations. Fig.12, J, K (Fritsch, Rich 1938).

Samples. RSA: 198, 201, 200, 203.

Note. *Differt a typo constrictione plus profunda, semicellulis hemisphericis, latitudine maxima prope partem basalem, serie granulorum majorum supra isthmum utrobique.* Long. cell., 84.0-98.0 μm ; lat., 63.0-74.0 μm ; isthm., 47.0-53.0 μm .

This variety differs in the rather deeper constriction (which resembles that of var. *truncatum* West), in the shape of the semicells, and in the row of large granules (tubercles) above the isthmus in each semicell. It is somewhat similar to a form described by Borge ("Die Algen der erstern Regnellschen Expedition: II. Desmidiaceen," Arkiv för Bot., 1, 1903, p.93) from Brazil (Fritsch, Rich 1938).

- VAR. **DEPRESSUM** IRÉNÉE-MARIE

Illustrations. Figs.84, 144 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. Long., 41.0 μm ; lat., 34.0 μm (1.2x); isthm., 25.0 μm . Cells much smaller, with truncate apex. Our form is smaller even than Irénée-Marie's (1956, p.90, I: 9) which is given as 50.0-52.0 μm x 44.0-45.0 μm , isthm. 26.0-26.5 μm . R. Grönblad called this "*C. connatum* f. cf. var. *skujae* var. *rotundatum*" (Grönblad, Croasdale 1971).

- VAR. **SUBELLIPTICUM** CLAASSEN

Illustrations. Tab.27, fig.8 (Claassen 1961).

Sample. RSA: 258.

Note. *Affinis C. connato var. truncato West, sed semicellulis plus deplanatis et sinu aliquanto profundiore differt.*

This is closely allied to *C. connatum* var. *truncatum* West (West, West 1908, p.26, Pl.LXVII, fig.18); but differs in the character of the sinus and in having more flattened semicells. Cells of medium size, about 1.3-1.4 times as long as broad, deeply constricted, sinus widely open; semicells subelliptic with a flattened apex. Cell wall smooth and colorless and thickened at the apices. Chloroplasts with two pyrenoids each. Length 48.0-49.5 μm ; breadth 37.0-40.0 μm ; breadth of isthmus 14.0-17.0 μm ; breadth of apex 14.0-17.0 μm (Claassen 1961).

280. COSMARIUM CONSPERSUM RALFS

- VAR. **CAPENSE** HODGETTS

Illustrations. Fig.12, A (Hodgetts 1926).

Samples. RSA: 124 (very rare), **125** (very rare), **126** (very rare), **127** (very rare).

Note. *Var. cellulis diametro 1/4 plo longioribus; semicellulis lateribus fere rectis leviterque divergentibus, aut leviter convexis, angulis superioribus valde rotundatis, apicibus rotundatis.* Long. cell., 70.0-76.0 μm ; lat., 41.5-44.0 μm ; lat. isthm., 18.0-22.5 μm .

The variety usually had semicells with almost straight sides, usually slightly divergent, as in the typical form of *C. conspersum*. The apical part of the semicell, however, was strongly rounded, somewhat as in *C. conspersum* var. *subrotundatum* W. West ("Alg. W. Ireland," Journ. Linn. Soc. Bot., 1892, xxix, p.152, t.21, fig.7). There were fifteen vertical series of granules visible in the from view. The vertical view was elliptic, as in the type (Hodgetts 1926).

- VAR. **LATUM** (BRÉB.) WEST ET WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

281. COSMARIUM CONSTRICTUM DELPONTE

Illustrations. Fig.16, B (Fritsch, Rich 1924).

Sample. RSA: 91, 99 (rare), 430.

Note. *Forma minor.* Long. cell., 17.0-22.0 μm ; lat. cell., 12.0-15.0 μm ; lat. isthm., 5.0-6.0 μm ; isthmo minus aperto. This small *Cosmarium* is probably best regarded as a form of Delponte's species. Probably *C. inane* Turner (K. Sv. Vet. Akad. Handl., xxv, No.5, 1892, p.57, Tab.VIII, fig.41) also belongs to this species (Fritsch, Rich 1924).

282. COSMARIUM CONTRACTUM KIRCHN.

- VAR. **CONTRACTUM**

- F. **CONTRACTUM**

Illustrations. Fig.66 (Grönblad, Croasdale 1971).

Samples. RSA: 6, 200 (forma 1), 258. – NAM: 307.

Note. *Forma membrana cellularum valde et densissime punctata.* Long. 29.0 μm ; lat. 23.0 μm ; lat. isthm. 7.0 μm ; crass. 13.5 μm (West 1912).

Forma 1. Semicells elliptical, often not far from circular, completely rounded, with or without a wide open sinus. Form possessing a finely punctate membrane and a narrow isthmus. Dorsal and ventral margins equally rounded. Long. cell., 36.0 μm ; lat., 24.0-25.0 μm ; isthm., 5.0-6.0 μm (Fritsch, Rich 1932).

Forma. A form with two pyrenoids in each semicell. Long., 37.0 μm ; lat., 25.0 μm (1.48x); isthm., 10.0 μm (Grönblad, Croasdale 1971).

- F. **JACOBSENII** (ROY) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192, 200 (forma 2), 295.

Note. Long., 32.0-34.0 μm ; lat., 20.0 μm ; ist., 4.0-6.0 μm ; crass., 16.0 μm (Rich 1932).

Forma 2. Semicells elliptical; the apex tending to be flat and slightly thickened; the sinus is more widely open; form possessing a finely punctate membrane and a narrow isthmus.; cf. forma *jacobsenii* (Roy) W. et G.S. West. Long. cell., 37.0-39.0 μm ; lat., 24.0-25.0 μm ; isthm., 6.0 μm (Fritsch, Rich 1938).

- VAR. **CRACOVIANSE** RACIBORSKI

Illustrations. Fig.67 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. In (Grönblad, Croasdale 1971) indicated as *Cosmarium ?contractum* Kirchn. var. *cracoviense* Raciborski (1885, p.84, 10: 10). Long., 32 μm ; lat., 24 μm (1.33x); isthm., 10 μm . Without the end view identification is uncertain; our plant might possibly be a relatively long form of *C. pseudoprotuberans* Kirchn. (Grönblad, Croasdale 1971).

- VAR. **ELLIPSOIDEUM** (ELFV.) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 186, 192, 198, 200, 201, 268, 328, 329. – NAM: 307.

Note. In sample **328:** long., 19.5 μm ; lat., 15.6 μm ; isthmus, 5.2 μm . In sample **329:** Long., 20.8 μm ; lat., 15.6 μm ; isthmus, 6.5 μm (Huber-Pestalozzi 1930).

Forma. Rather a small form; long., 24.0-25.0 μm ; lat., 21.0 μm ; ist., 5.0 μm ; crass., 13.0-14.0 μm (Rich 1932).

Long. cell., 25.0-28.0 μm ; lat., 20.0-24.0 μm ; isthm., 4.5-6.0 μm ; diam. zygospor., 22.0-25.0 μm . The length and breadth more nearly equal; zygospor. globose and smooth; dimensions a little less than those given by Messrs. West (West, West 1905, p.172, Pl.LXI, figs.28, 35) (Fritsch, Rich 1938).

- VAR. **PSEUDOGARTANENSE** CLAASSEN

Illustrations. Tab.24, fig.6 (Claassen 1961).

Sample. RSA: 269.

Note. *Cellulae plus orbiculatae quam in typo, membrana marginis apicalis incrassata.*

The semicells are more rounded than in the typical form; cell wall thickened at apices and punctate. This is near var. *gartanense* W. et G.S. West (West, West 1905, p.173, Pl.LXI, fig.27) in shape; but the apex is not retuse-emarginate. Length 47.0-48.0 μm ; breadth 30.0-31.0 μm ; breadth of isthmus 14.0 μm (Claassen 1961).

283. COSMARIUM CONTROVERSUM W. WEST

Illustrations. Fig.108 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. Long., 96.0 μm ; lat., 70.0 μm (1.37x); isthm., 28.0 μm . R. Grönblad on his list of findings, says "*ad C. decoratum*", on his drawing he says "*C. controversum* (= *C. decoratum*?)". H. Croasdale agrees that these two species are fundamentally similar, differing only in the triangular pits of *C. decoratum* West et West (1895, p.61, 7: 21) which replace the small circular pores of *C. controversum* which R. Grönblad shows in his drawing. Perhaps the two species should be combined, under the earlier name *C. controversum* (Grönblad, Croasdale 1971).

284. COSMARIUM CREMATUM RALFS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 124, 125, 126 (very rare).

Note. Long., 32.0 μm ; lat., 22.7 μm ; lat. isthm., 12.0 μm (Hodgetts 1926).

285. COSMARIUM CRUCIFERUM DE BARY (SYN.: *PENIUM CRUCIFERUM* (DE BARY) WITTR.)

Illustrations. Fig.52 (Grönblad, Croasdale 1971).

Samples. NAM: 304.

Note. Long., 19.0 μm ; lat., 11.0 μm (1.7x); isthm., 9.0 μm (Grönblad, Croasdale 1971).

286. COSMARIUM CUCURBITA BRÉB.

- VAR. **CUCURBITA**

- F. **CUCURBITA**

Illustrations. Fig. nostr.13, I (Fritsch, Rich 1938); Fig.50 (Grönblad, Croasdale 1971).

Samples. RSA: 300, 327. – NAM: 307.

Note. Long., 32.6 μm ; lat., 17.0-18.2 μm ; or 35.0 μm and 15.6 μm respectively (Huber-Pestalozzi 1930).

In article Fritsch and Rich (1938) absent information about samples in which this form found.

Long. cell., 27.0-30.0 μm ; lat., 16.0-17.0 μm ; lat. zygospor. sine sp., 24.0-26.0, cum sp., 37.0 μm . The wall is rather coarsely punctate, the puncta are strictly

aligned near the isthmus, and the part of the semicell immediately above the isthmus is free of them. Numerous zygospores were observed. These were spherical, and provided with large tubercles. Homfeld ("Beitrag zur Kenntnis der Desmidiaceen Nordwestdeutschlands", Pflanzenforschung, Heft 12, 1929, p.41, Tab.V, fig.54) has recorded smooth zygospores for this species, but his figure is scarcely convicting; they may not belong to this species, nor is it certain that they are mature. Grönblad ("New Desmids from Finland and N.Russia", Acta Soc. pro Fauna et Flora Fennica, xlix, No.7, 1921, p.43, Pl.VII, fig.63) figures a verrucose zygospore which is also possibly not quite mature. Messrs. West (West, West 1908, p.106, Pl.LXXIII, figs.31-33) record the zygospore as verrucose, although they had previously described them as smooth. Either the tubercles develop at a late stage, or there happen to be two very similar species, the one with smooth, the other with verrucose zygospores (Fritsch, Rich 1924).

Long. cell., 32.0 μm ; lat., 20.0 μm (Rich 1940).

Forma. A form more tapered to a rounded apex, the sinus less notched. Long., 37.0 μm ; lat., 19.0 μm ; isthm., 18.0 μm . R. Grönblad suggested also "*C. cucurbitinum* Biss." which is possible, but this species is in general larger (Grönblad, Croasdale 1971).

- F. **LATIOR** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 91 (rather rare).

Note. Long. cell., 42.0 μm ; lat. cell., 26.0 μm (Fritsch, Rich 1924).

- F. **MINOR** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192.

- VAR. **ATTENUATUM** G.S. WEST (SYN.: *COSMARIUM CONICUM* W. ET G.S. WEST)

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 91 (not uncommon), **198, 200, 201, 204, 224, 226.**

Note. Long. cell., 30.0-35.0 μm ; lat. cell., 17.0-21.0 μm ; lat. isthm., 16.0-17.0 μm .

There does not appear to be any decisive point of distinction between *C. conicum* and the variety *attenuatum* of *C. cucurbita* (cf. also Fritsch, Ann. Biol. lacustre, vii, 1914, p.49, and Schmidle, Nuov. Notarisia, ser. viii, 1897, p.70). The variety *brevius* of *C. conicum* described by Gutwinski (Bull. Acad. Sci. Cracovie, 1909, p.452, Pl.VII, fig.16) seems to be much the same as the forma *laticus* of *C. cucurbita*. Various individuals were seen in our material connecting var. *attenuatum* with the forma *laticus*, although in many specimens the one or other type is clearly recognizable (Fritsch, Rich 1924).

Long. cell., 27.0 μm ; lat., 16.0 μm (Fritsch, Rich 1938).

287. COSMARIUM CUCURBITINUM (BISS.) LÜTKEMÜLLER

- VAR. **CUCURBITINUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 200.

Note. **Forma.** Long. cell., 66.0 μm ; lat., 26.0-27.0 μm (Fritsch, Rich, 1938).

- VAR. **SUBPOLYMORPHUM** NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 106 (rather rare).

Note. Long. cell., 75.0-84.0 μm ; lat. cell., 35.0-41.0 μm (Fritsch, Rich, 1924).

288. COSMARIUM CUNNINGTONII G.S. WEST (SYN.: *COSMARIUM BICORNE* BORGE, *C. TAXICHONDRUM* LUND. VAR. *OCELLATUM* SCHMIDLE)

Illustrations. Fig.94 (Grönblad, Croasdale 1971). Figs.2-4 (Coesel, van Geest 2009).

Samples. NAM: 307, 400-418. – BOT: 419-424.

Note. *Forma.* Long., 45.0 μm ; lat., 37.0 μm (1.2X); isthm., 10.0 μm . A larger form with fewer verrucae and puncta. For this plant R. Grönblad said “cf. *C. wellheimii* Schmidle 1898, 2: 25”, but H. Croasdale thinks that because of the shape of the semicell it resembles more closely *C. taxichondrum* var. *ocellatum*. It is possible that some granules and ocelli were obscured by the chloroplast. However, H. Croasdale agrees with Schmidle (1898, p.30) that this probably should be a separate species rather than a variety of *C. taxichondrum* (Grönblad, Croasdale 1971).

Cosmarium cunningtonii, described by West (1907) from Tanganyika is better known under the name of *C. bicorne* described from Borge (1928) also from Tanganyika. Comparing the figures referring to those two species provided by the above-mentioned authors there can be hardly any doubt that we have to do with one and the same species.

C. cunningtonii is a characteristically shaped taxon. Most conspicuous are the two big, subapical tubercles. Borge's (1928) illustration of *C. bicorne* shows a cell outline that is slightly undulate, suggesting that, next to the big subapical tubercles, also smaller, much more flattened elevations occur. Indeed, in later records of *C. bicorne*, e.g., by Grönblad and al. (1958: fig. 196, 197) such additional tubercles are clearly illustrated. However, according to fig. 200 in that same paper, those additional sculpturing is not always observed, so subject of variation. As variable the development of those additional tubercles, so variable also the markedness of the surrounding cell wall pores. West (1907), in his description of *C. cunningtonii*, mentions and depicts conspicuous scrobicles in the centre of the semicell. The figures of *C. bicorne* in Grönblad and al. (1958) partly show delicate punctae, partly thick dots, and also in our own Okavango material both cells with fine punctae and cells with conspicuous, angular scrobicles were encountered.

Cosmarium cunningtonii is only known from Africa, i.e., Tanzania (West 1907, Borge 1928), Sudan (Grönblad & al. 1958), Mozambique (Rino 1972), Mali (Couté, Rousselin 1975), Cameroon (Compère 1977) and Namibia (Grönblad, Croasdale 1971, as *C. taxichondrum* var. *ocellatum* Schmidle). In the Okavango Delta *C. cunningtonii* was widely distributed on all four sampling sites (Coesel, van Geest 2009).

289. COSMARIUM DEBARYI ARCH.

- VAR. **MINOR** CLAASSEN

Illustrations. Tab.25, figs.15, 16 (Claassen 1961).

Sample. RSA: 269.

Note. *Differt a typo speciei cellulis dimidio minoribus et in medio margine apicali incisura minime profunda. Formae intermediae haud visae.*

These specimens are about half the size of the typical form (West, West 1908, p.61, Pl.LXX, figs.14-16; Pl.XCIII, fig.2); apical margin with a shallow median incision. Length 46.5-48.0 μm ; breadth 22.5-23.0 μm ; breadth of isthmus 17.0 μm ; thickness 18.0-20.0 μm (Claassen 1961).

290. COSMARIUM DECEDENS (REINSCH) RACIB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 384, 397.

291. COSMARIUM DECORATUM W. ET G.S. WEST

- VAR. **DECORATUM**

Illustrations. Figs.103, 104 (Grönblad, Croasdale 1971); Figs.1-16 (Claassen, Eicker 1985); Pl.16, Fig.2 (Williamson 1994).

Samples. RSA: 198, 199, 200, 262, 274, 312-316, 356. – NAM: 307. – SWA: 377.

Note. Long. cell., 79.0-90.0 μm ; lat., 58.0-65.0 μm ; isthm., 22.0-30.0 μm ; crass., 35.0-40.0 μm . The individuals noticed were just like those described by Messrs. West (West, West 1895, p.61, Pl.VII, fig.21) from Madagascar except that the markings on the surface did not always appear to be triangular; frequently they were more or less obovate (Fritsch, Rich, 1938).

Cell wall sculpture only distinct in the median parts of the front, vertical and side views of the semicell as the semicell is not flat but ovate in side view and elliptic in vertical view. In this respect I do not agree with Messrs. West's figures (West, West 1895, Pl.7, fig.21) (Claassen 1961).

Forma. Long., 160.0 μm ; lat., 110.0 μm ; isthm., 40.0 μm . A form about twice as large as the type, the semicells more tapered to a narrower apex, the granules more numerous and sharper (Grönblad, Croasdale 1971).

Length 73.0-80.0 μm ; breadth 56.0-58.0 μm ; isthmus 24.0-25.0 μm ; ratio of length to breadth 1.3-1.4 (Williamson 1994).

- VAR. **GALPINII CLAASSEN**

Illustrations. Tab.29, fig.11 (Claassen 1961); Figs.28-42 (Claassen, Eicker 1985).

Sample. RSA: 276, 317-319.

Note. *A typo speciei celulis latioribus et membranae sculptura in media tantum parte conspicua differt.*

Cells broader than in the type; cell wall sculpture only distinct in the median part of the semicell; cells about 1.2 times longer than broad. Length 84.0 μm ; breadth 70.0 μm ; breadth of isthmus 24.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

- VAR. **WATERBERGENSE CLAASSEN**

Illustrations. Tab.24, fig.11 (Claassen 1961).

Sample. RSA: 280.

Note. *A typo speciei hiatibus, quibus sculptura membranae consistit, plus confertis – qui ornatus non per totam superficiem membranae apparet – et magnis granulis in ordinem circum marginem cellulae dispositis bene distincta.*

Cell wall sculpture only distinct in the median part of the semicells and with a series of fairly large granules situated on the margins; cells about 1.4 times longer than broad. Length 73.0-82.0 μm ; breadth 52.0-60.5 μm ; breadth of isthmus 20.0-23.5 μm (Claassen 1961).

292. COSMARIUM DEPRESSUM (NÄG.) LUND.

- VAR. **MINUTUM (HEIMERL) KRIEG. ET GERL.**

Illustrations. Fig.72 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 28.0 μm ; lat., 28.0 μm ; isthm., 10.0 μm ; crass., 15.0 μm (Grönblad, Croasdale 1971).

293. COSMARIUM DIDYMOCHONDRUM NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 222.

294. COSMARIUM DIFFICILE LÜTKEM.

- VAR. *DILATATUM* BORGE 1925, PL.1, FIG.38.

Illustrations. Pl.16, Fig.4 (Williamson 1994).

Samples. RSA: 343.

Note. Length 2.6.6-29.5 μm ; breadth 16.0-17.5 μm ; isthmus 4.5-5.0 μm ; ratio of length to breadth 1.6-1.75 (Williamson 1994).

- VAR. *SUBLAEVE* LÜTKEM.

Illustrations. Fig.88 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. *Forma.* Long., 35.0 μm ; lat., 29.0 μm ; isthm., 6.0 μm ; with three horizontal rows of puncta across the face of the semicell. It differs in its slightly more tapered semicells and lack of apical wall thickening. R. Grönblad suggested "*C. zonatum*" for the plant, and it seems to lie partway between this and *C. difficile*. H. Croasdale, however, believes that it differs more sharply from *C. zonatum* because of its closed sinus, smaller size, less strongly tapered cells and fewer rows of puncta (Grönblad, Croasdale 1971).

295. COSMARIUM DIPLOSPORUM (LUND.) LÜTKEM. (SYN.: *CYLINDROCYSTIS DIPLOSPORA* LUND.)

- VAR. *DIPLOSPORUM*

Illustrations. Fig.51 (Grönblad, Croasdale 1971).

Samples. RSA: 203, 205. – NAM: 307.

Note. Long. cell., 62.0 μ ; lat., 34.0 μ . The curious double zygospores characteristic of this species were present. The spores were flattened on the faces adjoining one another, and measured about 39.0 μm by 30.0 μm . Schmidle ("Die ... in Ost-Afrika gesammelten Desmidiaceen", Eng. Bot. Jahrb., xxvi, p.1, 1899, p.16) found a variety *stenocarpa* in East Africa, but that differs from the individuals here recorded in having quadrate zygospores (Fritsch, Rich 1938).

Long., 57.0 μm ; lat., 29.0 μm (2x); isthm., 28.0 μm . R. Grönblad identified this plant with a "?" on his figure, without it on his list. The identification seems most probable, but without details of wall and chloroplast one cannot be sure (Grönblad, Croasdale 1971).

- VAR. *MAJUS* WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 201.

Note. Long. cell., 83.0-90.0 μm ; lat., 42.0-44.0 μm ; isthm., 39.0-41.0 μm . The dimensions are less than those given by Messrs. West (West, West 1904, p.61, Pl.IV, fig.43), but there is close agreement in other respects (Fritsch, Rich 1938).

296. COSMARIUM DISPERSUM JOHNS.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 383.

297. COSMARIUM DOCIDIODES LÜTKEM. (SYN.: *PENIUM MINUTUM* (RALFS) CLEVE)

- VAR. *CRASSUM* WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 199.

Note. Long. cell., 85.0 μm ; lat., 16.0 μm (Fritsch, Rich 1938).

298. COSMARIUM DOIDGEI F.E. FRITSCH ET F. RICH

- VAR. **DOIDGEI**

Illustrations. Fig.12, *G-I* (Fritsch, Rich 1938).

Samples. RSA: 202, 203.

Note. *C. parvum*, ca. *tam longum quam latum, profunde constrictum, sinu angusto-lineari extrorsum ampliato; semicellulae a fronte visae late subpyramidatae, angulis lateralibus rotundatis, marginibus lateralibus superioribus retusis, apice recto angusto, papillo singulo supra isthmum, membrana glabra; semicellulae a latere visae pyriformes, apice convexo, papillo singulo bene evoluto infra apicem in utroque latere; semicellulae a vertice visae ellipticae, papillo rotundato in utroque latere.* Long. cell., 18.0-20.0 μm ; lat., 19.0-21.0 μm ; isthm., 4.0-5.0 μm ; crass., 11.0 μm .

The retuse character of the upper lateral margins, combined with the widening of the sinus towards the outside, gives the lateral angles of the semicells the appearance of being slightly upturned. The papilla in the median part of each semicell is well developed, and directed towards the apex (cf. Fig.12, *G*). Side- and end-views of this species rather recall *C. bireme* Nordst., but the front-view is altogether different. There is also resemblance to *C. sinostegos* Schaarschm. (Fritsch, Rich 1938).

- VAR. **DEPRESSUM** COESEL ET VAN GEEST

Illustrations. Figs.5-7 (Coesel, van Geest 2009).

Samples. BOT: 400-411.

Differs from the nominate variety by more depressed cells with a relatively broader apex. Cell length 14.0-17.0 μm , cell breadth 15.0-19.0 μm . *Type*: our fig. 5. *Type locality*: water-course near Chief's Island (sample **402**), P.F.M. Coesel, 3 October 2006, plankton collection #2006.44 in the Amsterdam University herbarium.

Cosmarium doidgei is a small-sized, smooth-walled *Cosmarium* species the most characteristic feature of which is in the slightly upturned lateral angles. In addition to that, semicells are provided with a marked central protuberance. Whereas the nominate variety as described by Fritsch, Rich (1938) from South Africa is about as long as broad, cells encountered in the Okavango Delta were consistently somewhat broader than long. In addition to that, they differed from the nominate variety by a broader apex. In that latter respect they agreed with *C. doidgei* as represented by Grönblad and al. (1958) from Sudan and by Rino (1972) from Mozambique. Like the cell pictured by Rino (1972: pl. 24/21) also the cells in our Okavango samples were marked by somewhat papillate lateral angles.

C. doidgei is only known from some African countries, see above. Records by Förster (1965) from Nepal and by Dürschmidt (1985) from Chile refer to quite different species. In the Okavango Delta, *C. doidgei* var. *depressum* was widely distributed on the site of Chief's Island (Coesel, van Geest 2009).

299. COSMARIUM ELEGANTISSIMUM LUND.

- VAR. **SIMPLICIUS** W. ET G.S. WEST

Illustrations. Fig.13, *D* (Fritsch, Rich 1938).

Samples. RSA: 198, 200, 201, 202.

Note. *Forma major.* Long. cell., 50.0-73.0 μm ; lat., 20.0-32.0 μm ; isthm., 17.0-26.0 μm .

The form present in the Belfast Pan is larger than var. *simplicius*, although it shows the same relative proportions. The side-view is only a little narrower than the front-view. The semicells commonly broaden slightly from the base upwards, being broadest near the top. Each semicell bears 8 or 9 horizontal rows of warts, 19 or 20 of which are visible round the margin. When viewed from the surface these warts appear circular, or somewhat oblong, but seen in optical section along the margin they are somewhat flattened at the apex.

C. elegantissimum bears considerable resemblance to *C. mansangense* W. et G.S. West, and the latter species should possibly be regarded but as a variety of the former. *C. mansangense* has been recorded from Weltevreden West Dam and Portuguese East Africa, and a variety from Natal (Fritsch, Rich 1938).

300. COSMARIUM EXIGUUM ARCH.

Illustrations. Fig.89 (Grönblad, Croasdale 1971).

Samples. RSA: 212. - NAM: 307.

Note. Long., 16.5 μm ; lat., 9.0 μm (1.83x); isthm., 4.0 μm (Grönblad, Croasdale 1971).

301. COSMARIUM FAVUM W. ET G.S. WEST

- VAR. AFRICANUM FRITSCH ET RICH

Illustrations. Fig.13, A-C (Fritsch, Rich 1938).

Samples. RSA: 200, 201, 203, 204.

Note. *Differt a typo sinu aperto extremo acuto, semicellulis cum apice deplanato, granulis fere totam membranam obtectis.* Long. cell., 64.0-67.0 μm ; lat., 52.0-53.0 μm ; isthm., 16.0 μm ; crass., 34.0-37.0 μm .

This is clearly a variety of this characteristic species, distinguished by the flattened apices of the semicells, a different isthmus, and the small size of the unornamented area above the isthmus. There are two pyrenoids in each semicell. The thick membrane is covered with large rounded granules, as seen in front-view, are arranged in about six horizontal and about twelve vertical rows; the granules of the row just above the isthmus are slightly smaller than others.

Schmidle ("Ueber einige von K. Bohlin ... gesammelte Süßwasseralgeln", Bih. K. Sv. Vet.-Akad., Handl.24, Afd.3, No.8, 1898, p.36) considered *C. favum* to be a variety of *C. margaritatum* (Lund.) Roy et Biss., but Messrs. West ("Notes on Freshwater Algae, II", Journ. Not., 1900, p.294) have given good reasons for retaining it as a separate species (Fritsch, Rich 1938).

302. COSMARIUM FORMOSULUM HOFF.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 12, 13 (abundant), **211, 213.**

Note. Long. 51.0-53.0 μm ; lat. 43.0-44.0 μm ; lat. isthm. 11.5-12.0 μm ; crass. 26.0 μm (West 1912).

303. COSMARIUM FRITSCHII HODGETTS

Illustrations. Fig.11, B (Hodgetts 1926).

Sample. RSA: 112 (very rare), **113** (very rare), **116** (very rare).

Note. *C. parvum, diametro 1.1 plo longioribus, profunde constrictum, sinu lineari extremo ampliato; semicellulae truncato-pyramidatae, angulis inferioribus valde rotundatis, granulis acutis tribus instructis, angulis superioribus rotundatis granulo acuto singulo vel granulis binis instructis; lateribus biundulatis, in medio granulo acuto praeditis; apicibus levissime*

convexis; seriebus duabus granulorum intra marginem, serie granulorum 4 vel 5 supra medium semicellulae instructae; medio semicellularum levi; a vertice visae ellipticae ad medium utrobique subtumidae, granulis concentricae digestis praeditae, in centro leves; a latere visae subglobosae; chromatophora singulain semicellula unaquaque, pyrenoide instructa. Long. cell., 28.8-29.0 µm; lat., 25.6 µm; lat. isthm., 6.4-8.0 µm; crass. 14.4 µm.

This does not appear to resemble very closely any known species, although it can be compared in some respects with *C. taxichondrum* var. *subundulatum* Boldt forma *subdenticulatum* W. et G.S. West (West, West 1895, p.67, t.7, fig.4). The acute granules are quite absent from the centre and also from the apex of the semicell (Fig.11, B). The four or five acute granules which form an arc above the centre of each semicell are sometimes rather larger than those elsewhere (Hodgetts 1926).

304. COSMARIUM FUELLEBORNIFORME COESEL ET VAN GEEST

Illustrations. Figs.22, 23 (Coesel, van Geest 2009).

Sample. BOT: 415 (occasionally).

Note. Cells 1.6 to 1.8 times longer than broad, deeply constricted. Sinus widely open from an acute-angled apex. Semicells subcircular. Cell wall thick, with scattered, coarse pore fields. Semicells in apical view (almost) circular. Chloroplast axial with a central pyrenoid and radiating, longitudinal lamellae. Cell length 78.0-86.0 µm, cell breadth 45.0-51.0 µm, breadth of isthmus 19.0-23.0 µm. *Type:* our fig. 23.

Type locality: water-course at Moremi (sample **415**), P.F.M. Coesel, 9 October 2006, plankton collection # 2006.57 in the Amsterdam University herbarium.

Almost certainly the above newly described *Cosmarium fuelleborniforme* is identical to *C. fuellebornii* Schmidle as represented by Thomasson (1966) from Lake Shiwa Ngandu, in Zambia. Whereas *C. fuellebornii* as originally described by Schmidle (1902) from Nyassa-See (= Lake Malawi, also in Zambia) is characterized by semicells that are distinctly broader than long, so elliptical in outline, semicells in *C. fuelleborniforme* are almost circular. The main discriminating feature, also with respect to the somewhat similar *C. moniliforme* Ralfs, however, is in the thick cell wall marked by strikingly coarse pore fields.

Maybe, also *C. fuellebornii* as represented by Bourrelly, Couté (1991) from Madagascar belongs to our new species although it does not fit all the above-described characteristics equally well (Coesel, van Geest 2009).

Mistake in (Coesel, van Geest 2009): Lake Malawi (known under this name in Republic of Malawi) or Lake Nyassa (known under this name in Mozambique) situated not in Zambia but in Malawi, Tanzania and Mozambique.

305. COSMARIUM FÜLLEBORNEI SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 192.

Note. Smaller than that found by Schmidle, but resembling it in general form, in side-view, and in *Pleurotaeniopsis* type of chloroplast. Long., 45.0 µm; lat., 38.0-39.0 µm; ist., 21.0 µm; crass., 32.0-33.0 µm (Rich 1932).

306. COSMARIUM FURCATOSPERMUM W. ET G.S. WEST

Illustrations. Fig.138 (Cholnoky 1955).

Samples. RSA: 224, 237.

Note. Eine bisher ziemlich selten gesehene, in den sauren Gewässern Süd-Afrikas aber wahrscheinlich allgemein verbreitete Form (Cholnoky 1955).

307. COSMARIUM GALPINII CLAASSEN

Illustrations. Tab.29, figs.5, 6 (Claassen 1961).

Sample. RSA: 289, 294.

Note. *Affinis C. isthmochondro* Nordst., *sed differt quod margo apicalis duorum ordinum – quorum alter tantum a fronte videri potest – granulis quaternis magnis est ornatus; porro membranae sculptura toto caelo differt.*

This species is near *C. isthmochondrum* Nordst. (West, West 1908, p.173, Pl.LXXXI, fig.7); but differs in that the apical margin contains two series of four large granules each (only one series visible in front view of semicell), and in the cell wall sculpture. Cell small, about 1.2 times as long as broad, fairly deeply constricted, sinus narrowly linear; semicells truncate-semicellular, apical margin straight, with a series of four large granules; cell wall colorless or yellowish-brown, punctate, and with a number of scattered granules. Vertical view more or less elliptic, with two circular series of granules in the centre, two series of four granules each on each side, and three smaller granules arranged in a triangle within the poles. Length 36.0 μm ; breadth 2.0 μm ; breadth of isthmus 14.0 μm ; thickness 24.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

308. COSMARIUM GAYANUM DE TONI

- VAR. GAYANUM

Illustrations. Fig.139 (Cholnoky 1955).

Samples. RSA: 226, 230.

Note. In 226 habe ich auch nur 60 μm large and 35 μm breite Individuen gesehen, da diese aber sonst den mir bekannten Diagnosen vollauf entsprechen - wie es auch durch die Fig. 139 gezeigt wird - halte ich es nicht für nötig, diese Formen zu benennen, desto mehr, da die Übergänge lückenlos sind (Cholnoky 1955).

- VAR. EBORACENSE W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 214, 215, 217, 218.

- VAR. ROTUNDATA F.E. FRITSCH

Illustrations. Fig.18 (Fritsch, Stephens 1921).

Samples. RSA: 74 (very rare), **91** (rare), **92** (rare), **97** (rare), **107** (rare), **108** (not uncommon), **110** (rather rare).

Note. *Apicibus semicellularum in aspectu frontali rotundatis haud truncatis, granulis minus regulariter ordinatis, praecipue in media parte semicellularum. Aspectus verticalis et lateralis typo similes sunt. Long. cell., 75.0-88.0 μm ; lat. cell., 48.0-58.0 μm ; lat. isthm., 16.0-18.0 μm ; crass., 35.0-36.0 μm .*

This variety is characterized by the complete rounding off of the apices of the semicells and by the more irregular arrangement of the granules, especially in the centre of the semicell. It appears to bear the same relation to the type as var. *subrotundatum* West, does to *C. conspersum* Ralfs. Schmidle (Alg. Carolinen, Hedwigia, xl, 1901, p.347, Tab.XII, fig.5) has described a var. major of *C. margaritatum* (Lund.) Roy et Biss., which comes rather close to this variety of *C. gayanum* (Fritsch, Stephens 1921).

Forma saepe longior, granulis frequentioribus et in seriebus varticalibus dispositis. Long. cell., 67.0-75.0 µm; lat. cell., 38.0-49.0 µm; lat. isthm., 12.0-18.0 µm; crass., 28.0 µm.

Many of the individuals agreed in the shape of their front-view entirely with the figure of var. *rotundata* (Fritsch, Trans. Roy Soc. S. Africa, ix, 1921, p.43, fig.18) but others were proportionally longer, thus approaching more to the shape of the type. All of these, except for occasional individuals that had a slight flattening of the apex on one or other semicell, possessed the rounded apices typical of the variety (Fritsch, Rich, 1924).

309. COSMARIUM GEMINATUM P. LUNDELL

- VAR. **TRIORDINATUM** BOURRELLY ET COUTÉ

Illustrations. Fig.16 (Coesel, van Geest 2009).

Sample. BOT: 400-418. – NAM: 419-424.

Note. *Cosmarium geminatum* var. *triordinatum* differs from the nominate variety in that it has three vertical series of compound verrucae/tubercles instead of two. Actually its overall cell wall sculpture is more luxurious than in the nominate variety originally described by Lundell (1871) from Sweden. Although, in that respect, there is some resemblance with *C. geminatum* forma *ornatum* described by Behre (1956) from Indonesia and with *C. geminatum* as represented by Skuja (1949) from Burma, until now the arrangement of big, compound verrucae in three distinct median series is only known from tropical African representatives of this species. Gerrath, Denny (1988: pl. 6/76) appeared to have encountered it in Sierra Leone. Possibly, *C. geminatum* var. *triordinatum* is identical to *C. subtriordinatum* described by West, West (1897) from Angola but as yet we prefer to consider it a variety of *C. geminatum*.

In the Okavango Delta *C. geminatum* var. *triordinatum* was widely distributed on all four sampling sites (Coesel, van Geest 2009).

310. COSMARIUM GEOMETRICUM W. ET G.S. WEST

- VAR. **ADOXOIDES** G.S. WEST

Illustrations. Fig.47 (West 1912).

Sample. RSA: 8.

Note. *Var. sinu lineari ad extremum ampliato; apice semicellularum leviter concavis vel rectis. Long. 9.5-10.0 µm; lat. 9.0-10.0 µm; lat. isthm. 2.5 µm; crass. 5.2 µm.* The semicells of this tiny desmid have the minutely apiculate angles and also the slightly papillate central area of *C. geometricum*, but the closed sinus of *C. adoxum* (West 1912).

311. COSMARIUM GLOBOSUM BULNH.

- VAR. **MINUS** HANSG.

Illustrations. Fig.36 (Cholnoky 1954b).

Sample. RSA: 215, 216.

Note. Most of the studied specimen are typical, and carried on their surface irregularly distributed markedly granulated gelatinous threads (visible in phase contrast microscope) (Cholnoky 1954b).

312. COSMARIUM GONIODES W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

313. COSMARIUM GRANATUM BRÉB.

- VAR. GRANATUM

- F. GRANATUM

Illustrations. Figs.73, 74 (Grönblad, Croasdale 1971); Pl.17, Fig.7 (Williamson 1994).

Samples. RSA: 45, 47 (rare), 48 (very rare), 51 (very rare), 60, 68, 160, 164 (rare), 210, 211, 213, 272, 346. – NAM: 305, 307 (forms), 385, 392, 395.

Note. *Long.*, 27.0-35.0 μm ; *lat.*, 20.0-27.0 μm ; *lat. isthm.*, 5.0-7.0 μm (Fritsch 1918).

Long. cell., 24.0-45.0 μm ; *lat. cell.*, 19.0-35.0 μm ; *lat. isthm.* 6.0-8.0 μm (Fritsch, Stephens 1921).

Also in sample 74 (rare) was found forma of that species. *Forma apicibus leviter incrassatis vel etiam retusis.* *Long. cell.*, 24.0 μm ; *lat. cell.*, 18.0 μm ; *lat. isthm.* 6.0 μm (Fig.11, H). Some specimens of this form had semicells in which the angles were more rounded than in Fig.11, H, such individuals grading over into the forms of *C. laeve* Rabenh (Fritsch, Stephens 1921).

In sample 164: *long.*, 35.0-36.0 μm ; *lat.*, 24.0-27.0 μm ; *ist.*, 6.0-7.0 μm (Fritsch, Rich 1930).

Of this extremely variable species two forms were found: (Fig.73) *long.*, 39.0 μm ; *lat.*, 24.0 μm (1.62x); *isthm.*, 9.0 μm and (Fig.74) *long.*, 41.5 μm ; *lat.*, 30.0 μm (1.38x); *isthm.*, 10.0 μm . Both these were from sample 307, and R. Grönblad also reported the species from sample 305 (Grönblad, Croasdale 1971).

Length 30.0-36.0 μm ; breadth 21.0-26.0 μm ; isthmus 5.6-9.0 μm ; ratio of length to breadth 1.3-1.6 (Williamson 1994).

Indicated as *C. granatum* Bréb. in Ralfs (Williamson 2000).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, North-West Province, KwaZulu Natal, Swaziland (orig.).

- F. PYRAMIDALE SCHMIDLE

Illustrations. Pl.17, Fig.2 (Williamson 1994).

Samples. RSA: 367.

Note. Length 46.0-48.0 μm ; breadth 27.0-28.0 μm ; isthmus 7.0 μm ; ratio of length to breadth 1.6-1.7 (Williamson 1994).

- VAR. AFRICANUM F.E. FRITSCH

Illustrations. Fig.11, C (Fritsch, Stephens 1921); Tab.25, figs.17, 18; Tab.29, fig.4 (Claassen 1961).

Samples. RSA: 74 (rather rare), 101 (very rare), 108 (very rare), 193, 194, 269, 298.

Note. *Semicellulis lateribus prope basin divergentibus, lateribus superioribus rectis vel levissime concavis, apicibus angustis truncatis, saepe cum membrana paullo incrassata; a latere visis lateribus minus convexis quam in typo, apicibus late rotundatis; a vertice visis allipticis inflatione mediana distincta.* *Long. cell.*, 30.0-38.0 μm ; *lat. cell.*, 21.0-24.0 μm ; *lat. apic.*, 4.0-5.0 μm ; *lat. isthm.*, 5.0-10.0 μm ; *crass.*, 10.0-15.0 μm .

This variety (*cf.* especially fig.11, C, aⁿ) seems to be near var. *subangulare* W. et G.S. West (West, West 1895, p.54, Pl.VIII, fig.4), but the latter has retuse upper lateral margins, a retuse and rather wider apex, and a much narrower isthmus. The end-view as also quite different. There is considerable resemblance to *C. pseudogranatum* Nordst., forma, Gutwinski ('Rozprawy Akad. Umiej. Wyzd. Mat.-Przyz. Krakow', ser.2, xiii, 1898, p.44, Tab.VII, fig.38) (Fritsch, Stephens 1921).

Long. cell., 29.0-33.0 μm ; *lat. cell.*, 19.0-21.0 μm ; *lat. isthm.*, 4.5-6.0 μm . The majority of the individuals were of the form shown in Fritsch, Trans. Roy Soc. S. Africa, ix, 1921, p.32, fig.11, C, a' (Fritsch, Rich, 1924).

This agrees exactly with Fritsch's variety occurring in the Transkei Territories (Rich 1932).

- VAR. **LATUM** RICH

Illustrations. Fig.2, C (Rich 1940).

Sample. RSA: 299.

Note. Cells very little longer than broad, deeply constricted, sinus narrowly linear with scarcely dilated apex; semicells truncate pyramidate; basal angles rounded-subrectangular; apex narrowly truncate, retuse. *Long. cell.*, 29.0-30.0 μm ; *lat.*, 26.0-28.0 μm ; *isthm.*, 8.0-9.0 μm . This variety comes near var. *africanum* Fritsch, but it is proportionately wider, and consequently more flattened in appearance. The dimensions come within the range of those of the type (West, West 1905, p.187), but the general appearance is different (Rich 1940).

314. **COSMARIUM HAMMERI** REINSCH

- VAR. **HAMMERI**

Illustrations. Fig.16, A (Fritsch, Rich 1924); Pl.17, Fig.5 (Williamson 1994).

Sample. RSA: 67 (rare), **91** (*forma minor, aut typica*; common), **92** (*forma minor*; rare), **332, 356, 386, 387, 430, 434**. - **NAM: 305, 306.**

Note. *Long. cell.*, 45.0 μm ; *lat. cell.*, 33.0 μm ; *lat. isthm.*, 12.0 μm (Fritsch, Stephens 1921).

Forma minor, lateribus superioribus vix retusis, apicibus late truncatis, membrana indistincte punctata. Long. cell., 38.0-41.0 μm ; *lat. cell.*, 34.0-36.0 μm ; *lat. isthm.*, 10.0-11.0 μm ; *crass.*, 16 μm .

Forma minor, aut typica, aut lateribus superioribus apicibusque vix retusis, paene rectis. Long. cell., 29.0-33.0 μm ; *lat. cell.*, 21.0-25.0 μm ; *lat. isthm.*, 5.0-7.0 μm .

Both these forms seem to have a simple elliptical end-view. In sample **91** some of the individuals had a front-view with the perfectly typical outline of the type, but others showed scarcely any retuseness of the upper lateral margins or apex. In some cases the apex was truncate or even slightly convex (*cf.* var. *africanum* Fritsch). In sample **92** all the individuals, though larger, showed these peculiar characteristics. *Cf. forma Borge* (Bih. K. Sv. Vet.-Akad. Handl., xxvii, Afd. Iii, No.10, 1901, p.24) (Fritsch, Rich 1924).

Length 38.0-41.0 μm ; breadth 27.0 μm ; isthmus 10.0-11.0 μm ; ratio of length to breadth 1.4-1.5; thickness 17.0-19.0 μm (Williamson 1994).

- VAR. **AFRICANUM** F.E. FRITSCH

Illustrations. Fig.11, B (Fritsch, Stephens 1921); Fig.14, C-H (Fritsch, Rich 1938); Fig.2, J, K (Rich 1940).

Sample. RSA: 67 (very rare), **74** (not uncommon), **192** (rare), **198, 200, 201, 299.**

Note. *C. 1¹/₆-1¹/₃ plo longius quam latum; semicellulae apicibus truncatis vel leniter convexis (interdum obliquis) marginibus lateralibus inferioribus late concavis, marginibus lateralibus inferioribus convexo-rotundatis vel raro subangularibus, interdum subrectis; a vertice visae ellipticae, polis rotundatis inflatione mediana distincta; a latere visae subcirculares vel elliptico-circulares.*

Membrana indistincte granulata. Lat. isthm., 6.0-8.0 μm ; lat. apic., 10.0-11.0 μm ; crass., 15.0 μm .

	M	μm	M	μm	M	M
Long. cell.	27	27	27	28	30	30
Lat. cell.	21	23	24	24	24	25

This variety appears to be rather widely distributed in South Africa, as it has also been observed in samples from other parts. The reference to *C. hammeri* Reinsch seems correct, since in front-view there is much resemblance to var. *homalodermum* (Nordst.) W. et G.S. West, which is much bigger, and var. *protuberans* W. et G.S. West, in which however, to judge by the figures given by Messrs. West, the upper part of the lateral margins is not nearly so markedly concave. The new variety, however, differs from both of those just mentioned in the fact that the apex is truncate (Fig.11, B, a', a'') or even slightly convex (Fig.11, B, a), and only very exceptionally faintly retuse; obliquity of the apex is not uncommon (Fig.11, B, a), and, when pronounced, has a curious effect on the side-view, which then appears to bear an apical papilla. The granulation of the membrane is also unusual. The median in end-view (Fig.11, B, c) is not as pronounced as is usual in the varieties of this species, and in this respect var. *africana* forms a transition to the type, which is altogether without a median inflation. The somewhat variable side-view (Fig.11, B, b, b') is also different.

It is possible that the f. *acuta* described by Turner ('K. Sv. Vet.-Akad. Hand.,' xxv, 1892, p.53, Tab.VIII, fig.15) belongs to this variety. A closely allied species appears to be *C. aequale* Turner ('K. Sv. Vet.-Akad. Hand.,' xxv, 1892, p.64, Tab.IX, fig.31) (Fritsch, Stephens 1921).

Forma marginibus lateralibus inferioribus late rotundatis vel saepe subrectis et leviter divergentibus. Long. cell., 22.0-26.0 μm ; lat., 17.0-21.0 μm ; isthm., 4.0-6.0 μm ; lat. apic., 11.0 μm ; crass., 12.0-13.0 μm ; diam. zygosp. sine spin., 24.0 μm .

There is considerable variation in the shape and degree of divergence of the lower parts of the lateral margins which are sometimes almost subparallel (cf. Fig.14, C, E). The apex is truncate, sometimes very slightly convex; not uncommonly the apices of the two semicells are not parallel to one another. All the angles are generally rounded. The end-view has a median protuberance. In all instances the cell wall is granulate. In some individuals the lower lateral margins were slightly sinuous, in this respect approaching var. *sinulatum* Borge (Fig.14, H) (Fritsch, Rich 1938).

Forma Fritsch and Rich (1938, Contributions to our Knowledge of the Freshwater Algae of Africa. 13. Algae from the Belfast Pan, Transvaal. *Trans. Roy Soc. S. Africa*, 25, Pt.II: fig.14, C). Long. cell., 26.0-29.0 μm ; lat., 21.0-24.0 μm ; isthm., 6.0-7.0 μm ; crass., 15.0 μm . The lower parts of the lateral margins are almost subparallel. In its general shape in front view it resembles *C. repandum* Nordst., but differs from that species in possessing only one pyrenoid per semicell (Rich 1940).

- VAR. INTERMEDIUM REINSCH

Illustrations. Pl.VI, fig.4 (Reinsch, 1878).

Sample. RSA: ? (Reinsch 1877).

Note. Longit. 0.0252-0.306 mm. Latit. 0.0252-0.0278 mm. Marginis terminalis latitudo dimidium (et paulo minus) diametri transversalis, isthmi latitudo triens diametri transversalis, isthmi latitudo triens diametri

transversalis. Sicut in specimine in “Desmid. Arctois” delineato cytoderma in isthmi angulo subincrassatum.

Haec forma maxime consentit cum speciminibus Germanicus et cum *C. homaloderma* Nordstedt. Forma *D*, octogibbosum, prius descripta, quam nunc speciem propriam puto, est disjungenda a *C. hammeri*. Nomen speciei antea inventae et descriptae retinerem (Reinsch, 1878).

- VAR. **MINOR** CLAASSEN

Illustrations. Tab.24, fig.13 (Claassen 1961).

Sample. RSA: 258.

Note. A *typo speciei cellulis dimidio minoribus differt. Formae intermediae haud visae.*

Cells less than half the size of the typical form (West, West 1905, p.181, Pl.LXII, figs.20, 21); and about 1.3-1.6 times longer than broad. Length 16.0-19.0 μm ; breadth 12.0 μm ; breadth of isthmus 3.0-4.0 μm (Claassen 1961).

- VAR. **PROTUBERANS** W. ET G.S. WEST

Illustrations. Fig.2, *L* (Rich 1940); Fig.37 (Cholnoky 1954b); Fig.68 (Grönblad, Croasdale 1971).

Sample. RSA: 210, 215, 216, 300, 383. – NAM: 307 (see note).

Note. In (Rich 1940) indicated as ? var. *protuberans* W. et G.S. West *forma*.

Forma. Long. cell., 23.0-24.0 μm ; lat., 18.0-20.5 μm ; isthm., 6.5-7.0 μm . The apex is broad and very slightly retuse. The vertical view was not seen (Rich 1940).

One cell of this rarely observed taxon shown on Fig.37 (Cholnoky 1954b).

Long., 28.0 μm ; lat., 20.0 μm (1.4x); isthm., 8.0 μm . R. Grönblad called this “*C. subbinale* Lag. var. *abyssinicum* Lag. f. *minor* Schmidle”, which Krieger and Gerloff (1962, p.104), have appropriately, made a synonym of *C. hammeri* var. *protuberans*. Unfortunately R. Grönblad did not show the end view of the semicell, or pyrenoids, but the general outline, relatively greater length, and smaller size match very well with the figure in West and West (1905, 62: 24). Sample “probably” **307** (R. Grönblad) (Grönblad, Croasdale 1971).

- VAR. **SCHMIDLEI** GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE ET SCOTT

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

315. COSMARIUM HAYNALDII SCHAARSCHM. (SYN.: *COSMARIUM TAXICHONDRUM* LUND. VAR. *HAYNALDII* (SCHAARSCHM.) RACIBORSKI)

- VAR. **HAYNALDII**

Illustrations. Fig.93 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Forma.* Long., 26.0 μm ; lat., 27.0 μm ; isthm., 9.0 μm ; crass., circa 15.0 μm . Our form differs in the more dentate lateral margin. Except for the presence of three (not two) larger verrucae in the upper middle face of the semicell, and the closed isthmus, our form closely resembles var. *ambadiense* Grönbl. et Scott in Grönblad, Prowse and Scott (1958, p.33, 14: 191-193) which Bourrelly (1961, p.345) say should belong to species *C. pseudotaxichondrum* Nordst. (1877, p.20, 2: 5). Lind (1967, p.367, 6: 10, 10a) shows a form very like ours, but smaller, and with the warts more pointed (Grönblad, Croasdale 1971).

- VAR. **AFRICANUM** COESEL ET VAN GEEST

Illustrations. Figs.11, 12 (Coesel, van Geest 2009).

Samples. BOT: 400-418. - NAM: 419-424.

Note. Differs from the nominate variety by a more excessive cell wall sculpturing. Cell length 22.0-27.0 μm , cell breadth 25.0-30.0 μm . *Type*: our fig. 11. *Type locality*: water course at Moremi (sample nr. 16), P.F.M. Coesel, 9 October 2006, plankton collection # 2006.57 in the Amsterdam University herbarium.

Cosmarium haynaldii, described by Schaarschmidt (1883) from Hungary, was transferred as a variety to *C. taxichondrum* P.Lundell by Raciborski (1889). In our opinion, however, this recombination is less felicitous as *C. haynaldii* is marked by a slightly undulate/dentate cell outline in contrast to a firm, smooth outline in *C. taxichondrum*. *C. haynaldii* var. *africanum* differs from the nominate variety by a more extensive and more pronounced cell wall sculpturing. The transversal series of three big tubercles in the median part of the semicell to both sides is extended by smaller granules and there are also scattered granules near the basal angles. Possibly, *C. haynaldii* var. *africanum* is closely related to *C. multituberculatum* F.E.Fritsch et F.Rich, described by Fritsch, Rich (1938) from South Africa.

From Africa, *C. haynaldii* (as *C. taxichondrum* var. *haynaldii*) has been reported by Grönblad (1962, Sudan), Grönblad, Croasdale (1971, Namibia) and Bourrelly & Couté (1991, Madagascar). In the Okavango Delta *C. haynaldii* var. *africanum* appeared to be widely distributed and locally rather common on all four sampling sites (Coesel, van Geest 2009).

- VAR. **AMBADIENSE** (GRÖNBLAD ET A.M. SCOTT) COESEL ET VAN GEEST (BASIONYM: *COSMARIUM TAXICHONDRUM* P. LUNDELL VAR. *AMBADIENSE* GRÖNBLAD ET A.M. SCOTT)

Illustrations. Fig.13 (Coesel, van Geest 2009).

Samples. BOT: 415 (in low cell numbers).

Grönblad, Croasdale (1971) emphasized already the resemblance between *C. taxichondrum* var. *haynaldii* and *C. taxichondrum* var. *ambadiense* and we too are of opinion that those taxa are closely allied. In view of the argumentation above we herewith like to transfer var. *ambadiense* from *C. taxichondrum* to *C. haynaldii*.

C. haynaldii var. *ambadiense* (as *C. taxichondrum* var. *ambadiense*) has been recorded from Sudan (Grönblad and al. 1958, Grönblad 1962), Zambia (Thomasson 1960), Uganda (Lind 1971) and from Ivory Coast [Bourrelly 1961, as *C. taxichondriforme* B.Eichler et Gutw. var. *ambadiense* (Grönblad et A.M.Scott) Bourr.]. Records by Compère (1967), Lind (1967) and Islam, Haroon (1980) are doubtful (Coesel, van Geest 2009).

316. COSMARIUM HELLBERGII GRÖNBL. ET CROASD.

Illustrations. Figs.105-107 (Grönblad, Croasdale 1971).

Sample. NAM: 305, 307.

Note. Semicells pyramidal with the broadest part at the very base and with concave upper margins; sinus linear and closed through all or most of its length; apex straight of slightly undulate. Semicells with large nodule at the lower outer extremity, and with 6-8 large round granules on the face: 4 widely-spaced in a horizontal row or arc across the upper part. Semicell in side view angularly circular, showing on the margin a granule from the upper and lower rows, and above the isthmus the large basal nodule. Chloroplast unknown. Long., 37.0-42.0 μm ; lat., 36.0-40.0 μm ; isthm., 11.0-12.5 μm ; crass. circa 22.0 μm .

The species belongs probably to the *C. retusum* Perty group, coming closest to *C. subdistichum* Raciborski (1892, p.376, I: 29), and to *C. warmingii* Børgesen (1890, p.946, 4: 34). But see also *Xanthidium heimii* Bourrelly (1961, p.339, 18: 5-7) (Grönblad, Croasdale 1971).

317. ? COSMARIUM HETEROCHONDRUM NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (rare).

Note. *Form.* Not enough seen to render a satisfactory diagnosis possible. Long., 32.0-36.0 μm ; lat., 25.0-30.0 μm ; ist., 6.0-7.0 μm ; crass., 16.0-18.0 μm . Attention should be drawn to the markings seen on the end-view (Rich 1932).

318. COSMARIUM HEXALOBUM NORDST. 1872

Illustrations. Figs.5, 6 (Williamson 1995).

Samples. RSA: 380.

Note. This taxon occurred frequently in the shallow roadside pool, and being an uncommon desmid seems worthy of extra description and accurate illustration.

In front view the semicells are truncate-pyramidal, the sinus being deep, linear and closed but slightly opened at the inner extremity. The basal angles are rounded but may show some small crenations. Usually between the basal angle and the apical angle there are two prominent but shallow crenae.

The apices are truncate and appear produced. The apical angles are rounded and well defined while between them are two broad, shallow but easily recognizable crenations. Across the base of the semicells are 4-6 elongated granules or ridges which vary in their degree of discernibility. Rows of prominent rounded granules, some paired, extend from within the marginal crenae towards the median part of the semicell although that part of the semicell surrounding the vertically disposed elongations is devoid of granules.

Within the two median crenae of the apices there are two similar crenae, and extending downwards from these are two rows of binate granules with 2-3 pairs in each row. The whole of the cell wall is covered in pores.

In side view the cells appear distinctly oblong with broad slightly convex apices and faintly convex or sub-parallel lateral margins. Curved rows of prominent granules cross the semicell breadth. In vertical view the semicells are elliptical with two large undulations within the median part of the margin on each long side. The ridges of the apical angles show prominently and beyond those are two curved rows of granules, sometimes binate, extending towards the poles. The apical area proper is devoid of granules but covered in easily discernible pores.

Range of dimensions: length 47.0-51.6 μm ; breadth 39.0-41.5 μm ; length:breadth 1.13-1.27; isthmus 18.0-21.0 μm ; thickness 24.0-26.0 μm .

Judging from the range of figures which has been publishes for this desmid it is a very variable taxon. Nordstedt's original figure (1872, p.33, Pl.7) fits closely to those illustrated here although his portrayal is rather more trapeziforme (Williamson 1995).

319. COSMARIUM HOLMIENSE LUNDELL

Illustrations. Fig.27 (Fritsch 1918).

Samples. RSA: 49, 100 (rare).

Note. *Forma ad var. integrum* Lund. *accedens.* Long., 54.0-58.0 μm ; lat., 33.0-35.0 μm ; lat. isthm., 15.0-17.0 μm .

Only two specimens were observed which agreed with the type, except in the nature of the apices; these were either slightly retuse or slightly convex, the two forms occurring on the two semicells of the same individual. These specimens should be compared with a form of var. *integrum* Lund., described by Borge (Beitr. z. Algenfl. v. Schweden. 2, Bot. Notiser, 1913, p.16, Tab.I, fig.10), which, however, lacks the small undulations of the lateral margins (Fritsch 1918).

320. COSMARIUM HUMILE (GAY) NORDST.

- VAR. **STRIATUM** (BOLDT) SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (rare). – NAM: 306.

321. COSMARIUM IMPRESSULUM ELFV.

Illustrations. Fig.10, C (Hodgetts 1926).

Samples. RSA: 112 (rare, see note), 115, 244, 253, 271, 299. – NAM:

307.

Note. The following form of this species occurred in sample 112, but was rare: - *Forma semicellulis inflatione mediana praeditis*. Long. cell., 20.8 μm ; lat., 17.0 μm ; lat. isthm., 4.5 μm ; crass., 11.2 μm (Fig.10, C).

It differs from the type in the semicells, having a slight median tumour, as shown in Fig.10, C. It may possibly be a form of *C. suborthogonum* Racib., a species which according to W. and G.S. West (West, 1908, p.86) is probably only a form of *C. impressulum*, differing from this in the end view showing a slight median swelling on each side (Hodgetts 1926).

Mistake in article of Hodgetts (1926) in citation of sample number in which (369) species was found. This number is absent in author's list of samples.

Forma Hodgetts (1926, Contributions to our Knowledge of the Freshwater Algae of Africa. 6. Some Freshwater Algae from Stellenbosch, Cape of Good Hope. *Trans. Roy. Soc. S. Afr.*, 13 (Prt.II): p.80, fig.10). Long. cell., 28.0 μm ; lat., 21.0 μm ; isthm., 5.0-6.0 μm . Margin markedly 8-undulate; the second undulation from the sinus is more prominent than in the type (Rich 1940).

Some specimens are considerably smaller than in the typical form; viz.: length 16.0-21.0 μm ; breadth 12.0-15.0 μm ; breadth of isthmus 3.0-4.0 μm (Claassen 1961).

322. COSMARIUM INTEGERRIMUM EHRENB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA, Gnadenthal, in the pond (Rabenhorst 1855).

323. COSMARIUM JAVANICUM NORDSTEDT

- VAR. **PROFUNDO-CONRICTUM** FRITSCH ET RICH

Illustrations. Fig.17, A-D (Fritsch, Rich 1924); Pl.17, Fig.8 (Williamson 1994); Pl.4, 9 (Williamson 2000).

Samples. RSA: 91 (not uncommon), 341, 392.

Note. *Differt a typo isthmo multo angustiore, marginibus lateralibus superioribus plerumque leviter concavis, angulis basalibus saepe leviter protrusis; apice semicellulae rotundato truncato, raro subretuso. Chromatophorae parietales pyrenoidibus pluribus quam in typo. Membrana in totam superficiem grosse punctata.* Long. cell., 102.0-166.0 μm ; lat. cell., 51.0-83.0 μm ; lat. isthm., 18.0-24.0 μm ; crass., 45.0 μm .

A few individuals agreed almost exactly with Nordstedt's figure of the type (Act. Univ. Lund, xvi, 1880, p.7, Tab.I,fig.10), except for the much deeper constriction and a slightly broader and flatter apex (Fig.17, B). The majority, however, showed the slight concavity of the upper lateral margins mentioned in the diagnosis (cf. Fig.17, A), and many had somewhat protruded basal angles.

C. maculatum Turner (K. Sv. Vet.-Akad. Handl., xxv, No.2, 1892, p.49, Tab.VII, fig.31) is very closely allied to *C. javanicum* Nordst., but differs in the character of the sinus and the greater convexity of the lateral margins. Its chloroplasts are unknown. Schmidle (Hedwigia, xxxiv, 1895, p.301, Tab.IV, figs.3, 4) has described a *Cosmarium* (*Pleurotaeniopsis*) *maculatifforme* from Sumatra, which Messrs. West (Trans. Linn. Soc., Bot., vi, 1901, p.163) have regarded as synonymous with *C. maculatum*. It is, however, more likely, in view of its type of constriction, that it is a form of *C. javanicum* Nordst. It is interesting to note that Schmidle speaks of the depth of constriction varying considerably.

C. maculatum var. *major* Gutwinski (Bull. internat. Acad. sc. Cracovie, No.9, 1902, p.588, Pl.XXXVII, fig.27) should doubtless be referred to *C. javanicum* and is probably the same as Schmidle's form, though larger (Fritsch, Rich 1924).

Length 114.0-120.0 μm ; breadth 60.0-61.0 μm ; isthmus 22.0-23.0 μm ; ratio of length to breadth 1.86-2.0; thickness 44.0-45.0 μm . According to Krieger and Gerloff (1962: 88) the typical variety is found on wet calcareous rocks. These specimens were found on wet rocks sprayed by the Nkobongo River at which point the water had a pH of 8.5 probably due, according to the nature reserve warden, to the use of phosphate fertilizers on the farmland immediately adjoining the river (Williamson 1994).

324. COSMARIUM KARIBANUM COESEL ET VAN GEEST

Illustrations. Fig.27 (Coesel, van Geest 2009).

Samples. BOT: 400-411.

Note. The algal species perfectly well meets the characteristics of *Cosmarium subalteum* forma *maius* as described by Thomasson (1965) from Lake Kariba, in Zambia. In our opinion, however, the morphological differences with respect to *C. subalteum* as described by Schmidle (1898) from Mozambique justify distinction on species level. Semicells of our taxon under discussion not only are much bigger but, more relevant, are semi-elliptic in outline versus pyramidate in *C. subalteum*. Moreover, *C. karibanum* is marked by a transversal series of conspicuous granules on either side of the isthmus.

C. karibanum distantly resembles some other large-sized, granulate *Cosmarium* species such as *C. decoratum* W. et G.S. West, *C. pseudodecoratum* Schmidle, *C. controversum* W. West and *C. magnificum* Nordst. and some illustrations of those species in papers on African desmids might refer to *C. karibanum*. However, when considering the original descriptions/illustrations of the above-mentioned species differences with respect to *C. karibanum* are quite obvious. In the Okavango Delta *C. karibanum* was widely distributed on the site of Chief's Island but nowhere common (Coesel, van Geest 2009).

325. COSMARIUM KJELLMANII WILLE

- VAR. **ORNATUM WILLE**

Illustrations. Figs.100, 145 (Grönblad, Croasdale 1971).

Samples. NAM: ? (Grönblad, Croasdale 1971).

Note. Long., 23.0 μm ; lat., 22.0 μm ; isthm., 7.0 μm (Grönblad, Croasdale 1971). No indication of sample number.

326. COSMARIUM LAEVE RABENH.

Note. It is manifest that *C. laeve* is very variable in South Africa, since other forms have already been recorded from the Cape (Fritsch 1918, p. 555). The specimens illustrated in Fig.11, A, E and F, were all drawn from the material in sample 74, but they only represent the outstanding forms, and numberless transitions between them were encountered. The typical form (Fig.11, E, a) has retuse apices and smooth, rounded sides, the membrane in the present material being never more than obscurely punctate and in many cases seemingly quite smooth (cf. Fritsch 1918, p. 555). According to Messrs. West's monograph, "this slight retuseness in the middle of the apex is characteristic of all forms of the species," but it appears doubtful whether this statement really applies. Messrs. West ("Freshwater Chlorophyc.," in J. Schmidt, 'Fl. Koh Chang, Bot. Tidsskrift,' xxiv, 1901, Tab.II, fig.14) have themselves figured specimens in which the retuse apex is scarcely recognizable (cf. also Raciborski 'Rozprawy Akad. Umiej. Krakow,' ser. 2, ii, 1892, Pl. VI, fig. 20, a), and in sample 74 forms were encountered (f. *rotundata*, Fig.11, F) in which the apices were smoothly rounded off and without any trace of retuseness (side-view as in Fig. 11, E, b). Such specimens might be regarded as not belonging to *C. laeve*, were it not that they are connected with the typical form by transition; thus individuals were occasionally met with in which one semicell showed a retuse apex, whilst the other was rounded off as in Fig.11, F. Numerous specimens were, moreover, observed in which the apex was retuse on the one semicell but merely slightly thickened on the other (Fig.11, E, a', a"). A reference to Fig.11, E, a, a', a", a'" further shows the shape of the semicells (either of one or both) is subject to considerable variation. Thus, the lower parts of the sides may be almost subparallel (Fig.11, E, a', especially the lower semicell), but sides may be somewhat angular (as in Fig.11, E, a"), and the width of the apex rather diverse (cf. Fig.11, E, a, a', a", etc.).

Specimens like those figured in Fig.11, E, a", lead over to the form of *C. rectangulare* Grun., shown in Fig.11, G (especially a'), whilst forms like those represented by the lower semicell in Fig.11, E, a', are transitional to forms of *C. granatum* Bréb. (cf. Fig.11, H, and p.32).

In some few cases individuals were observed in which the sides of the semicells converged very markedly (f. *acuminata*, Fig.11, D); in these the apex was not retuse, but more or less rounded, and the semicells, in side-view (Fig.11, D, b), were more rounded than was the case with the other forms (cf. Fig.11, E, b).

It would thus appear that *C. laeve* Rabenh. may vary in respect of the apex, the punctuation of the membrane, and the form of the lateral margins, extreme conditions approaching on the one hand to *C. granatum* Bréb., on the other hand to *C. rectangulare* Grun. (Fritsch, Stephens 1921).

- VAR. LAEVE

- F. LAEVE

Illustrations. Fig.90 (Grönblad, Croasdale 1971); Fig.17, Fig.6 (Williamson 1994).

Samples. RSA: 14, 28, 51, 52, 53, 91 (common), 133 (rare), 134 (rare), 136 (rare), 138 (common), 139 (rare), 140 (common), 143 (rare), 151 (rare; with var. *distentum* G.S. West), 152 (common), 154 (common), 156 (rare), 167

(rare), **168** (rare), **171** (common), **174** (rare), **192** (rare), **198** (rather rare), **212**, **267**, **268**, **360**, **430**. – **NAM: 307**. – **LES: 426**.

Note. *Forma membrana laevi*. *Long.*, 18.0-30.0 μm ; *lat.*, 15.0-21.0 μm ; *lat. isthm.*, 3.5-5.0 μm ; *crass.*, 10.0 μm (Fritsch 1918).

Long. cell., 16.0-19.0 μm ; *lat. cell.*, 12.0-13.0 μm ; *lat. isthm.*, 4.0 μm (Fritsch, Rich 1924).

Long. cell., 23.0-31.0 μm ; *lat.*, 14.0-20.0 μm ; *ist.*, 4.0-6.0 μm ; *crass.*, 14.0-15.0 μm . This was the most widely distributed species of the genus. The numerous individuals seen exhibited considerable variation in the proportion of length to breadth and in the degree of convexity of the lateral margins of the semicells (Fritsch, Rich 1930).

Long. cell., 21.0-22.0 μm ; *lat.*, 13.0-14.0 μm ; *isthm.*, 4.0 μm (Fritsch, Rich 1938).

Long., 17.5-18.0 μm ; *lat.*, 12.0-12.5 μm (1.4-1.5x); *isthm.*, 3.5-5.0 μm (Grönblad, Croasdale 1971).

Length 29.0-33.0 μm ; *breadth* 23.0-24.0 μm ; *isthmus* 7.0-8.0 μm ; *ratio of length to breadth* 1.2-1.4 (Williamson 1994).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

(?) - F. ACUMINATA (?)

Illustrations. Fig.11, *D* (Fritsch, Stephens 1921).

Samples. **RSA: 74** (rare).

Note. *Long. cell.*, 30.0 μm ; *lat. cell.*, 22.0 μm ; *lat. isthm.*, 6.0 μm ; *crass.* 14.0 μm . *Lateribus valde convergentibus, apicibus subrotundatis non retusis; semicellulis a latere visis lateribus plus rotundatis* (Fritsch, Stephens 1921).

(?) - F. ROTUNDATA (?)

Illustrations. Fig.11, *F* (Fritsch, Stephens 1921).

Samples. **RSA: 74** (rather rare), **87, 89** (rather common).

Note. *Long. cell.*, 30.0-31.0 μm ; *lat. cell.*, 18.0-19.0 μm ; *lat. isthm.*, 5.0-6.0 μm . *Apicibus non retusis* (Fritsch, Stephens 1921).

Long. cell., 30.0-33.0 μm ; *lat. cell.*, 20.0-22.0 μm ; *lat. isthm.*, 6.0-7.0 μm (Fritsch, Rich 1924).

(?) - F. TYPICA (?)

Illustrations. Fig.11, *E, a, b* (Fritsch, Stephens 1921).

Samples. **RSA: 67, 74** (with zygospores), **83**.

Note. *Long. cell.*, 22.0-36.0 μm ; *lat. cell.*, 16.0-24.0 μm ; *lat. isthm.*, 4.5-6.0 μm ; *crass.* 12.0 μm ; *lat. zygosp.*, 16.0 μm . *Membrana saepe laevis* (Fritsch, Stephens 1921).

- VAR. DISTENTUM G.S. WEST

Illustrations. Fig.48 (West 1912).

Sample. **RSA: 11, 14, 15, 16, 134, 151** (common), **167, 174** (common).

Note. *Var. semicellulis latioribus, lateribus subdilatis; a vertice visi cum tumore parvo ad medium utrobique.* *Long.* 26.0-29.0 μm ; *lat.* 21.0-24.0 μm ; *lat. isthm.* 6.0-7.0 μm ; *crass.* 15.5 μm .

This desmid occurred abundantly in the above-mentioned localities. Forms of *C. laeve* appear to be very widely distributed and by no means uncommon throughout the African continent (West 1912).

In samples **134, 151, 167** and **174** – together with the type. *Long. cell.*, 24.0-28.0 μm ; *lat.*, 19.0-22.0 μm ; *ist.*, 4.0-6.0 μm ; *crass.*, 13.0-15.0 μm .

The scrobiculations on the wall were sometimes plainly evident, in other cases the wall appeared quite smooth, the variety in this respect varying like the type (Fritsch, Rich 1930).

- VAR. **MAJUS** CLAASSEN

Illustrations. Tab.24, fig.7 (Claassen 1961).

Sample. RSA: 267, 269.

Note. *Differt a typo speciei cellulis multomaioribus. Formae intermediae haud visae.* This differs from the typical form in having much larger dimensions. Cells 1.5-1.7 times longer than broad. Length 48.0-50.0 μm ; breadth 29.0-32.0 μm ; breadth of isthmus 10.0-11.0 μm (Claassen 1961).

- VAR. **MESSIKOMMERI** CROASD. (SYN.: *COSMARIUM LAEVE* RABENH. VAR. *ROTUNDATUM* MASSIK. 1935)

Illustrations. Pl.17, Fig.3 (Williamson 1994).

Sample. ? (Williamson 1994), **386.**

Note. Length 26.0-28.0 μm ; breadth 17.0-18.0 μm ; isthmus 4.0-5.0 μm (Williamson 1994).

In (Williamson 1994) was not indicated sample number.

A variety without perceptible retuse apices (Williamson 2000).

- VAR. **OCTANGULAREM** (WILLE) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 68 (very rare).

Note. *Long. cell., 16.0 μm ; lat. cell., 15.0 μm ; lat. isthm., 3.0 μm* (Fritsch, Stephens 1921).

This taxon from sample **68** indicated as forma *minor* in (Fritsch, Stephens 1921).

- VAR. **PSEUDO-OCTANGULARIS** FRITSCH ET RICH

Illustrations. Fig.17, A (Fritsch, Rich 1930).

Samples. RSA: 158 (rather common), **299.**

Note. *Semicellulis a fronte visis formae var. octangularis* (Wille) W. et G.S. West, *sed marginibus lateralibus e partibus duabus solum constantibus, iis inferioribus plus minus divergentibus, iis superioribus valde convergentibus, apice angusto, distincte retuso in media parte; a latere visis leviter ellipticis; a vertice ellipticis, sine tumore mediano. Long. cell., 16.0-18.0 μm ; lat., 14.0-17.0 μm ; ist., 4.0 μm ; crass., 7.0-8.0 μm .*

The large number of individuals in this sample were very constant, except as regards the degree of divergence of the lower lateral margins. A few were also seen in which the apex was much broader than is shown in Fig.17, A, a. Usually there was a slight thickening of the membrane where the retuseness occurs in the middle of the apex (Fritsch, Stephens 1921).

Long. cell., 21.0 μm ; lat., 16.0 μm . The lower lateral margins are more or less markedly divergent, and the apex is slightly retuse, as in Griqualand West (sample **158**) (Rich 1940).

- VAR. **SEPTENTRIONALE** WILLE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 51, 112 (very rare).

327. COSMARIUM LOBATUM BOERGESEN

- VAR. **ELLIPTICA** FRITSCH ET RICH

Illustrations. Fig.14, L-N (Fritsch, Rich 1938).

Samples. RSA: 200 (*forma major*), **202** (rare), **203, 205** (typical and *forma major*).

Note. Differt a typo semicellulis in aspectu verticali late ellipticis polis rotundatis, membrana scrobiculata. Long. cell., 44.0-64.0 μm ; lat., 36.0-48.0 μm ; isthm., 17.0-19.0 μm ; crass. circa 31.0-36.0 μm .

The dimensions agree well with those given by Boergesen for the type ("Desmidiaceae", in Warming, Symbolae ad floram Brasiliae centralis cognoscendam, 1890, p.42). The rounded papilla, on each side of the semicell in front-view and at the poles in end-view, is well marked. The shape of the end-view is, however, distinctive, as is also the scrobiculate membrane. The front-view shows a decided resemblance to *Staurastrum brevispinum* Bréb, forma *major* W. et G.S. West (West, West 1912, Pl.CXXIII, fig.4).

Forma major. Long. cell., 115.0-120.0 μm ; lat., 80.0 μm ; isthm., 30.0 μm ; crass., 70.0 μm (Fritsch, Rich 1938).

328. COSMARIUM LOGIENSE BISSET

- F. LOGIENSE (SYN.: *COSMARIUM AMOENUM* BRÉB. VAR. *INTUMESCENS* NORDST. IN WILLIAMSON 1994)

Illustrations. Pl.14, Fig.13 (Williamson 1994); Pl.3, 9 (Williamson 2000).

Sample. RSA: 336, 355, 361, 386, 388, 394.

Note. Length 65.0-71.0 μm ; breadth 42.0-47.0 μm ; isthmus 15.5-17.5 μm ; ratio of length to breadth 1.5-1.6; thickness 26.0-28.0 μm . The cell wall granules are often closely surrounded by 3-6 smaller pores which sometimes give a polygonal appearance. There is a superficial resemblance to *C. amoenum* var. *constrictum* which differs in its pattern of granulation, in the vertical view, smaller dimensions and which lacks the circles of punctae round the larger cell wall pores (Williamson 1994).

This was identified as *Cosmarium amoenum* var. *intumescens* Nordst. in (Williamson 1994) but has now been reassigned, albeit with only slightly more confidence! Since first examined it has been variously but temporarily assigned to a number of species including *C. conspersum* var. *capense* (Hodgetts 1926), *C. gyanum* var. *rotundata* Fritsch (Fritsch, Stephens 1921) and *C. margaritatum* f. *subrotundatum* W. et G.S. West (West, West 1912), but either the dimensions and the shape, or the size and pattern of granules are not in agreement with the specimens which overall seem to be nearest to *C. logiense* Biss.

Dimensions: length 65.6-71.4 μm , breadth 42.5-46.7 μm , isthmus 15.4-17.5 μm , thickness 27.0-28.0 μm , length/breadth 1.48-1.6 (Williamson 2000).

In (Williamson 2000) indicated as: (?) *Cosmarium logiense* Biss.

- F. EXPANSA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 10.

Note. A rather small form: *long.* 50.0 μm ; *lat.* 46.0 μm ; *lat. isthm.* 17.0 μm . This form should be compared with that described and figured by Gutwinski from Poland as "*C. logiense* forma?" (*vide* Rozpraw. Wydz. Mat.-przyr. Akad. Umiej. Krakow. xxxiii, 1896, p.25, t.7, f.33) (West 1912).

- F. SUBCIRCULARE WILLIAMSON

Illustrations. Pl.5, 4', 4" (Williamson 2000).

Samples. RSA: 396.

Note. Differs from type by being broader and with semicells which are almost semicircular. Semicells almost semicircular, margins minutely granulate and convex. Basal angles rounded with maximum breadth of the semicell at the base. Sinus linear, deep and closed. Cell wall densely covered in small rounded-conical granules which are surrounded at their base by a hexagonal pattern of

pores. Granules in 22-24 more or less vertical rows, but rather less noticeably disposed horizontally and often irregular in the middle of the semicell. Vertical view oblong-elliptic with sub-parallel margins.

Dimensions: length 60.0-65.5 μm , breadth 53.0-57.0 μm , isthmus 15.5-17.5 μm , thickness 28.0-29.2 μm .

It can be seen that the breadth of the specimens is greater than usually attributed to *C. logiense* Biss. and the semicells are more depressed and semicircular. Couté and Tell (1981: Pl.IV, figs.5, 6) show an SEM photograph which demonstrates the hexagonal pattern of pores around the granules, exactly matching the pattern which is just discernible by transmitted light microscopy (Williamson 2000).

329. COSMARIUM LUNDELLII DELP.

- VAR. LUNDELLII

Illustrations. Fig.54 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. Forma. A small form, apparently scrobiculate or punctate in the central area. Long., 47.0 μm ; lat., 50.0 μm ; isthm., 28.0 μm . R. Grönblad suggested for this "*C. perforatum* Lund.", which implies that the central pores that he shows are scrobiculations. H. Croasdale does not believe his plant is *C. perforatum*, which is typically of a very different shape, being angular, with wide open sinus, and is also much larger (Grönblad, Croasdale 1971).

- VAR. CORRUPTUM (TURNER) W. ET G.S. WEST (SYN.: *COSMARIUM CORRUPTUM* TURNER)

Illustrations. Fig.55 (Grönblad, Croasdale 1971).

Samples. RSA: 91 (rather common), **382, 392.** – **NAM: 305.**

Note. Long. cell., 31.0-42.0 μm ; **lat. cell.,** 39.0-42.0 μm ; **lat. isthm.,** 20.0-22.0 μm ; **crass.,** 25.0 μm .

With respect to the shape of the front-view our specimens on the whole agreed better with Turner's figures (K. Sv. Vet.-Akad. Handl., xxv, No.2, 1892, p.51, Tab.VIII, fig.2) than with those in Messrs. West's monograph (West, West 1905, p.139, Pl.LVII, figs.5, 6). They never showed so well-defined a truncate apex as is there depicted, in fact some specimens were almost rounded at the summit. Our dimensions practically agree with those of f. *minor* Gutwinski (Sprawoz. Kom. Fizyogr. Ak. Umiej. Krakow, xxx, 1895, p.88, Tab.III, fig.19), which, however, seems to stand nearer to *C. lundellii* Delp. as figured by Messrs. West than to *C. corruptum* (Fritsch, Rich 1924).

Long., 59.0 μm ; lat., 48.0 μm (1.22x); isthm., 25.0 μm . R. Grönblad did not name this plant. It resembles somewhat *C. pachydermum* Lund. var. *indicum* Iyengar et Vimala Bai, but in outline our plant more closely resembles *C. lundellii*, and its puncta are closer, and very prominent at the margin (Grönblad, Croasdale 1971).

330. COSMARIUM MALMEI BORGE

Illustrations. Fig.12, B (Hodgetts 1926).

Samples. RSA: 119 (very rare).

Note. Long. cell., 53.3 μm ; **lat.,** 25.3 μm ; **lat. isthm.,** 22.6 μm .

This appears to be a form of *C. malmei* Borge ("Algen Erst Regnellsh. Exped. II, Desmid.," Archiv f. Bot., 1903, Bd.1, p.85, t.2, fig.11), a species about which little is known. The cell-wall was colorless, with large conical obtuse granules in vertical series, about eleven or twelve vertical rows being visible in

front view. The end view is circular. The original account by Borge does not include any description of the chloroplast. The present specimens showed a well-marked stellate chloroplast in each semicell, with a large central pyrenoid.

In front view very closely resembles that of *C. (Dysphinctium) williei* Turner ("Alg. E. India," Kongl. Sv. Vet.-Akad. Handl., Bd.25, 1892, p.42, t.8, fig.40), which, however, has an oval vertical view (Hodgetts 1926).

331. COSMARIUM MANSANGENSE W. ET G.S. WEST

- VAR. MANSANGENSE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (very rare).

Note. Long., 70.0-72.0 μm ; lat., 27.0-28.0 μm . This species closely resembles *C. elegantissimum* Lund. var. *simplicius* W. et G.S. West. It appears to differ from the latter in its larger number of granules and its more deeply constricted cells (Rich 1932).

- VAR. AFRICANUM FRITSCH ET RICH

Illustrations. Fig.18, *D* and *E* (Fritsch, Rich 1924).

Samples. RSA: 91 (not uncommon).

Note. *Semicellulae a frontae visae formae ejusdem quam in typo, sed 1.5-2 plo majores constrictione profundiore; membrana crassa, chromatophoris parietalibus pyrenoidibus pluribus; verrucis membranae a superficie visis circularibus vel rectangularibus, in sectione opticali visis apicibus deplanatis vel emarginatis, ca. 32 in ambitu semicellulae et ca. 18 series verticales in aspectu frontali.* Long. cell., 91.0-124.0 μm ; lat. cell., 35.0-45.0 μm ; lat. isthm., 27.0 μm .

The chloroplasts of *C. mansangense* were not described in the original diagnosis, but there can be no doubt that the variety here established belongs to this species and that the latter will prove to possess the same parietal chloroplasts (Fritsch, Rich 1924).

332. COSMARIUM MARGARITATUM ROY ET BISS.

- VAR. MARGARITATUM

- F. MARGARITATUM

Illustrations. Fig.39 (Nyygard 1932); Fig.111 (Grönblad, Croasdale 1971); Pl.5, 2 (Williamson 2000).

Samples. RSA: 184 (1 specimen was observed), **394. – NAM: 302.**

Note. The individual recorded corresponds very well to the diagnosis in Messrs. West's monograph (West, West 1912, p.18, t.99, fig.10), except that 16-17 oblique decussating series of granules are visible across the semicell; Messrs. West give about 12. Further, the semicells were nearly as strongly rounded as in f. *subrotundata* West (West, West 1912, p.18, t.100, fig.1), which, however, has hollow granules, and this is not so in the present specimen. Length 102.0 μm , breadth 80.0 μm , breadth of isthmus 32.0 μm ; 35-36 granules visible at the margin of the semicell; two pyrenoids in each semicell (Nyygard 1932).

Long., 88.0 μm ; lat., 64.0 μm (1.37x); isthm., 22.0 μm . Our plant differs from the type as shown by Wests (1912, pp.8, 10) and other authors, in being relatively longer and in having the sides of the semicell straight from rather square basal angles (Grönblad, Croasdale 1971). In (Grönblad, Croasdale 1971) indicated as *Cosmarium margaritatum* (Lund.) Roy et Biss.

This unusual elongate-quadrate form occurred fairly on the wet rocks examined. Not only are the quadrate semicells with their more or less straight lateral margins striking, but the cell wall is covered in geminate granules which

appear mainly to radiate from the margins to the semicell centre. A row of elongated or germinate granules arcs across the semicell on each side of the isthmus. Between the granules are some irregular pores.

Dimensions: length 50.0-54.0 μm , breadth 37.3-39.2 μm , isthmus 17.0-21.0 μm , thickness 25.0-26.0 μm , length/breadth 1.27-1.44, breadth/thickness 146-1.56. Indicated as *Cosmarium margaritatum* (Lund.) Roy et Biss. *forma* (Williamson 2000).

- F. SUBROTUNDATA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 191 (very rare).

- F. MINOR BOLDT.

Illustrations. Pl.18, Fig.1 (Williamson 1994).

Samples. RSA: 299, 332, 337, 351.

Note. In (Rich 1940) indicated as ? *Cosmarium margaritatum* (Lund) Roy et Biss. f. *minor* Boldt. Long. cell., 50.0 μ ; lat., 40.0 μ ; isthm., 13.0-14.0 μ . The punctulation between the granules were not observed (Rich 1940).

Length 48.5 μm ; breadth 47.7 μm ; isthmus 16.0 μm ; ratio of length to breadth ca. 1.0; thickness 24.0 μm (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium margaritatum* (Lund.) Roy et Biss. var. *margaritatum* f. *minor* (Boldt) W. et G.S. West.

333. COSMARIUM MARGARITIFERUM MENEGH.

- VAR. EXCERTUM FRITSCH ET RICH

Illustrations. Fig.18. A-C (Fritsch, Rich 1924).

Sample. RSA: 91 (not uncommon).

Note. *Marginibus lateralibus semicellularum convexis, cum incisura manifesta tertia parte ab apice, ita ut tertia pars superior cujusque semicellulae excerta videtur; apice lato truncato; granulis aequalibus plus minusve verticaliter dispositis, granulo quoque punctis 6 regulariter dispositis circumdato. Aspectus lateralis typo similis est; aspectus verticalis in medio leviter inflatus. Long. cell., 39.0-45.0 μm ; lat. cell., 35.0-36.0 μm ; lat. isthm., 11.0-12.0 μm ; crass. 22.0 μm .*

This is a very well-marked form characterized by the incision found about one-third of the way down the apex (Fig.18, A), the vertical arrangement of the granules, and the fact that the minute punctae around them are not confined to the central region of the semicell. We cannot, however, say certainly whether these punctae extend to the extreme margin of the latter (Fritsch, Rich 1924).

334. COSMARIUM MAXIMUM (BOERGES.) W. ET G.S. WEST (SYN.: COSMARIUM OBSOLETUM (HANTZSCH) REINSCH SUBSP. MAXIMUM BOERGESSEN)

- VAR. MAXIMUM

Illustrations. Fig.15, B (Fritsch, Rich 1924).

Sample. RSA: 91 (rare), **199** (very rare).

Note. *Forma latior et minor. Long cell., 97.0-99.0 μm ; lat. cell., 105.0-111.0 μm ; lat. isthm., 18.0 μm .*

The specimens agreed altogether with those figured by Boergesen (Vidensk. Medd. Nat. Foren. Kjøbenhavn, 1890, p.42, Tab.VI, fig.37), except as regards dimensions and the relation of length to breadth. They showed the same slight retuseness of the middle of the lateral margins, and it appears that this feature is distinctive of the type, although not evident in var. *minor* W. et G.S. West (Journ. Bot., 1897, p.114, Tab.267, fig.21) (Fritsch, Rich 1924).

Forma Fritsch et Rich. Long. cell., 80.0 μm ; lat., 70.0 μm ; isthm., circa 20.0 μm . The dimensions are less than in the form described from Natal, and the breadth does not exceed the length (Fritsch, Rich 1938).

- VAR. MINOR WEST

Illustrations. Tab.27, fig.5 (Claassen 1961).

Sample. RSA: 258.

Note. Cells slightly larger than in the typical form. Length 69.5-70.0 μm ; breadth 55.5-58.0 μm (with spines 60.5-66.0 μm); breadth of isthmus 12.0-14.5 μm (Claassen 1961).

335. COSMARIUM MBABANICUM WILLIAMSON

Illustrations. Pl.18, Fig.4 (Williamson 1994).

Sample. SWA: 377 (?).

Note. This handsome desmid was found to thinly populate a stream near Mbabane, Swaziland (sample ? 377). The cells are large being 1.7-1.8 times longer than broad. In front view the semicells are almost circular with slightly flattened apices. The sinus is a shallow widely-open excavation whilst the isthmus is elongated. The cell wall is thickly covered with rounded granules arranged in horizontal and decussating rows, about 22 granules across the semicell and 40-42 around each margin. Over the whole cell surface each granule is surrounded by a hexagonal pattern of pores except at the elongated isthmus which is devoid of any wall features. In lateral view the semicells are circular, the apices convex. In vertical view the semicells are sub-circular to broadly elliptical. The chloroplast in this preserved material was not observable. Length 130.0-140.0 μm ; breadth 76.0-78.0 μm ; crass. 65.0-70.0 μm .

This desmid bears some resemblance to *C. striolatum* (Näg.) Archer var. *norstedtii* (Möb.) Krieger (1932) (basonym: *C. glyptodermum* W. et G.S. West 1895) but differs in various ways. The dimensions and ratio of length to breadth are much greater, the isthmus is elongated, the cell wall granulation is denser, the semicells have a constant globular shape and in vertical view is broadly elliptical. These differences and the fact that it does not fit any other taxon warrants its description as a new species (Williamson 1994).

336. COSMARIUM MEDIOSCROBICULATUM W. WEST

- VAR. AEQUALE KRIEG. ET GERL.

Illustrations. Pl.18, Fig.5. (Williamson 1994).

Sample. RSA: 332, 356, 382.

Length 44.6-62.0 μm ; breadth 40.0-57.6 μm ; isthmus 24.5-33.0 μm ; ratio of length to breadth 1.1-1.2; thickness 27.0-35.0 μm . This seems nearest to these specimens which are characterized by a widely-open sinus, elliptical semicells and a scrobiculate cell wall.

This should be compared with *C. lundelli* var. *corruptum* f. *scrobiculatum* Irénée-Marie (1956) which is very similar in the front view but present much narrower vertical and lateral aspects (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium medioscrobiculatum* W. et G.S. West var. *aequale* Krieg. et Geitl.

- VAR. INFLATUM PRINTZ

Illustrations. Figs.63, 64 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. Long., 68.0-70.0 μm ; lat., 59.0-61.0 μm (1.11-1.18x); isthm., 38.0-40.0 μm . In size, shape and ornamentation our plant seem very similar to this

variety. R. Grönblad suggested “var. *egranulatum* Gutw. forma in Bourrelly et Manguin (1949, p.187, 4: 46)” (Grönblad, Croasdale 1971).

337. COSMARIUM MENEGHINII BRÉB.

- VAR. MENEGHINI

- F. MENEGHINI

Illustrations. Fig.10 (Fritsch, Stephens 1921), Fig.17, *B* (Fritsch, Rich 1930).

Sample. RSA: 31 (rare), **82** (very rare), **112, 113, 115, 168, 198, 210, 216, 268.** – **NAM: 305.**

Note. *Forma marginibus lateralibus inferioribus leviter divergentibus; alioqui typo et non var. nano Wille similis est. Long., 24.0 µm; lat., 15.0 µm; lat. isthm., 5.0 µm* (Fritsch 1918).

Forma marginibus omnibus evidenter retusis et interdum undulatione exigua in media margine superiore retusa. Long. cell., 14.0 µm; lat., 12.0 µm; ist., 3.0 µm; crass., 10.0 µm (Fritsch, Rich 1930).

Long. cell., 15.0 µm; lat., 11.0 µm; isthm., 3.0 µm. A single zygospore observed was globose, and furnished with short acute spines (Fritsch, Rich 1938).

- F. AFRICANA FRITSCH ET STEPHENS

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 63 (rare), **71** (rare).

Note. *Forma “marginibus lateralibus interioribus leviter divergentibus; alioqui typo et non var. nano, Wille similis est,”* Fritsch (1918, p.555). *Long. cell., 18.0-24.0 µm; lat. cell., 12.0-15.0 µm; lat. isthm., 5.0 µm* (Fritsch, Stephens 1921).

338. COSMARIUM MICROSPHINCTUM NORDST.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 234.

339. COSMARIUM MINUTISSIMUM ARCH.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. *Forma. Long., 9.1 µm; lat., 7.8 µm* (Huber-Pestalozzi 1930).

340. COSMARIUM MONILIFORME (TURP.) RALFS

- VAR. MONILIFORME

- F. MONILIFORME

Illustrations. Pl.17, Fig.4 (Williamson 1994).

Sample. RSA: 201, 350.

Note. Long. cell., 32.0 µm; lat., 20.0 µm; isthm., 4.0 µm (Fritsch, Rich 1938).

Length 21.0 µm; breadth 13.5 µm; isthmus 7.7 µm; ratio of length to breadth 1.5 (Williamson 1994).

Drakensberg, KwaZulu Natal (orig.).

- F. PANDURIFORMIS HEIMERL

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 200.

Note. A very small form; long., 14.0-15.0 µm; lat., 7.0-9.0 µm; diam. zygosp., 13.0-14.0 µm. The zygospore had a smooth membrane (Fritsch, Rich 1938).

- VAR. SUBPYRIFORME W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 200, 203.

Note. Long., 30.0-36.0 μm ; lat., 15.0-18.0 μm ; isthm., 4.5-6.0 μm ; crass., 16.0 μm ; diam. zygosp., circa 30.0 μm . The zygospore had a very thick wall (Fritsch, Rich 1938).

341. COSMARIUM MONODII BOURRELLY

Illustrations. Figs.66, 141 (Grönblad, Croasdale 1971).

Sample. NAM: 301, 307.

Note. Long., 114.0 μm ; lat. with spines 99.0 μm ; isthm., 34.0 μm . R. Grönblad named this plant, with apparently some question in his mind. His sketch does not show the fine and coarse scrobiculations which partially characterize the species, but this feature is shown in the photo (Fig.141) (Grönblad, Croasdale 1971). In (Grönblad, Croasdale 1971) indicated as *Cosmarium ? monodii* Bourrelly.

342. COSMARIUM MONOMAZUM LUND.

- VAR. MONOMAZUM

Illustrations. Fig.14, O, P (Fritsch, Rich 1938).

Sample. RSA: 200, 202, 203, 390.

Note. *Forma membrana punctata.* Long. cell., 26.0-29.0 μm ; lat., 28.0-30.0 μm ; isthm., 7.0-10.0 μm ; crass. max., 14.0-20.0 μm .

There are about 16 slightly emarginate and flattened warts just within the margin of the semicell, while the centre is provided with a rather large tubercle. The vertical view has truncate poles, a large median tubercle on each side, and a series of emarginate warts extending from pole to pole just within each lateral margin. The cell wall is punctate. The dimensions are less than those given by Messrs. West for the type (West, West 1908, p.140) (Fritsch, Rich 1938).

- VAR. SUBMONOMAZUM (RICH.) FÖRSTER 1982, TAF.27, FIG.10

Illustrations. Pl.18, Fig.2 (Williamson 1994).

Sample. RSA: 356.

Note. Length 32.0 μm ; breadth 32.0 μm ; isthmus 13.0 μm ; ratio of length to breadth 1.0 (Williamson 1994).

343. COSMARIUM MOREMIENSE COESEL ET VAN GEEST

Illustrations. Figs.24, 25 (Coesel, van Geest 2009).

Sample. BOT: 400-411 (not indicated exactly in which of these samples),

415.

Note. Cells 1.2 times longer than broad, deeply constricted. Sinus closed or narrowly open, linear or slightly undulate. Semicells in frontal view trapezoid, the apical angles broadly rounded. Apical part of the cell wall provided with transversal series of broad, rather flat tubercles intermingled with coarse scrobicles, basal part beset with smaller tubercles/granula and less distinct scrobicles. Semicells in outline with an unsculptured separation between a coarsely crenate apical part and a densely granulate basal part. Cell length 44.0-50.0 μm , cell breadth 36.0-41.0 μm , cell thickness 27.0-29.0 μm , breadth of isthmus 10.0-12.0 μm . *Type*: our fig. 24. *Type locality*: water course at Moremi (sample **415**), P.F.M. Coesel, 9 October 2006, plankton collection # 2006.57 in the Amsterdam University herbarium.

At first glance *C. moremiense* somewhat resembles *C. salisburyi* and *C. transvaalense*, both also described from Africa (Fritsch, Rich 1938). A decisive differentiating characteristic of *C. moremiense*, however, is in the sculpturing of the semicell outline: broadly crenate in the apical part, densely granulate in the basal part and with an almost unsculptured stretch in between. *C. moremiense* was rather frequently encountered in sample **415** originating from the site of Moremi, in lower cell numbers it was also found in some samples from the site of Chief's Island (Coesel, van Geest 2009).

344. COSMARIUM MULTIORDINATUM W. ET G.S. WEST

- VAR. **BHURMENSE** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 198, 200.

Note. Long. cell., 84.0-91.0 μm ; lat., 63.0-66.0 μm ; isthm., 20.0 μm ; crass., 44.0 μm . The warts were rather more numerous and scarcely conical in form, although much more pointed than in the West's figure of the type. There were two pyrenoids in each semicell (Fritsch, Rich 1938).

345. COSMARIUM MULTITUBERCVLATUM FRITSCH ET RICH

Illustrations. Fig.18, A-O (Fritsch, Rich 1938).

Sample. RSA: 200, 201, 202, 204, 205.

Note. *C. parvum*, ca. *tam longum quam latum, profunde constrictum, sinu angusto-lineari vel saepe paullo aperto, plerumque introrsum leviter ampliato, pyrenoidibus 2 in quaque semicellula; semicellulae a fronte visae semiellipticae, angulis inferioribus subrectangularibus, lateribus convexis cum crenis vel spinis parvis 4, apicibus plus minus convexis et leviter undulatis, intra apicem cum tuberculis bene evolutis 2-4 et in superficies cum tuberculis rotundatis in seriebus transversalibus 1-3 dispositis interdum non evolutis; semicellulae a latere visae trapeziformes, apicibus latis truncatis, cum tuberculo in angulo apicali unoquoque et saepe cum tuberculis 1 vel 2 infra angulum apicale; semicellulae a vertice visae ellipticae, polis rotundatis 1-3 papillatis, lateribus cum tuberculis 3-4 in media parte. Zygosporae polyhedricae, angulis cum spina brevi obtusa.* Long. cell., 25.0-30.0 μm ; lat., 27.0-32.0 μm ; isthm., 5.0-7.5 μm ; crass., 15.0-18.0 μm ; diam. zygosp. sine proc., 30.0 μm ; c. proc., 40.0-50.0 μm .

This is a highly variable species allied to *C. taxichondrum* Lund., but all the different forms observed appeared to grade into one another to such a degree that a distinction of separate varieties did not appear feasible. The sinus, though generally more or less open, is closed in some individuals (A, D). The convex lateral margins are provided with 4 prominences which either take the form of mere crenations or appear as well-defined, though small, spines. The apex is more or less convex and slightly undulate. It is in the ornamentation of the surface of the semicell that the greatest degree of variability is found. There are always a number of rather pointed tubercles just beneath the apex, commonly 3 or 4 in number (A-C, F), but sometimes there are only 2 (N). In some cases these constitute the only ornamentation present, but commonly there are further transverse rows of rather more rounded tubercles on the surface of the semicell, either only one row (F) or several (D, N). The infra-apical tubercles appear also in the end-view (E, G), while the side-view shows the surface-markings as one or more tubercles at and below the apical angles of the semicells (J, M). A rather extreme form, in which the subapical tubercles are large and markedly pointed is

seen in *L*. Only two zygospores were seen; they were polyhedral, and each angle was surmounted by a short blunt spine (Fritsch, Rich 1938).

346. COSMARIUM NANUM CLAASSEN

Illustrations. Tab.24, fig.12 (Claassen 1961).

Sample. RSA: 253.

Note. *Affinis C. pseudarcto* Nordst., *sed cellulis ad apicem leviter deplanatis et sinu profunde constricto distincta.*

Near *C. pseudarctorum* Nordst. (West, West 1908, p.32, Pl.LXVIII, figs.12-14; Pl.LXXIII, figs.40, 41); but the cells are slightly depressed at the apices and are deeply constricted at the sinus. Cells very small, 1.7-1.8 times as long as broad; sinus narrowly linear; semicells semicircular with a slightly truncately-rounded apex. Cell wall smooth. Each chloroplasts contains one central pyrenoid. Length 14.0-20.0 μm ; breadth 8.0-12.0 μm ; breadth of isthmus 3.0-4.5 μm (Claassen 1961).

347. COSMARIUM NORIMBERGENSE REINSCH

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 268. – NAM: 307.

348. COSMARIUM NOVAE-SEMLIAE WILLE

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 305.

349. COSMARIUM NYLSTROMICA CLAASSEN

Illustrations. Tab.26, fig.13 (Claassen 1961).

Sample. RSA: 253.

Note. *Affinis C. năgeliano* Bréb., *sed cellulis multo maioribus, numero undulationum membranae et forma angulorum basalim semicellularum differt.*

This somewhat resembles *C. năgelianum* Bréb. (West, West 1908, p.14, Pl.LXVI, fig.12); but differs in the number of undulations, the delineation of the basal angles of the semicells, and in having larger dimensions. Cells of medium size, about 1.2-1.3 times longer than broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells truncate-pyramidate, basal angles rounded, sides with 4-5 undulations, apical margin with four undulations; cell wall smooth and colorless. In each semicell there is one exile chloroplast containing a single central pyrenoid. Length 41.0-49.0 μm ; breadth 33.0-36.0 μm ; breadth of isthmus 18.0-19.5 μm ; breadth of apex 18.0-20.0 μm (Claassen 1961).

350. COSMARIUM OBLIQUUM NORDST.

- VAR. **OBLIQUUM**

- F. **MINIMA** WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 261.

351. COSMARIUM OBSOLETUM (HANTZSCH) REINSCH

- VAR. **OBSOLETUM**

Illustrations. Fig.53 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. Long., 49.0 μ ; lat., 55.0 μ ; isthm., 32.0 μ (Grönblad, Croasdale 1971).

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.28, figs.1-3 (Claassen 1961).

Sample. RSA: 258, 259, 261, 268, 269, 270.

Note. *Hae cellulae praeter membranae crassationem ad semicellularem basium angulos, etiam alteram membranae crassationem ad apicem ostendum, polis plus quam in typo applanatis.*

This differs from the typical form (West, West 1905, p.133, Pl.LVI, figs.1-3) in the cell wall being thickening at the apices; semicells more depressed. Length 40.0-46.0 μm ; breadth 46.0-50.0 μm ; breadth of isthmus 12.0-13.0 μm (Claassen 1961).

352. COSMARIUM OBTUSATUM SCHMIDLE (SYN.: *COSMARIUM OCHHODES* NORDST. VAR. *OBTUSATUM* GUTWINSKI)

- VAR. **OBTUSATUM**

Illustrations. Pl.19, Fig.4 (Williamson 1994); Pl.5, 3 (Williamson 2000).

Sample. RSA: 10, 40 (rare), **70, 71** (not uncommon), **91** (rare), **341, 392.**

- **NAM: 307.**

Note. *Long.* 67.0 μm ; *lat.* 56.0 μm ; *lat. isthm.* 14.0 μm (West 1912).

Side by side with specimens showing typical dimensions (*long.*, 63.0 μm ; *lat.*, 51.0 μm ; *lat. isthm.* 15.0 μm), others were observed which were relatively broader (*long.*, 66.0 μm ; *lat.*, 60.0 μm ; *lat. isthm.*, 15.0 μm). The apex was moreover, in some cases, faintly undulate. It is possible that these variations indicate a distinct form (Fritsch 1918).

Long. cell., 60.0-64.0 μm ; *lat. cell.*, 54.0-57.0 μm ; *lat. isthm.*, 15.0-16.0 μm ; *crass.*, 21.0-24.0 μm (Fritsch, Stephens 1921).

Long. cell., 91.0-96.0 μm ; *lat. cell.*, 71.0-75.0 μm ; *lat. isthm.*, 18.0-22.0 μm .

Large specimens agreeing in dimensions with those originally described by Gutwinski (Bot. Centralbl., xliii, 1890, p.68; Sprawozd. Kom. fizyogr. Akad. Umiej. Krakowie, czesc.II, xxvii, 1892, p.51, Tab.II, fig.3) (Fritsch, Rich 1924).

Usually the margins are described as undulate but in the case of these specimens shallowly crenate could be a better description (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium obtusatum* (Schmidle) Schmidle.

- VAR. **UNDULATUM** FRITSCH ET RICH

Illustrations. Fig.14, A, B (Fritsch, Rich 1938); Fig.80 (Grönblad, Croasdale 1971); Pl.20, Fig.1 (Williamson 1994).

Sample. RSA: 198, 199, 200, 343, 356. - **NAM: 307.**

Note. *Differt a typo semicellulis in aspectu frontali vertice undulato, marginibus lateralibus undulationibus 5 vel 6.* *Long. cell.*, 47.0-55.0 μm ; *lat.*, 42.0-46.0 μm ; *isthm.*, 12.0-16.0 μm .

This variety differs in the fact that the apex is often as markedly undulate as the lateral margins and that the latter possess five or six undulations only. There are two pyrenoids in each semicell. The end-view (Fig.14, A) is very similar to that of the type (Fritsch, Rich 1938).

Long., 44.0 μm ; *lat.*, 38.0 μm (1.16x); *isthm.*, 13.0 μm . Lateral margins with only 5-6 undulations, apex also undulate (Grönblad, Croasdale 1971).

Length 52.0-54.0 μm ; breadth 47.0-49.0 μm ; isthmus 15.5-17.0 μm ; ratio of length to breadth 1.0-1.11; thickness 24.0-26.0 μm (Williamson 1994).

353. COSMARIUM OCELLATUM EICHL. ET GUTW.

- VAR. **ROTUNDATUM** FRITSCH ET RICH

Illustrations. Fig.14, I-K (Fritsch, Rich 1938).

Sample. RSA: 198, 199, 200, 201.

Note. *Differt a typo semicellulis in aspectu frontali late rotundatis fere semiellipticis, sinu late aperto.* Long. cell., 19.0-24.0 μm ; lat., 18.0-22.0 μm ; isthm., 3.0-5.0 μm ; crass., 10.0 μm ; lat. zygosp., 21.0 μm .

The variety is characterized by the rounded semicells and the widely open sinus. The zygospires observed were polyhedral with rounded angles, and sides measuring between 20.0 and 30.0 μm . A similar zygospire has been recorded by Homfeld ("Beitrag zur Kenntnis der Desmidiaceen Nordwestdeutschlands", Pflanzenforschung, Heft 12, 1929, p.47) for the type.

The form of the semicells is like that of some varieties of *C. tothophorum* Nordst. (= *C. onychonema* Racib.) (Fritsch, Rich 1938).

354. COSMARIUM OKAVANGICUM COESEL ET VAN GEEST

Illustrations. Figs.8-10 (Coesel, van Geest 2009).

Sample. BOT: 400 (low cell number). – **NAM: 421** (low cell number).

Note. Cells 1.2 to 1.5 times longer than broad, deeply constricted. Sinus closed, linear. Semicells in frontal view consisting of a rectangular basal part and a wider, low-trapeziform part with broadly rounded angles and retuse sides. Cell wall in the centre of the semicell with a pronounced tubercle, otherwise smooth. Semicells in apical view elliptic with on either long side a pronounced tubercle. Cell length 18.0-21.0 μm , cell breadth 13.0-15.0 μm , cell thickness including tubercles 12.0-13.0 μm , breadth of isthmus 3.0-4.0 μm . *Type:* our Fig. 8. *Type locality:* water course near Chief's Island (sample nr. 1), P.F.M. Coesel, 3 October 2006, plankton collection # 2006.42 in the Amsterdam University herbarium.

Cosmarium okavangicum is a small-sized, smooth-walled species with a prominent tubercle in the centre of the semicell. Its outline in frontal view, somewhat reminding that of a chef's cap, is most characteristic and we could not find any resembling species in the literature (Coesel, van Geest 2009).

355. COSMARIUM ORTHOSTICHUM LUND.

- VAR. **COMPACTUM** W. ET G.S. WEST

Illustrations. Fig.15, A-D (Fritsch, Rich 1938).

Sample. RSA: 198, 199, 200, 205, 244, 272.

Note. *Forma.* Long. cell., 16.0-21.0 μm ; lat., 17.0-18.0 μm ; isthm., 5.0-7.0 μm ; crass., 11.0 μm ; zygosp., 17.0-20.0 μm .

This form is, in some respects, intermediate between the type and its var. *compactum*. It resembles the latter in dimensions and the possession of a closed sinus, but the granules are less numerous, and although those in the centre of the semicell are sometimes larger than those near the edge this is not always so. In the end-view about 5 transverse rows of granules each comprising 3 or 4 are seen. The cells were sometimes found in short rows; in other cases large numbers of individuals, in part arranged in pairs, occurred embedded in mucilage. The zygospire is dark brown in color; it is spherical, and furnished with bi- (or tri-) furcate spines. Zygospires of this species have not previously been described (Fritsch, Rich 1938).

- VAR. **PSEUDOPUMILUM** CLAASSEN

Illustrations. Tab.25, fig.3 (Claassen 1961).

Sample. RSA: 241.

Note. *Affinis var. pumilo* Lund., *sed semicellulis minus applanatis et sculptura membranae toto caelo differt.*

This differs from var. *pumilum* Lund. (West, West 1908, p.169, Pl.LXXX, figs.20, 21) in having less flattened semicells and in the sculpture of the cell wall. Cells small, a little longer than broad, deeply constricted, sinus open outwards; semicells subelliptic, with a somewhat flattened apex. Cell wall granulate, granules without any definite arrangement; chloroplasts with one pyrenoid each. Length 23.0-29.0 μm ; breadth 19.5-24.0 μm ; breadth of isthmus 8.5-12.0 μm (Claassen 1961).

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.26, fig.8 (Claassen 1961).

Sample. RSA: 254, 256.

Note. *A typo speciei numero et dispositione granulorum in membrana et sinu angustiore differt.*

This differs from the typical form (West, West 1908, p.167, Pl.LXXX, figs.12-19) in the number and disposition of the granules, and a having a narrower sinus. Cell wall granulate, granules arranged in 9-10 vertical series with 4-6 granules in each series; granules more or less of the same size. Length 19.0-22.0 μm ; breadth 16.0-18.0 μm ; breadth of isthmus 5.5-6.0 μm (Claassen 1961).

356. COSMARIUM PACHYDERMUM LUND.

- VAR. **PACHYDERMUM**

Illustrations. Fig.58 (Grönblad, Croasdale 1971); Pl.19, Fig.5 (Williamson 1994).

Sample. RSA: 355. - NAM: 307.

Note. Long., 76.0 μm ; lat., 58.0 μm (1.3x); isthm., 25.0 μm (Grönblad, Croasdale 1971).

Length 100.0 μm ; breadth 73.0 μm ; isthmus 23.0 μm ; ratio of length to breadth 1.36 (Williamson 1994).

- VAR. **AETHIOPICUM** W. ET G.S. WEST (SYN.: *COSMARIUM LUNDELLII* DEPL. VAR. *AETHIOPICUM* W. ET G.S. WEST)

Illustrations. Pl.19, Fig.6 (Williamson 1994).

Sample. RSA: 92, 104 (rare), 362.

Note. *Forma major. Long cell., 120.0-129.0 μm ; lat. cell., 100.0-105.0 μm ; lat. isthm., 40.0-42.0 μm ; scrobiculis membranae bene evolutis* (Fritsch, Rich 1924).

Length 69.0 μm ; breadth 54.0 μm ; isthmus 20.0 μm ; ratio of length to breadth 1.27; thickness 31.0 μm (Williamson 1994).

- VAR. **INDICUM** IYENG. ET VIMALA BAI

Illustrations. Fig.59 (Grönblad, Croasdale 1971).

Sample. NAM: 304.

Note. Long., 66.0 μm ; lat., 53.0 μm (1253x); isthm., 20.0 μm . R. Grönblad does not show punctuation, which in this variety is fine and sparse, but the size, shape and proportions of the cell agree very well. For this plant R. Grönblad suggested "*C. subcucumis*" Schmidle, which however, is relatively longer (Grönblad, Croasdale 1971).

- VAR. **TUBERCULATUM** F.E. FRITSCH

Illustrations. Fig.10 (Fritsch, Stephens 1921).

Sample. RSA: 74 (very rare).

Note. *Cellulis ca. 1½plo longioribus quam latis, a latere visi lateribus minus convexis apicibus minus rotundatis et cum membrana incrassata; semicellulis cum tuberculo late rotundato infra apicem utrobique e excavatione*

vdosa orto. Long. cell., 70.0-90.0 µm; lat. cell., 48.0-58.0 µm; lat. isthm., 18.0-26.0 µm; crass., 30.0-36.0 µm.

This variety differs from the type in three respects, viz. the relation between length and breadth of the cell (the semicells being more circular than elliptical), the shape of the semicells in side-view, and the broad, rounded tubercle occurring a little way beneath the apex in the median line of each semicell (Fig.10, A). This tubercle arises from the base of a shadow depression, - a fact which is particularly obvious in the end-view (Fig.10, C); in the front-view it only becomes distinctly visible on focusing down to about one-quarter of the thickness of the semicell. This variety, in the possession of this feature, appears to bear much the same relation to *C. pachydermum* Lund., that *C. aitchisonii* Schaarschmidt ("Afganistan Algae," 'Journ. Linn. Soc., Bot.,' xxi, 1884-5, p.246, Pl.V, fig.20) does to *C. nitidulum* De Not. The end- and side views of *C. aitchisonii* Schaarschmidt, are, however, not known, but should they prove to resemble those of *C. nitidulum* De Not., the former species would be better regarded as a variety of the latter.

The membrane of var. *tuberculatum* often showed a minute granulation, but its presence was not always determinable (Fritsch, Stephens 1921).

- VAR. **WATERBERGENSE** CLAASSEN

Illustrations. Tab.28, fig.4 (Claassen 1961).

Sample. RSA: 252, 277, 278, 279, 280, 282, 283, 296.

Note. *Affinis C. pachydermo var. aethiopicum* W. et G.S. West, *sed cellulis aliquanto minoribus et ad apicem deplanatis differt.*

This is near *C. pachydermum* var. *aethiopicum* W. et G.S. West (West, West 1905, p.140, Pl.LVII, figs.8, 9); but differs in having smaller dimensions and flattened apices and in the cell wall sculpture. Cell wall more or less regularly granulate, granules small. Length 43.0-54.0 µm; breadth 36.0-46.0 µm; breadth of isthmus 21.0-25.0 µm (Claassen 1961).

357. COSMARIUM PAPPEKUILENSE G.S. WEST

Illustrations. Fig.40 (West 1912), Fig.17, C (Fritsch, Rich 1930), Fig.15, E-G (Fritsch, Rich 1938).

Sample. RSA: 6, 141 (rare), **143** (*forma sinu minus aperto*; very common), **146** (rare), **153** (*forma sinu minus aperto*; rare), **159** (rare), **160** (rare), **162** (*forma typica, sed minor*; rare), **163** (*forma typica, sed minor*; rare), **164** (*forma typica, sed minor*; rare), **168** (*forma typica, sed minor*), **198, 199, 200** (rather common), **202, 203, 205.**

Note. *C. parvum, circiter tam longum quam latum, profundissime constrictum, sinu acutangulo et aperto; semicellulae transverse suboblongae, margine ventrali leviter convexo, margine dorsali (apice) recto, lateribus rotundo-convexis; semicellulae a latere visae cubcirculares; a vertice visae oblongae, polis rotundatis, lateribus subrectis; membrana minute granulata, granulis in seriebus verticalibus circ. 15 dispositis, 7-8 in serie unaquaque, chromatophora singula aziali in semicellula unaquaque, cum pyrenoide centrali, in lobos radiatos subangustos subirregulariter producta.*

Long. 27.0 µm; lat. 27.0-28.5 µm; lat. isthm. 8.0 µm; crass. 13.0 µm.

In general outline this species agrees most closely with *Cosmarium bioculatum* Bréb. var. *hianis* W. et G.S. West, but differs in its larger size, its distinctly granulate cell-wall, and in the irregularly lobed chloroplasts. From *Cosmarium wittrockii* Lund it differs in its oblong semicells, both in front and vertical views, and in its much finer granulation. The form of the front view is also

very like that of *Cosmarium staurastroides* Eichl. et Gutw., but its other characters are quite different (West 1912).

Forma typica, sed minor. Long. cell., 19.0-23.0 μm ; lat., 17.0-21.0 μm ; ist., 6.0-7.0 μm ; crass., 10.0 μm .

Forma sinu minus aperto, seriebus verticalibus granulorum minus distinctis, sed granulis in series concentricas marginem parallelas evidenter dispositis. Long. cell., 26.0-29.0 μm ; lat., 23.0-26.0 μm ; ist., 6.0-8.0 μm ; crass., 15.0 μm (Fig.17, C).

Cosmarium papkuilense, despite its single chloroplast and pyrenoid and the widely open sinus, is probably closely allied to *C. pseudobroomei* Wolle; the end-views are almost identical (Fig.17, C, c). Our specimens differed from the type in the fact that the two margins of the sinus did not as a rule diverge at once, but showed a subparallel course for a short distance (Fig.17, C, a). As a general rule, too, the flat apex of the semicell was not as wide as in the individual figured by West (Ann. S. Afr. Mus., ix, 1912), p.87, Pl.I, fig.40), beginning to slope off the convex lateral margins rather gradually and not suddenly. The granules were never arranged in such strict vertical series as in West's figure, but, on the other hand, showed a marked concentric disposition, parallel to the margins of the semicells. The end-views, on the other hand, were just of the shape shown by West.

In 1913 Borge (Bot. Notiser, 1913, p.13, Tab.I, fig.6) published a new species of *Cosmarium* under the name *C. hians*. This would appear to be a form of *C. papkuilense*, as the differences between the two are quite insignificant. This species was called "*pappekuilense*" by G.S. West, but the place Pappelkuil is now spelt Papkuil, so that the specific name should read "*papkuilense*" (Fritsch, Rich 1930).

Long. cell., 27.0-34.0 μm ; lat., 25.0-31.0 μm ; isthm., 8.0-10.0 μm ; crass., 17.0-20.0 μm . The rather coarse granules, which are sometimes emarginate, were arranged in about 8 vertical and 5 horizontal rows (Fritsch, Rich 1938).

358. COSMARIUM PARVULUM BRÉBISSON

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 3.

Note. *Forma semicellulis a fonte visis marginibus lateralibus emarginatis, lobulis basalibus paulo productis rotundatis extrorsum se adtingentibus, margine terminali levissime inciso.* Longit. 0.0305 mm. Latit. 0.013 mm. Inter *Spirogyram* (Reinsch 1878).

359. COSMARIUM PEARSONI G.S. WEST

Illustrations. Fig.42 (West 1912).

Samples. RSA: 17.

Note. *C. mediocre, circiter 1¹/₆-plo longius quam latum, profundissime constrictum, sinu angustissimo-lineari ad extremum ampliato; semicellulae subseniculares, apice indistincte et subanguste truncato, angulis basalibus leviter rotundatis; a latere visae circulares; a vertice visae subanguste ellipticae; membrana dense granulata, ad marginem semicellulae uniuscujusque circiter 48-50, granulis parvis margines versus in seriebus confertis verticalibus ordinatis, centrum versus granulis paucioribus et irregulariter dispositis; pyrenoidibus binis in semicellula unaquoque.* Long. 73.0 μm ; lat. 62.0-64.0 μm ; lat. isthm. 22.0 μm ; crass. 35.0 μm .

The species should be carefully compared with *Cosmarium botrytis* var. *depressum* W. et G.S. West, from which it is distinguished by the density and disposition of its smaller granules (West 1912).

360. COSMARIUM PERFORATUM LUND.

Illustrations. Pl.20, Fig.3 (Williamson 1994).

Samples. RSA: 344, 375.

Note. Length 46.0-60.0 μm ; breadth 41.0-51.0 μm ; isthmus 21.0-28.0 μm ; ratio of length to breadth 1.12-1.17; thickness 27.0-32.0 μm (Williamson 1994).

361. COSMARIUM PERICYMATIUM NORDST.

- VAR. **LATIOR** FRITSCH ET RICH

Illustrations. Fig.15, *H-J* (Fritsch, Rich 1938).

Samples. RSA: 200.

Note. *Differt a typo semicellulis latioribus, constrictione profundiori, undulationibus marginis semicellulae plus numerosis. Pyrenoidibus in quaque semicellula 2.* Long. cell., 44.0-48.0 μm ; lat., 31.0-37.0 μm ; isthm., 19.0-21.0 μm ; crass., 27.0-28.0 μm .

This variety differs from the type in the broader semicells, the deeper constriction, and the more numerous undulations round the margin of the semicell. There are two pyrenoids in each semicell. The cell wall is densely punctate. The vertical view is like that of the type (Fritsch, Rich 1938).

362. COSMARIUM PERMACULATUM GRÖNBLAD ET A.M. SCOTT

- VAR. **BITUBERCULATUM** COESEL ET VAN GEEST

Illustrations. Figs.31-33 (Coesel, van Geest 2009).

Samples. BOT: 400.

Note. Differs from the nominate variety by the presence of two prominent subapical tubercles. Cell length 47.0-55.0 μm , cell breadth 37.0-40.0 μm . – *Type:* our fig. 31. *Type locality:* water course near Chief's Island (sample **400**), P.F.M. Coesel, 3 October 2006, plankton collection # 2006.42 in the Amsterdam University herbarium.

The alga represented in our figs. 31 and 32 well agrees with *Cosmarium permaculatum* as described by Grönblad and al. (1958) from Sudan, except for the two prominent subapical tubercles that are wanting in the original diagnosis of this species. Characteristic of *C. permaculatum*, apart from the cell outline, is the pattern of scattered, coarse pore fields. Interestingly, next to cells with broadly rounded basal angles (in agreement with the figures in Grönblad and al. 1958) in our Okavango material also cells were encountered with papillate basal angles. This suggests the occurrence in rudimentary form of additional cell wall protuberances, similar as in *C. pseudosulcatum*. *C. permaculatum* has only been recorded from some African countries, i.e., Sudan (Grönblad and al. 1958), Uganda (Grönblad and al. 1964), Zambia (Thomasson 1966) and Mali (Couté, Rousselin 1975). In the Okavango Delta *C. permaculatum* var. *bituberculatum* was widely distributed and locally rather common on the site of Chief's Island. It was also found with zygospores (fig. 33). The nominate variety, on the other hand, was not encountered (Coesel, van Geest 2009).

363. COSMARIUM PERPUSILLUM WEST

Illustrations. Fig.28, D-H (Fritsch 1918).

Samples. RSA: **36, 37** (very rare), **38, 39, 45, 131** (rare), **132** (rare), **159** (rare), **164** (rare), **165** (rare).

Note. Long., 18.0-20.0 μm ; lat., 15.0-18.0 μm ; lat. isthm., 3.0-4.0 μm ; crass., 9.0 μm .

It appears that the specimens in these samples belong to the above species, although they exhibit considerable variation in several respects, apart from being larger. Typical specimens have subhexagonal semicells, with the lower lateral margins slightly retuse and the upper lateral margins provided with one median crest; the apex is generally slightly retuse. I have in no case observed a protrusion of the lateral angles.

Considerable variation is firstly exhibited in the degree of divergence of the lower lateral margins, which in some cases become almost subparallel, giving the lower part of the semicell the rectangular appearance characteristic of *C. meneghinii* Bréb. Further, whilst in many individuals these lower margins are typically retuse, in others they are almost, if not quite, straight. There are often appreciable differences between the two semicells, and even between the two sides of a semicell, in both these respects. Other variations concern the upper lateral margins. They may lack the median crest and have a more or less concave edge, which may sometimes, however, be almost straight. In this respect also there may be diversity on the two sides of the same semicell.

Lastly, the apex varies considerably in breadth and in the degree of development of the retuse character, being sometimes practically truncate.

In those, in which the lower lateral margins become subparallel, the cell is proportionally rather longer than broad (long., 20.0-21.0 μm ; lat., 16.0-17.0 μm). Such specimens, except for the frequent presence of the median crest on the upper lateral margins, approach very closely to *C. meneghinii* Bréb. And it may be questioned whether *C. perpusillum* West, would not better be placed as variety of the former species, since it appears to be connected with it by a whole series of transitional forms in the South African flora. Forms somewhat resembling those here described have been recorded under *C. meneghinii* Bréb., by Borge (Alg. d. esten Regnell. Exped., ii, Desmid., Arkiv. f. Bot. i, 1903, p.98, Tab.III, fig.24), and Raciborski (De nonnull. Desmid. Polonia, Pamiećnik Wyd. Ak. Umiet. w. Krakow, x, 1885, Tab.XI, fig.5); cf. also var. *nanum* Wille.

It should be added that there are no appreciable differences in the side- and end-views of the specimens (Fritsch 1918).

The specimens observed were typical, except that the lateral angles were not very markedly protuberant. Long. cell., 17.0-18.0 μm ; lat., 14.0-15.0 μm , ist., 3.0-4.0 μm (Fritsch, Rich 1930).

364. COSMARIUM PHASEOLUS BRÉB.

- VAR. MINUS (BOLDT) KRIEG. ET GERL.

Illustrations. Fig.41a (Grönblad, Croasdale 1971).

Samples. RSA: **212, 213, 237.** - NAM: **307.**

Note. Der Übergang nach dem Typus ist ganz allmählich (Cholnoky 1955). In (Cholnoky 1955) indicated as *Cosmarium phaseolus* Bréb. f. *minus* Bold.

Long., 22.2 μm ; lat., 21.5 μm ; isthm., 6.0 μm ; crass., 13.0 μm . The face view is not as good for *C. phaseolus* as the end view. R. Grönblad suggested "C.

tumidum?” Lund., which is, however, a larger and thicker plant (Grönblad, Croasdale 1971).

365. COSMARIUM PLATYDESMIUM (NORDST.) NORDST. ET SCHMIDLE

Illustrations. Figs.79, 143 (Grönblad, Croasdale 1971).

Samples. NAM: 304.

Note. Long., 49.0 μm ; lat., 42.0 μm ; isthm., 22.0 μm ; wall scrobiculate. R. Grönblad said “cf. *C. platydesmium* in Skuja - Burma” (Skuja 1949, p.134, 29: 1, 2) (Grönblad, Croasdale 1971).

366. COSMARIUM PPLICATUM REINSCH

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: ? (Reinsch 1878).

Note. *Cosmarium plicatum* Reinsch, *B. minus* (Sp. et Gen. nov., Acta Senckenberg, Vol.vi, p.6, tab.iii, C, fig.ii, 1, 2, 3. – *C. sinuosum* Lundell, Desmid. Suec., p.47). Longit. 0.0393 mm, lilit. 0.0224 mm, latit. 0.0112 mm. Cellulae polis paulo impressis, cytiodermata (speciminum vacuorum) margine subtiliter longitudinaliter striato. Maxime consentit et in magnitudine et in forma semicellularum cum formae B (minus) speciminibus Erlangensibus margine terminali plerumque subrecto (Reinsch 1878).

367. COSMARIUM POLYGONUM (NÄG.) ARCHER

- VAR. POLYGONUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 112.

- VAR. HEXAGONUM GRÖNBLAD

Illustrations. Fig. nostr. 17, D (Fritsch, Rich 1930).

Samples. RSA: 174 (rare).

Note. Long. cell., 11.0-12.0 μm ; lat., 10.0 μm ; ist., 2.0 μm ; crass., 5.0-7.0 μm .

In front-view this variety is more like a form of *C. pseudobirenum* Boldt or *C. abbreviatum* Racib., whilst side and end-views are remarkably like var. *omphalum* (Schaarschm.) Racib. of *C. phaseolus* Bréb. (= *C. bioculatum* Bréb. var. *omphalum* Schaarschmidt, Mat. Term. Közlemlenyek Mag. Tud. Akad. Budapest, xviii, 1884, p.270, fig.9).

Cosmarium praecisum Borge (Algenfl. d. Tåkernsees, 1921, p.21, Tab.I, fig.18), except for its rather larger dimensions, seems to be altogether identical with *C. polygonum* var. *hexagonum* Grönbl., and both should perhaps be regarded as forms of *C. pseudobirenum* Boldt (cf. also Strøm, Naturw. Unters. d. Sarekgebirges, iii, 1923, p.478) (Fritsch, Rich 1930).

368. COSMARIUM POLYMORPHUM NORDSTEDT

Illustrations. Figs.20, 21 (Coesel, van Geest 2009).

Samples. BOT: 400-418. – NAM: 419, 420.

Note. As its name already suggests, *Cosmarium polymorphum* is supposed to be a polymorphic species. Presumably as a consequence of that, morphologically quite different algae have been depicted under that name. Most likely, most of them are not identical to *C. polymorphum* as originally described by Nordstedt (1870) from Brazil. In the Okavango Delta, however, we frequently encountered a *Cosmarium* species that fits Nordstedt's (1870) description pretty well. Semicells are principally characterized by three transversal series of big

tubercles: one apical, one subapical and one basal series. The tubercles are intermingled with scrobiculae. As far as known, the nominate variety of *C. polymorphum* has not been recorded from Africa before but it may be easily confused with other species, particularly *C. transvaalense* F.E. Fritsch et F.Rich, see, e.g., Grönblad and al. (1958: pl. 16/234) and Bourrelly, Couté (1991: pl. 31/10). In the Okavango Delta *C. polymorphum* was widely distributed and locally common on the sites of Chief's Island, Moremi and Mohango (Coesel, van Geest 2009).

369. COSMARIUM PORTIANUM ARCH.

- VAR. PORTIANUM

Illustrations. Pl.20, Fig.2 (Williamson 1994).

Samples. RSA: 198, 199, 202, 214, 343, 355.

Note. Long. cell., 20.0-25.0 μm ; lat., 18.0-22.0 μm ; isthm., 6.0 μm ; crass., 10.0-12.0 μm . In dimensions the individuals agree with the tropical forms of *C. portianum* which are said to be considerably smaller than those occurring in temperate regions (West, West 1908, p.167) (Fritsch, Rich 1938).

Length 24.0-47.0 μm ; breadth 21.0-36.0 μm ; isthmus 6.5-13.5 μm ; ratio of length to breadth 1.13-1.3 (Williamson 1994).

- VAR. ORTHOSTICHUM SCHMIDLE

Illustrations. Pl.3, 10 (Williamson 2000).

Sample. RSA: 386, 387.

Note. Several species have been considered for these specimens including *C. orthostichum* Lund. and *C. wittrockii* Lund. but the final identification must still be considered tentative. The main features of the cells are – transversely elliptical semicells showing irregular vertical rows of granules with pores between. Sometimes the pores are linked by faint striae giving a reticulate appearance. The sinus is acutely open, the end view broadly elliptical. In side view the semicells are globose. None of illustrations available seem to provide a satisfactory match with perhaps the exception of Förster (1965; Pl.3, 33).

In (Williamson 2000) indicated as: (?) *Cosmarium portianum* var. *orthostichum* Schmidle.

370. COSMARIUM PRAEMORSUM BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 16 (abundant).

Note. *Forma cellulis paullo longioribus*; long. 55.0-60.0 μm ; lat. 43.0-4.6 μm ; lat. istm. 13.0 μm (West 1912).

371. COSMARIUM PSEUDAMOENUM WILLE

Illustrations. Tab.29, figs.9, 10 (Claassen 1961); Fig.2, B (Rich 1940).

Sample. RSA: 290, 294, 295, 299, 430. – NAM: 307.

Note. Long. cell., 41.0-46.0 μm ; lat., 22.0-25.0 μm ; isthm., 19.0-20.0 μm . Cell wall uniformly granulate; one pyrenoid in each semicell. Cells not so deeply constricted as in *C. amoenum*, otherwise very like this species, which is also present in the same sample (299). Messrs. W. and G.S. West (West, West 1912, p.31) say that the distinctions between *C. pseudoamoenum* and *C. amoenum* are very slight, hence it is interesting to find both species present together (Rich 1940).

In (Hancock 1973) indicated as *C. pseudoamoenum* Wille.

372. COSMARIUM PSEUDARCTOUN NORDST.

Illustrations. Fig.2, *H-I* (Rich 1940).

Samples. RSA: 238, 299, 300.

Note. *Forma.* Long. cell., 12.0-14.0 μm ; lat., 8.0 μm . One of the smaller *forma* of this species; the lateral margins are nearly parallel (Rich 1940).

Die hier gesehenen Exemplare entsprechen vollkommen der „Forma“, die West and West (1912) auf Taf. 68, Fig. 15 darstellen (Cholnoky 1955). In (Cholnoky 1955) indicated as *Cosmarium pseudoarctoun* Nordst.

373. COSMARIUM PSEUDOATLANTHOIDEUM WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 45.

Note. Long., 24.0-25.0 μm ; lat., 18.0-19.0 μm ; lat. isthm., 6.0 μm .

The dimensions are rather larger than usual. This species comes very close to some forms of *C. granatum* Bréb; *cf.* also *C. aequale* Turner, which, however, has a different end-view and is larger (Fritsch 1918).

374. COSMARIUM PSEUDOBIREMUM BOLDT

- VAR. **PUNCTATUM** FRITSCH ET RICH

Illustrations. Fig.15, *K-M* (Fritsch, Rich 1938).

Samples. RSA: 198, 200.

Note. *Differt a typo isthmo angustiori, tuberclo mediano in aspectu frontali majore, membrana delicate punctata.* Long. cell., 24.0-27.0 μm ; lat., 25.0-27.0 μm ; isthm., 5.0-6.0 μm ; crass., 15.0-16.0 μm .

This variety differs from the type in its narrower isthmus, in the greater prominence of the median protuberance, and the delicately punctate cell wall. The protuberance usually projects a little beyond the apex, giving the middle of the latter a curiously interrupted appearance in front-view. The side-view of the semicell seems to be circular with a somewhat flattened apex (Fritsch, Rich 1938).

375. COSMARIUM PSEUDOBOOMEI WOLLE

- VAR. **PSEUDOBOOMEI**

Illustrations. Figs. 109, 146 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 38.0 μm ; lat., 39.0 μm ; isthm., 13.0 μm . Semicells rectangular with large granules in circa 14 vertical and also decussate rows; end view showing no median protuberance (Grönblad, Croasdale 1971).

- VAR. **COMPRESSUM** G.S. WEST

Illustrations. Fig. 18, *F-H* (Fritsch, Rich, 1924); Fig.110 (Grönblad, Croasdale 1971).

Samples. RSA: 89, 91, 97, 99, 102, 110, 111 (in samples **89-111** never common). – **NAM: 305.**

Note. *Forma paullo longior quam latior, lateribus plus minusve rotundatis.* Long. cell., 42.0-57.0 μm ; lat. cell., 40.0-52.0 μm ; lat. isthm., 12.0 μm ; crass., 30.0 μm .

We have referred these forms to the var. *compressus*, since in the majority of the individuals the length as only very slightly greater than the breadth and the lateral margins in front-view were rounded in the way shown in West's figures (G.S. West, Journ. Linn. Soc., Bot., xxxviii, 1907, p.123, Pl.VII, fig.11). Borge has described a form of the species from South America (Arkiv f. Bot., I, 1903, p.87, Tab.II, fig.13), which comes very close to some specimens observed by us,

although smaller. The two may well be identical and nearly related to var. *compressum* (Fritsch, Rich, 1924).

Long., 27.0 μm ; lat., 28.0 μm ; isthm., 12.0 μm . Granules quite regularly arranged in 10 vertical rows of 4 granules each, 18-20 granules around the margin. Our plant agrees very well with West's (1907, p.123, 7: 11) except for its slightly smaller size and fewer, more regularly arranged granules (Grönblad, Croasdale 1971).

- VAR. **CONVEXUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 33, 83, 185, 192.

Note. *Forma ad var. convexum* W. et G.S. West *accedens, sed fere tam longum quam latum*. Long., 37.0-40.0 μm ; lat., 36.0-39.0 μm ; lat. isthm. 11.0 μm .

This form resembles the type more nearly in its dimensions, but the lateral margins are pronouncedly convex and the apex is slightly convex. The granules are arranged in evident vertical series (Fritsch 1918).

Long., 40.0-44.0 μm ; lat., 40.0 μm ; ist., 13.0 μm (Rich 1932).

376. **COSMARIUM PSEUDOCONNATUM** NORDST.

- VAR. **PSEUDOCONNATUM**

Illustrations. Fig.86 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 66.0 μm ; lat., 47.0 μm (1.4x); isthm., 38.0 μm . Our plant is a little larger than the size given in West and West (1908, p.27), but even larger ones have been reported from Sudan by Grönblad, Prowse and Scott (1958, p.31), and from Indonesia by Scott and Prescott (1961, p.66, 25: 4). The figure regrettably shows no details of chloroplast and wall structure, but the identification is R. Grönblad's and seems plausible (Grönblad, Croasdale 1971).

- VAR. **ELLIPSOIDEUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. Long., 59.8 μm ; lat., 49.0 μm ; isthmus, 41.6 μm (Huber-Pestalozzi 1930).

377. **COSMARIUM PSEUDOEXIGUUM** RACIB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 200, 203.

Note. Long. cell., 24.0-27.0 μm ; lat., 11.0-13.0 μm ; isthm., 3.5-4.0 μm ; crass., 7.0-8.0 μm . The apex is subtruncate, sometimes faintly retuse, and the lateral margins are parallel. The semicells in side-view are elliptic (Fritsch, Rich 1938).

378. **COSMARIUM PSEUDOMANSANGENSE** FÖRSTER 1981

Illustrations. Pl.17, Fig.9 (Williamson 1994); Pl.4, 10 (Williamson 2000).

Samples. RSA: 341, 392, 394.

Note. Length 100.0 μm ; breadth 38.0 μm ; isthmus 27.0 μm ; ratio of length breadth ca. 2.6. This plant should also be compared with the somewhat similar *C. pseudomansangense* var. *scrobiculatum* Bourr. et Couté (1991) which has a scrobiculate cell wall rather than one with emarginate verrucae (Williamson 1994).

379. COSMARIUM PSEUDONITIDULUM NORDSTEDT

- VAR. PSEUDONITIDULUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 224.

- VAR. ANGUISSIMUM GRÖNBL. IN GRÖNBLAD, SCOTT ET CROASDALE

Illustrations. Fig.78 (Grönblad, Croasdale 1971).

Samples. NAM: 305.

Note. Long., 46.0 μm ; lat., 39.0 μm (1.18x); isthm., 19.0 μm . Cells a little smaller than the type and without thickening of the wall at the apex (Grönblad, Croasdale 1971).

- VAR. VALIDUM W. ET G.S. WEST (= *COSMARIUM PACHYDERMUM* LUND. VAR. *MINUS* NORDST.)

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 70, 71.

Note. Long. cell., 70.0-72.0 μm ; lat. cell., 55.0-58.0 μm ; lat. isthm., 18.0-21.0 μm . Cell-wall thick and densely punctate (Fritsch, Stephens 1921).

380. COSMARIUM PSEUDOPAHYDERMUM NORDST.

- VAR. INCRASSATA FRITSCH ET RICH

Illustrations. Fig.16, A, B (Fritsch, Rich 1938).

Samples. RSA: 198, 200, 201, 204.

Note. *Differt a typo dimensionibus minoribus, apice in aspectu frontali subrotundato et incrassato; in aspectu laterali semicellulis in media parte cum membrana valde incrassata.* Long. cell., 90.0-102.0 μm ; lat., 52.0-62.0 μm ; isthm., 17.0-20.0 μm ; crass., 45.0-46.0 μm .

The general form of the cell in front-view is like that in Nordstedt's figure of the type ("Freshwater Algae collected in New Zealand and Australia", K. Sv. Vet.-Akad. Hundl., 22, No.8, 1888, p.53, fig.20a), but the apex is not truncate, being somewhat rounded. At the apex the membrane is markedly thickened, while a still more pronounced thickening occurs over the middle part of each semicell, as is clearly seen in the side-view (Fig.16, B). The end-view is much as in the type except for the special thickening of the wall. The latter is thick and scrobiculate throughout. There are two pyrenoids in each semicell (Fritsch, Rich 1938).

381. COSMARIUM PSEUDOPRAEMORSUM HODGETTS

Illustrations. Fig.11, A (Hodgetts 1926).

Samples. RSA: 112 (very rare).

Note. *C. parvum, paulo longius quam latum, profunde constrictum, sinu lineari, extremo ampliato; semicellulae truncato-pyramidatae, angulis inferioribus valde rotundatis, lateribus leviter convexis, apicibus late subtruncatis; membrana granulis acutis concentricè digestis ornata, granulis ad apicem multo minoribus vel nullis; serie granulorum 4 vel 5 supra isthmum praedita; semicellulae tumoribus centralibus binis 4-granulatis instructis, granulae tumorum elongatae et cruciate dispositae; semicellulae a vertice visae ellipticae ad medium utrobique tumoribus binis praeditae, a latere visae subgloboae; chromatophorae singulae in semicellula unaquaque, pyrenoide instructae.* Long. cell., 28.0 μm ; lat., 24.0-27.0 μm ; lat. isthm., 8.0-9.0 μm ; crass., 15.0-17.0 μm .

Apart from the two small tumours in the centre of each semicell, this species closely resembles a small form of *C. praemorsum* Bréb. The four granules of each tumour were usually elongated (rarely rounded) and cruciately arranged. There

was a row of four or five granules placed transversely just above the isthmus. The apex of the semicell was either free of granules, or had the latter much reduced in size.

It may be compared with *C. subturpinii* Borge (Algenfl. des Tåkernsees, 1921, p.20, t.1, fig 17), which however, is much larger, and possesses binate central tumours which have large and more or less concentrically arranged granules; and the apex of the semicell is granulate (Hodgetts 1926).

382. COSMARIUM PSEUDOPROTRACTUM CLAASSEN

Illustrations. Tab.25, figs.4-6 (Claassen 1961).

Samples. RSA: 246, 247.

Note. *Affinis C. protractum* (Näg.) De Bary, *sed lobo polari amplius rotundato, forma cellulae a latere visae et dispositione granulorum differt.*

Near *C. protractum* (Näg.) De Bary (West, West 1908, p.181, Pl.LXXXII, fig.8; Pl.XCLV, figs.4, 5); but the shape of the apical lobe, the shape of the semicells in lateral view and the arrangement of the granules differ. Cells of medium size, longer than broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells 3-lobed, with a subrectangular incision between the apical lobe and each lateral lobe, lateral and apical lobes broadly rounded and fairly short; lobes granulate, granules large and arranged in 3-4 more or less distinct horizontal rows and in somewhat irregular vertical rows. Side view of semicell subovate; vertical view rather narrowly elliptic, with a smooth protuberance at the middle on each side. Chloroplasts axile, with one pyrenoid each. Length 48.0 μm ; breadth 32.0-34.0 μm ; breadth of isthmus 12.5-14.0 μm ; thickness 20.0-21.0 μm ; breadth of apical lobe 16.0-19.0 μm (Claassen 1961).

383. COSMARIUM PSEUDOPROTUBERANS KIRCHN.

- VAR. PSEUDOPROTUBERANS

Illustrations. Fig.18, T, U (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 201.

Note. *Formae pro parte ad var. alpinum Racib. accedentes.* Long. cell., 17.0-18.0 μm ; lat., 13.0-16.0 μm ; isthm., circa 4.0 μm ; crass., 7.0-8.0 μm .

Most of the forms present show the upper lateral margins practically merged in the apex, which is generally uniformly convex; the greatest width of the semicell comes just below the apex. These forms, though smaller, resemble var. *angustius* Nordst., and also approach var. *alpinum* Racib. in their wide apex. Other forms present, though showing smaller dimensions than are given by Messrs. West for the type, correspond to their Fig.7 (West, West 1908, Pl.LXXII) except for having a more closed sinus (Fritsch, Rich 1938).

- VAR. RETUSIFORME FRITSCH ET RICH

Illustrations. Fig.18, V (Fritsch, Rich 1938).

Samples. RSA: 200.

Note. *Differt a typo apice semicellulae in aspectu frontali retuso.* Long. cell., 12.0-16.0 μm ; lat., 10.0-12.0 μm ; isthm., circa 3.0 μm .

The sides are upwardly diverging, as in the type, the greatest width being above the middle of the semicell; the convex apex is retuse in the middle. The side-view of the semicell is circular. There is some resemblance to *C. sexangulare* Lund. forma *minima* Nordst., but the lower lateral margins are longer than the upper ones (Fritsch, Rich 1938).

- VAR. TUMIDUM BORGE

Illustrations. Pl.19, Fig.1 (Williamson 1994).

Samples. RSA: 341.

Note. Length 37.0-39.0 μm ; breadth 31.5-33.6 μm ; isthmus 10.0 μm ; ratio of length to breadth 1.16-1.2; thickness 22.5 μm (Williamson 1994).

384. COSMARIUM PSEUDOPYRAMIDATUM LUND.

- SUBSP. PSUDOPYRAMIDATUM

Illustrations. Fig.16, C-E (Fritsch, Rich 1938); Pl.20, Fig.4 (Williamson 1994).

Samples. RSA: 91 (common), **192, 198, 200, 201, 203, 205, 230, 233, 235, 236, 253, 259, 300, 369, 398, 430.**

Note. Long. cell., 43.0-57.0 μm ; lat. cell., 25.0-32.0 μm ; lat. isthm., 10.0-12. μm (Fritsch, Rich 1924).

Forma marginibus lateralibus solum leviter convexis, apice obscure truncato interdum subretuso. Long. cell., 51.0-59.0 μm ; lat., 32.0-36.0 μm ; isthm., 8.0-10.0 μm ; zygosp., 46.0-47.0 μm .

The lateral margins of this form are only slightly convex, and the apex is obscurely truncate, sometimes even little retuse. There is a slight thickening of the membrane in the middle of the apex and the cell wall is finely scrobiculate. There is one pyrenoid in each semicell. Compare the form recorded by Borge ("Beiträge zur Algenflora von Schweden", Arkiv för Bot., 6, No.1, 1906, p.37, Tab.II, fig.22). The few zygospores observed were globose, and furnished with scattered submamillate warts (Fritsch, Rich 1938).

Forma. Long. cell., 56.0-57.0 μm ; lat., 38.0 μm ; isthm., 10.0-11.0 μm . There is one pyrenoid, and the surface is scrobiculate. It is a little larger than the type, but not so big as var. *maximum* Boergesen. Very similar to the forms seen in Belfast Pan (Rich 1940).

In einigen der angeführten Materialien habe ich auch grössere -z. B. 55.0-59.0 μm lange and 35.0-39.0 μm breite - Exemplare gesehen, die aber mit allmählichen Übergängen zu dem Typus gebunden sind and so halte ich ihre Benennung für überflüssig, desto mehr, da die Art auch eine viel grössere Varietät - die var. *stenonotum* Nordst. - hat (Cholnoky 1955).

Length 44.0-46.0 μm ; breadth 24.0-25.0 μm ; isthmus 8.5 μm ; ratio of length to breadth 1.8-1.9 (Williamson 1994).

- SUBSP. MAXIMUM BOERGESEN

Illustrations. Fig.17, E-G (Fritsch, Rich 1924).

Samples. RSA: 91 (common).

Note. *Forma minor, area paullo incrassata in media semicellula supra isthmum, apicibus semicellularum plerumque rotundatis, interdum leviter deplanatis vel etiam subretusis, punctis membranae manifestissimis.* Long. cell., 75.0-90.0 μm ; lat. cell., 45.0-57.0 μm ; lat. isthm., 14.0-18.0 μm ; crass., 35.0-38.0 μm .

This is a very well-marked form, intermediate in many respects between Boergesen's subspecies *maximum* (Botany of the Faeroes, i, 1901, p.222, Pl.VII, fig.8) and Nordstedt's "*forma major excavata*" (K. Sv. Vet.-Akad. Handl., xxii, No.8, 1888, p.54, Tab.VI, fig.1). In the shape of the semicells (cf. Fig.17, E) it approaches nearer to the former, in dimensions it comes nearer to the latter. The thickening of the membrane in the region above the isthmus, plainly evident in side- and end-views (Fig.17, F), is invariably recognizable. Nordstedt's and Boergesen's figure show the same feature, but no mention of it is made in the

text in either case. In our specimens the basal angles of the semicells were almost invariably rounded. The punctation of the membrane appears to be due to a kind of pitting of the wall, rather than to granulation (*cf.* Fig.17, *E*).

The majority of the individuals showed one pyrenoid per semicell, but there were occasionally two, either only in one or in both semicells. Such cases render a distinction between *C. pyramidatum* and *C. pseudopyramidatum* very difficult. Messrs. West state in their monograph (West, West 1905, p.202) that the two species differ in size and in the number of pyrenoids in the chloroplasts. Since, however, Lütkenüller (Österr. Bot. Zeitschr., xliii, 1893, Tab.II, figs.1-7) has figured individuals of *C. pyramidatum* Bréb., with a varying number of pyrenoids (1-5) per semicell, these distinction fall away. The type-forms of the two species are different enough, but it is evident that they are connected with one another by numerous transitional forms.

Globose or broadly elliptical zygospores (Fig.17, *G*) were seen in sample **91** agreeing with those of *C. pseudopyramidatum* Lund., except for their larger dimensions (diam., 60.0-75.0 μm). It can hardly be doubted that they belong to the form just described (Fritsch, Rich 1924).

385. COSMARIUM PSEUDOQADRIFARIUM CHOLNOKY (SYN.: *COSMARIUM PSEUDOQADRIFARIUM* CHOLNOKY, MISTAKE IN THE SPECIES NAME, BUT VALID NAME IS *C. PSEUDOQADRIFARIUM* CHOLNOKY)

Illustrations. Fig.38 (Cholnoky 1954b).

Samples. RSA: 212, 213.

Note. This new species is close to the *C. quadrifarium* Lund but in different in dimensions, especially in the size ratio. The cells are ellipsoidal, the semicells indistinctly angular, oblong-ellipsoidal, the isthmus is deep, the margins of the cell has equally trained, round, smooth grooves, as extensions of the cell wall near the edge and the adjacent cell wall sections are visible. Cell wall near the isthmus is smooth. Cells is 28.0-30.0 μm in length, 30.0-32.0 μm in width, isthmus 9.0-10.0 μm . Chromatophore is deeply dissected, with 2 pyrenoids in each semicell (Cholnoky 1954b).

386. COSMARIUM PSEUDORETUSIFORME GRÖNBLAD

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

Note. Krieger an Gerloff (1965, p.227) have changed the name of this plant to *C. geometricum* W. et G.S. West var. *retusiforme* (Grönbl.) Krieg. et Gerl. H. Croasdale believes that R. Grönblad's species (1921, p.35, 7: 21-23) should be retained, since it has a very different sinus and end view (Grönblad, Croasdale 1971).

387. COSMARIUM PSEUDORETUSUM DUCEL.

- VAR. *AFRICANUM* (FRITSCH) KRIEG. ET GERL. (SYN.: *COSMARIUM HAMMERI* REINSCH VAR. *AFRICANUM* FRITSCH)

Illustrations. Figs.69-71, 142 (Grönblad, Croasdale 1971).

Samples. NAM: 304, 307.

Note. Long., 25.0-31.0 μm ; lat., 19.0-26.5 μm (1.1-1.37x); isthm., 7.0-9.0 μm . Some of our plants are slightly larger than var. *africanum*, and some are shown with two pyrenoids (Fig.69), although one pyrenoid is typical for this species (Grönblad, Croasdale 1971).

388. COSMARIUM PSEUDOSEXANGULARE NODGETTS

Illustrations. Fig.9, C (Hodgetts 1926).

Samples. RSA: 112, 116 (very rare).

Note. *C. parvum*, paullo longius quam latum, profunde constrictum, sinu lineari, extremo ampliato; semicellulae late hexagone angulis rotundatis, marginibus lateralibus inferioribus subrectis et divergentibus, marginibus lateralibus superioribus retusis; apicibus rotundato-truncatis; semicellulae a vertice visae ellipticae polis rotundatis, in medio utrobique leviter inflatae, a latere visae subcirculares; membrana cellularum punctato-scribiculata, punctis distantibus. Long. cell., 25.6 μ m; lat. cell., 23.0 μ m; lat. isthm., 7.3 μ m; crass., 16.0 μ m.

This shows considerable resemblance to *C. hammeri* var. *africanum* Fritsch (Trans. Roy. Soc. S. Afr., ix, pt.1, 1921, p.30, fig.11, B), but differs in having the lower lateral margins of the semicells almost straight and divergent. The end-views of the two are almost identical.

The present species also somewhat resembles *C. sexangulare* forma *minima* Nordst. (West, West 1905, p.82, Tab.72, figs.4, 5), especially in the form of the upper lateral margins, but differs in not having a retuse apex.

The end-view of *C. pseudosexangulare* differs from that of *C. sexangulare* in having a median tumour on each side (Hodgetts 1926).

389. COSMARIUM PSEUDOSULCATUM RICH

- VAR. PSEUDOSULCATUM

Illustrations. Fig. nostr.17, A-C (Fritsch, Rich 1938).

Samples. RSA: 198, 200, 202, 203, 204.

Note. Long. cell., 41.0-49.0 μ m; lat., 31.0-36.0 μ m; isthm. 8.0-10.0 μ m; crass., 25.0-28.0 μ m; lat. apic., 18.0 μ m.

This *Cosmarium* is no doubt the same as the one described from Southern Rhodesia under the above name. In the earlier material the number of apical tubercles could not be exactly ascertained. Examination of the present material has shown that there are usually two median closely approximated tubercles just below the apex on either face of the semicell, while a further tubercle generally occurs at each apical angle. The distribution is plainly seen in the end-view (Fig.19, C). The tubercles, however, vary in number and degree of development, and the thickened lateral angles probably represent other less pronounced tubercles. The membrane is always rather thick. The annular thickening at the isthmus was frequently observed (though not figured) in the Rhodesian material; in the specimens found in the Belfast Pan this thickening is almost invariably present. The apex of the semicell is usually slightly convex, but sometimes almost truncate. The upper lateral margins are often slightly retuse (Fritsch, Rich 1938).

- VAR. BITUBERCULATUM (F.E. FRITSCH BET F. RICH) COESEL (SYN.: *COSMARIUM BITUBERCULATUM* FRITSCH ET RICH)

Illustrations. Fig.12, E, F (Fritsch, Rich 1938); Fig.87 (Grönblad, Croasdale 1971). Figs.28-30 (Coesel, van Geest 2009).

Sample. RSA: 199, 200, 201, 203, 204, 205. - BOT: 400-418. - NAM: 305, 419-424.

Note. *C. submediocre*, paullo longius quam latum, profunde constrictum, sinu late, aperto; semicellulae a fronte visae late subhexagonis, angulis basalibus obtusis rotundatis, marginibus lateralibus inferioribus divergentibus, superioribus apicem versus convergentibus et in apicem transientibus, apicibus leviter convexis, infra apicem papillis contiguis 2 magnis, in superficiem cum

scrobiculis parvis hexagonaliter dispositis; semicellulae a latere non distincte visae, subcirculares; semicellulae a vertice visae ellipticae, polis rotundatis, papillis rotundatis 2 intra marginem in utroque latere.

Long. cell., 43.0-50.0 μm ; lat., 35.0-41.0 μm ; isthm., 10.0-14.0 μm ; crass., 20.0-22.0 μm .

This species is characterized by the shape of its semicells in the front-view (Fig.12, E) and by the two large median papillae situated just beneath the apex. It shows considerable resemblance to *C. pseudosulcatum* Rich (1935) in which, however, the cell is proportionally longer, the semicells are of a different shape, and there is a characteristic thickening of the membrane in the neighborhood of the isthmus. There is some similarity to *C. sulcatum* Nordst., but, unlike that species, the broadest part of the semicell is distinctly above the middle, and characteristic apical papillae are present. Similar papillae are found in *C. mamilliferum* Nordst., of which Messrs. West have described a var. *madagascariense*, but here the isthmus is closed and the shape of the semicell in front-view different, while the dimensions are less; the end-view is, however, practically identical with that of the new species. It is of interest to note that all the *Cosmaria* possessing two infra-apical papillae are confined to the southern hemisphere or occur in regions near it (Fritsch, Rich 1938).

Long., 36.0 μm ; lat., 33.0 μm ; isthm., 10.0 μm . Our plant is slightly smaller than Fritsch and Rich's (43-50 x 35-41), and shows the broadest part of the semicell about in the middle, not slightly above it. It seems closer to this plant, however, than to R. Grönblad's suggestion of *C. pseudosulcatum* Rich in Fritsch et Rich (Fritsch, Rich 1938, p.194, 17: A) which is also larger, relatively longer, has a slightly elongate isthmus and nodular thickening on the wall at the isthmus and at the lateral and upper angles (Grönblad, Croasdale 1971).

There can be but little doubt that the alga represented in our fig. 28-30 is identical to *Cosmarium bituberculatum* as described by Fritsch, Rich (1938) from South Africa. However, already on an earlier occasion (Coesel 2002) it was argued that this species be better considered a variety of the polymorphic species *C. pseudosulcatum* F. Rich. Next to the two big subapical tubercles additional cell wall protuberances may be developed as a consequence of which also cell outline and shape of the sinus are subject of some variation. It is even not to be precluded that *C. pseudosulcatum* is identical to *C. heterochondrum* earlier described by Nordstedt (1880) from Senegal, or to *C. mediogemmatum* described by West, West (1897) from Angola.

C. pseudosulcatum (including var. *bituberculatum*) is only known from the African continent (Rich 1935, Fritsch, Rich 1938, Grönblad and al. 1958, Grönblad, Croasdale 1971, Compère 1977, Bourrelly, Couté 1991). Records from India by Pandey, Pandey (1981) and Bongale (1987), judging from the accompanying illustrations, refer to other species. In the Okavango Delta *C. pseudosulcatum* var. *bituberculatum* was widely distributed on all four sampling sites and locally quite common (Coesel, van Geest 2009).

390. COSMARIUM PSEUDOTAXICHONDRUM NORDST

- VAR. **ATOMICUM** CLAASSEN

Illustrations. Tab.25, figs.1, 2 (Claassen 1961).

Samples. RSA: 241.

Note. *Affinis* *C. pseudotaxihondro* var. *siamensi* W. et G.S. West, *sed membrana haud undulata, cellula a vertice visa ad polum utrimque denticulo ornata distincta est.*

This variety is near var. *siamense* W. et G.S. West (W. and G.S. West, Siamese Desmids, Botanisk Tidsskrift, Bind 24, 1902, p.173, Tavle 3, fig.26); but there are no undulations; each pole has small tooth in vertical view. Length 31.0-32.0 μm ; breadth 28.0-28.5 μm ; breadth of isthmus 11.0-12.0 μm ; thickness 16.0-18.0 μm (Claassen 1961).

391. COSMARIUM PSEUDOTUS COESEL ET VAN GEEST

Illustrations. Figs.18, 19 (Coesel, van Geest 2009).

Samples. BOT: 415, 418.

Note. Cells 1.15 to 1.25 times longer than broad, deeply constricted. Sinus closed, linear. Semicells in frontal view trapeziform with bigranulate crenations at the apical and lateral margins. Cell wall with an intramarginal series of broad, emarginate verrucae, otherwise smooth. Semicells in apical view ellipsoid with a slightly papillate, median inflation and four series of cell wall granules running from pole to pole. Cell length 45.0-51.0 μm , cell breadth 36.0-46.0 μm , cell thickness 23.0-26.0 μm , breadth of isthmus 13.0-15.0 μm . *Type*: our fig. 19. *Type locality*: water course at Moremi (sample 415), P.F.M. Coesel, 9 October 2006, plankton collection # 2006.57 in the Amsterdam University herbarium.

No doubt, the alga represented in our figs. 18 and 19 is identical to *Cosmarium otus* as recorded by Grönblad and al. (1958: pl. 15/201) from Sudan. However, this alga differs essentially from *C. otus* as originally described by Krieger (1932: pl. 11/8) from Indonesia in that it is in want of any apical or basal spines and provided, in apical/lateral view, with four series of granules instead of two. Whereas *C. otus* Krieger appears to be confined to the Indo-Malaysian/Northern Australian region (Krieger 1932, Hirano 1950, Scott, Prescott 1961, Vyverman 1991, Coesel, Dingley 2005), our newly described species likely is an African endemic (Coesel, van Geest 2009).

392. COSMARIUM PSEUDOXANTHIDIUM COESEL ET VAN GEEST (SYNONYM: *XANTHIDIUM DECORATUM* FRITSCH ET RICH)

Illustrations. Fig.19, A-C (Fritsch, Rich 1938); Fig.26 (Coesel, van Geest 2009).

Sample. RSA: 198, 200, 201. – BOT: 415 (few cells).

Note. *X. mediocre*, circa $1\frac{1}{4}$ plo longius quam latum, profunde constrictum, sinu lineari; semicellulae a fronte visae pyramidatae, angulis inferioribus rectangularibus, marginibus lateralibus convexis cum serie spinarum 4, apicibus latis convexis spina majore valida ad angulum superiorem unumquemque, verrucis truncatis 4-5 infra apicem, in superficiem semicellulae tumoribus superioribus 3, inferioribus 4, cum granulo centrali 1 et granulis periphericis 8-10, granulis inter tumores hexagonaliter dispositis; semicellulae a latere visae circulares, cum spina valida acuta apicali, marginibus lateralibus tumoribus rotundatis 2 vel 3 et intra marginem cum tumoribus similibus diverse dispositis; semicellulae a vertice visae ellipticae, polis bipapillatis, tumoribus rotundatis pluribus superpositis in marginibus lateralibus et intra marginem verrucis truncatis 4 vel 5, spina valida polos versus utrobique. Long. cell., 48.0-54.0 μm ; lat., 38.0-44.0 μm ; isthm., 10.0-12.0 μm ; crass., 33.0 μm ; long. spin. apic., 7.0-8.0 μm .

The species is characterized by (a) the marked and sometimes curved spines at the apical angles of the semicells, (b) the row of truncate verrucae just beneath the apex on either face of the semicell (cf. the end-view, Fig.19, B), and (c) the two approximately transverse rows of tumours on the face of the semicell (very

conspicuous along the lateral margins of the end-view, and also along the margins of the side-view, Fig.19, C), each tumour bearing one central and 8-10 peripheral granules; other granules are disposed in a hexagonal pattern between the tumours. It appears that the spines at the apical angles may occasionally be forked, or in other specimens they may be strongly reduced and scarcely more prominent than those on the lateral margins of the semicell.

In the side- and end-views there is some resemblance to *X. quadridentatum* W. et G.S. West ("A Contribution to the Freshwater Algae of Ceylon", Trans. Linn. Soc. (Bot.), vi, 2 ser., 1902, p.160, Pl.XX, fig.21), but *X. decoratum* has a different front-view and is decidedly more ornate (Fritsch, Rich 1938).

Delimitation between the genera *Cosmarium* and *Xanthidium* is problematic because of the occurrence of intermediate forms. The form, however, described as *Xanthidium decoratum* by Fritsch & Rich (1938) from South Africa, when considering its cell wall sculpture, obviously has more in common with *Cosmarium* than with *Xanthidium*. A distinct inflation of the semicell centre, characteristic of most *Xanthidium* species, is wanting. The transversal series of tubercles, on the contrary, remind those of many *Cosmarium* species. Actually, the species under discussion shows affiliation with various forms of *Cosmarium freemanii* W. et G.S. West (e.g., Bourrelly, Couté 1991). The name of *Cosmarium decoratum* already having been used (West, West 1895: 61, pl. 7/21) we had to choose another epithet.

Cosmarium pseudoxanthidium (under the name of *Xanthidium decoratum*) has only been recorded from a number of African countries: South Africa (Fritsch, Rich 1938), Zambia (Thomasson 1960), Uganda (Lind 1971) and Madagascar (Bourrelly, Couté 1991) (Coesel, van Geest 2009).

393. COSMARIUM PULCHERRIMUM NORDSTEDT

Illustrations. Pl.VI, fig.8 (Reinsch 1878).

Samples. RSA: 4 (*C. pulcherrimum* ? Nordst.).

Note. Longit. 0.0421 mm, latit. 0.0333 mm, latit. Isthmi 0.0084 mm. Cellularum superficies in media parte punctulate-verruculosa, margines laterales 5-6 gibberulis verruculosus instructi, verruculae marginum indistincte radiatim dispositae. Cosmaria compluria a clar. Nordstedt descripta; - *Cosmarium subspeciosum*, *pynochondrum*, *costatum*, *subreniforme*, *pulcherrimum*, maxima versimilitudine mihi videntur formae cohaerentes uius speciei. Sample information not indicated (Reinsch 1878).

Cosmarium pulcherrimum ? Nordst., forma cellulis ellipticis diametro transversali tres quintas diametri longitudinalis aequante, semicellulis semicircularibus, marginibus aequaliter crenato-incisis introrsum verruculis radialiter positis verrucosis; isthmi latitudo quarta pars diametri transversalis. Longit. 0.0306 mm, latit. 0.0196 mm (Reinsch 1877).

394. COSMARIUM PUNCTULATUM BRÉBISSON

- VAR. PUNCTULATUM

Illustrations. Pl.VI, fig.7 (Reinsch 1878).

Samples. RSA: 3, 19 (rare), **23, 26** (rare), **36** (rare), **67** (very rare), **91** (rather rare), **106** (rather rare), **108** (rather rare), **109** (rather rare), **115, 122** (very rare), **215-218, 323, 327**.

Note. Longit. 0.248 mm. Latit. 0.0224 mm. Cellularum cytoderma verruculis punctiformibus absque ordine dispositis subtiliter verruculosum.

Certissime species propria, nullo modo C. margaritiferi Meneghini, forma juvenilis. Inter Spirogyram (Reinsch 1878).

The abundant individuals in sample **23** were very typical; *long.*, 32.0-36.0 μm ; *lat.*, 28.0-30.0 μm ; *lat. isthm.*, 8.0-10.0 μm ; *crass.*, 17.0-18.0 μm . Some had a slightly concave apex. In many cases the end-view showed a slight median non-granulated inflation (Fritsch 1918).

A small form. *Long. cell.*, 27.0 μm ; *lat. cell.*, 24.0 μm ; *lat. isthm.*, 8.0 μm (Fritsch, Stephens 1921).

Long. cell., 33.0-36.0 μm ; *lat. cell.*, 29.0-34.0 μm ; *lat. isthm.*, 9.0 μm ; *crass.*, 17.0 μm (Fritsch, Rich 1924).

- VAR. **SERIATUM** KRIEGER

Illustrations. Fig.97 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Long.*, 16.5 μm ; *lat.*, 19.0 μm ; *isthm.*, 7.0 μm . Our form differs from Krieger's form (1932, p.183, 12: 11) from the Sunda in the semicells being relatively broader and more pyramidal, and in there being more space between the three median rows of granules and the intramarginal granules. Other varieties and forms of *C. punctulatum* have been figured in the literature but none of this small size. R. Grönblad did not suggest a name for this plant (Grönblad, Croasdale 1971).

- VAR. **SUBPUNCTULATUM** (NORDST.) BOERGESEN (= *COSMARIUM SUBPUNCTULATUM* NORDST.)

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 34, 35, 36, 37, 38, 39, 41, 48, 192, 299, 322, 329.

Note. *Long.*, 25.0-26.0 μm ; *lat.*, 21.0-22.0 μm ; *lat. isthm.*, 7.0-8.0 μm . The dimensions are rather smaller than those typical for this variety. Most of the specimens, which were in no case numerous, possessed the form shown in Fig.17 on Pl.LXXXIV of Messrs. West's monograph, the apex being generally quite or almost quite smooth (Fritsch 1918).

Forma major et densius punctata (Huber-Pestalozzi 1929).

Forma minor. *Long.*, 26.0 μm ; *lat.*, 23.4 μm (Huber-Pestalozzi 1930).

Forma. The dimensions are a little smaller than those typical of this variety, agreeing more nearly with those found by Fritsch in specimens from the Cape Peninsula (1917). And with a space free from granules in the middle of the end-view. *Long.*, 28.0 μm ; *lat.*, 23.0-24.0 μm ; *ist.*, 7.0 μm ; *crass.*, 16.0 μm . Forms of this variety are recorded by Huber-Pestalozzi (1929) from Marseilles, O.F.S. (Rich 1932).

Long. cell., 23.0-24.0 μm ; *lat.*, 20.0-23.0 μm ; *isthm.*, 7.0-8.0 μm . The apex of the semicell is granulate. The dimensions are a little less than those given for the variety by Messrs. West (West, West 1908, p.209, pl.lxxxiv, fig.19), but are similar to those found in other South African individuals. It is closely allied to *C. anisochondrum* Nordst., in which species, however, the constriction is dapper, and the isthmus consequently narrower, and the basal angles of the semicell are more rectangular (Rich 1940).

395. COSMARIUM PYGMÆUM ARCH.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (rather common).

Note. The semicells had the more angular form of some of the published figures, e.g. Bernard (Sur quelques Algues unicellulaires d'eau douce récoltées dans le domaine Malais, 1909, Pl.IV, fig.92). This was one of the few species in

our samples of which the zygospores were present; the latter were large in proportion, measuring from 16-19 μm in diameter. Long. cell., 12.0-15.0 μm ; lat., 10.0-11.0 μm ; ist., 3.0-4.0 μm ; crass. 6.0-7.0 μm (Rich 1932).

396. COSMARIUM PYRAMIDATUM BRÉB.

- VAR. PYRAMIDATUM

Illustrations. Pl.19, Fig.3 (Williamson 1994).

Samples. RSA: 192 (very rare), **230, 258, 259, 261, 269, 322, 327, 356.**

Note. Long., 83.0-110.0 μm ; lat., 46.0-57.0 μm (Huber-Pestalozzi 1930).

Forma. Smaller than *forma tropica* W. et G.S. West, but resembling it in its slightly inflated semicells, and apices less truncate than in type. Long., 100.0 μm ; lat., 67.0 μm ; ist., 20.0 μm . The type recorded from Orange Free State (Huber-Pestalozzi) (Rich 1932).

Length 70.0 μm ; breadth 44.5 μm ; isthmus 16.0 μm ; ratio of length to breadth 1.57. A very large specimen was found in sample **358** differing from the above only in size (length 136.0 μm ; breadth 100.0 μm ; isthmus 33.0 μm ; thickness 60.0 μm ; ratio of length to breadth 1.37 – f. *tropica* W. et G.S. West (?)) (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium pyramidatum* Bréb. in Ralfs 1848.

Orange Free State, North-West Province (orig.).

- VAR. ELONGATUM CLAASSEN

Illustrations. Tab.27, fig.10 (Claassen 1961).

Samples. RSA: 256.

Note. *Differt a typo speciei cellulis dimidio longioribus, nulla latitudinis discrepantia.*

The cells are about 1.5 times longer than the typical form; but the difference in breadth is slight. Cells very large, slightly more than twice as long as broad; sides of semicells almost straight, apex slightly concave, cell wall with a thickening of the apices and densely punctate. Length 149.0-150.0 μm ; breadth 69.5-70.0 μm ; breadth of isthmus 26.0-28.0 μm (Claassen 1961).

- VAR. MAJUS CLAASSEN

Illustrations. Tab.24, figs.4, 5 (Claassen 1961).

Samples. RSA: 268, 269, 270.

Note. *A typo speciei et cellulis aliquantulo maioribus et quod membranae cellularum in apicibus crassiores flunt, et semicellularis non ita constanter truncatis et pyramidalibus differt.*

The shape of the cells in front view is somewhat variable, the cells are larger than in the typical form, and the cell wall is densely punctate and thickened at the apices. This may also be compared with *C. pseudopyramidatum* Lund. subsp. *maximum* Börgesen *forma minor* Fritsch et Rich (F.E. Fritsch and F. Rich, Trans. Roy. Soc. of S. Afr., Vol.XI, Part 4, 1924, p.347. fig.17, E-G) to which it has a great resemblance as far as the shape of its semicells in front view is concerned, but from which it differs in having larger dimensions, in having no thickening of the membrane in the region above the isthmus, as seen in lateral and vertical view in the majority of the specimens investigated, and in the individuals always containing two pyrenoids per semicell. Length 118.0-130.0 μm ; breadth 70.0-76.0 μm ; breadth of isthmus 26.0-30.0 μm (Claassen 1961).

397. COSMARIUM QUADRATULUM (GAY) DE TONI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 5.

398. COSMARIUM QUADRATUM RALFS

- VAR. QUADRATUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 395, Gnadenthal, in the pond (Rabenhorst 1855).

- VAR. AFRICANUM F.E. FRITSCH

Illustrations. Fig.12 (Fritsch, Stephens 1921); Tab.24, fig.12 (Claassen 1961).

Samples. RSA: 23 (rare), **62** (rather rare), **258**.

Note. That new variation described also on the basis of information, published in (Fritsch 1918), where was only indication of a *forma*.

Forma apice leviter retuso, membrana levissime punctata. Long., 49.0 μm ; lat., 25.0 μm . Compare with forms described by Lundell (Desm. Suec., Nov. Act. reg. soc. scient. Upsala, Ser.3, viii, 1871, p.47) and Nordstedt (Freshw. Alg. New Zealand, etc., K. Sv. Vet.-Ak. Handl., xxii, 1888, p.55, Tab.VI, fig.5) (Fritsch 1918).

“*Forma apice leviter retuso, membrana levissime punctata*” (Fritsch 1918, pp.552, 553). *Semicellulis apice leviter retusis, angulis basalibus evinder productis lateribus convexis vel leniter concavis; a latere visis in apicem paullo incrassatis. Membrana levissime punctata.* Long cell., 39.0-49.0 μm ; lat. cell., 21.0-25.0 μm ; lat. isthm., 11.0-12.0 μm ; crass., 14.0-15.0 μm . The outstanding feature of this variety is the retuse character of the apex, which is to be observed in all cases, though varying somewhat in depth. In side-view (Fig.12, b) the membrane at the apex of the semicell invariably appears thickened. The punctuation of the membrane is rather faint (Fritsch, Stephens 1921).

Cells about 1.6-1.8 times as long as broad; basal angles of semicells less prominent than in the type; cell wall distinctly punctate. Length 41.0-64.0 μm ; breadth 24.0-36.0 μm ; breadth of isthmus 8.0-10.0 μm (Claassen 1961).

North-West Province, Swaziland (orig.).

- VAR. WILLEI SCHMIDLE (SYN.: COSMARIUM QUADRATUM F. WILLEI W. ET G.S. WEST)

- F. PUNCTATA HODGETTS

Illustrations. Fig. 10, A, B (Hodgetts, 1926).

Samples. RSA: 119 (very rare).

Note. *F. membrana crassa et punctata.* Long. cell., 69.0 μm ; lat., 34.7 μm ; lat. isthm., 27.0 μm ; crass., 30.6 μm .

This is a punctate form of *C. quadratum* forma *willei* W. et G.S. West. The latter, however, appears to be much better considered as a variety rather than a form, and this change in the nomenclature has been made. The present form has the same straight or slightly convex sides to the semicells as the var. *willei*. Each semicell contained two very distinct stellate chloroplasts, each with a pyrenoid (Hodgetts 1926).

399. COSMARIUM QUADRIFARIUM LUND.

- F. QUADRIFARIUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 213.

Note. Observed in the same sample with *C. pseudoquadrifarium* Cholnoky but I did not observe any transitional forms (Cholnoky 1954b).

- F. POLYSTICHUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 223.

400. COSMARIUM QUADRUM LUND.

- VAR. QUADRUM

Illustrations. Fig.19 (Fritsch, Stephens 1921).

Samples. RSA: 74, 77, 85, 328.

Note. *Forma paullo minor, isthmo valde incrassato, granulis saepe plus minus excavatis. Long. cell., 48.0-57.0 µm; lat. cell., 44.0-52.0 µm; lat. isthm., 15.0-18.0 µm.*

This form, as far as dimensions are concerned, comes between var. *minus* Nordst., and the type, but it is especially distinguished by the strong thickening of the membrane at the inner edge of the isthmus, which is usually more or less triangular in shape; the thickening and longitudinal extension of this region was sometimes even more pronounced than in Fig.19. An isthmus of a similar character is found in *C. orthopleurum* Roy et Biss. (Journ. Bot., xv, 1886, p.194, Tab.269, fig.16), which is probably but a variety of *C. quadrum*, in which, however, intergranular punctations are present. The granules in the present form were generally more or less hollow (cf. var. *sublatum* (Nordst.) W. et G.S. West), although specimens were seen in which they were very nearly solid. In all other respects there was complete agreement with the type (Fritsch, Stephens 1921).

- VAR. DISTENTUM FRITSCH ET RICH

Illustrations. Fig.18 (Fritsch, Rich 1930).

Samples. RSA: 147, 148, 149 (not uncommon), 185 (rare).

Note. *Semicellulis a fronte visis var. minus Nordst. similibus, sed granulis in series concentricas marginem parallelas dispositis, isthmo interne valde axi longitudinali dilatato; a vertice visis ellipticis lateribus deplanatis parallelis polis rotundatis, tumore mediano manifesto. Long. cell., 45.0-54.0 µm; lat., 44.0-51.0 µm; ist., 13.0-16.0 µm; crass., 19.0-20.0 µm.*

In front view of this variety is only distinguishable from small forms of the type (e.g. var. *minus* Nordst.) in the fact that the granules are arranged in rather definite series concentric with the margin of the semicell, and that the inner edge of the isthmus is strongly dilated in the direction of the longitudinal axis (Fig.18, a), somewhat as in the form described by Fritsch (Trans. Roy. Soc. S. Afr., ix, 1921, p.44, fig.19). It is, however, much more markedly characterized by the end-view, which, though in general outline like that of the type with flat parallel sides and rounded poles, shows a very distinct median protuberance which is developed to a slightly different extent in different individuals (Fig.18, c). In the possession of this protuberance var. *distentum* approaches *C. broomei* Ralfs, but in the latter the protuberance is more prominent than in the specimens here recorded, and a comparison of Fig.18, c with fig.12, b or d on Plate C in Messrs. West's monograph (West, West 1912, p.20, Pl.C, figs.3-6) will bring out the nature of the difference. The protuberance is confined to the median part of each semicell, and, as a result, the side-view of the latter has a different appearance, according as one focuses on the surface (circular) or on the middle part (rhomboidal, Fig.18, b). In *C. broomei*, on the other hand, as far as the published figures show, there is no such sharp demarcation between the non-inflated and the inflated parts of the end-view. Moreover, in this species the granules are arranged in vertical series.

In sample 149 the majority of the individuals showed rather rounded semicells, with a less plainly demarcated apex, and such individuals were on the whole a little larger than those in the other two samples (Fritsch, Rich 1930).

Precisely similar to the variety found in Griqualand West (Rich 1932).

- VAR. **MIINUS** NORDSTEDT

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 67.

Note. *Long. cell.*, 48.0 μm ; *lat. cell.*, 45.0 μm ; *lat. isthm.*, 12.0 μm (Fritsch, Stephens 1921).

- VAR. **SUBLATUM** (NORDST.) W. ET G.S. WEST (SYN.: *COSMARIUM SUBLATUM* NORDST.)

- F. **SUBLATUM**

Illustrations. Fig. nostr.8 (Rich 1932); Pl.21, Fig.1 (Williamson 1994).

Samples. RSA: 192 (rare), **356**.

Note. It will be seen from Fig.8 how very closely the forms here observed resemble those figured by Nordstedt for New Zealand. The dimensions also agree closely with those given by him. The granules of the lowest row in the semicell are smaller than the others. In vertical view the sides are parallel. Variations in the shape in the semicell are illustrated (see Fig.8, *A, D, E*). *Long.*, 82.0-100.0 μm ; *lat.*, 71.0-96.0 μm ; *ist.*, 25.0-30.0 μm ; *crass.*, 48.0 μm (Rich 1932).

Length 78.0 μm ; *breadth* 75.0 μm ; *isthmus* 24.0 μm ; ratio of length to breadth 1.04; *thickness* 37.0 μm (Williamson 1994).

- F. **DILATATUM** SCOTT ET GRÖNBL.

Illustrations. Pl.21, Fig.6 (Williamson 1994).

Samples. RSA: 192 (rare), **356, 338** (abundant), **345**.

Note. *Length* 70.0-78.5 μm ; *breadth* 70.0-82.6 μm ; *isthmus* 20.0-28.0 μm ; ratio of length to breadth 1.0-1.09 broader than long; *thickness* 33.6-37.8 μm ; ratio of breadth to thickness ca. 2.13.

The main features of this desmid are, straight broad apices, divergent lateral margins, decussating rows of granules, intergranular pores arranged hexagonally, widely dilated inner sinus, oblong vertical view. It bears some resemblance to *C. lacunatum* G.S. West (1907) which however has more outwardly divergent lateral margins, and apical angles which are more narrowly rounded. Although G.S. West described intergranular pores they were not illustrated (Williamson 1994).

401. COSMARIUM QUASILLUS LUND.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 191 (rare).

Note. *Forma.* Smaller than the type. *Long.*, 50.0 μm ; *lat.*, 47.0 μm ; *ist.*, 12.0 μm (Rich 1932).

402. COSMARIUM QUINARIUM LUND.

Illustrations. Fig.97 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. *Forma.* *Long.*, 31.0 μm ; *lat.*, 27.0 μm (1.15x); *isthm.*, 9.0 μm . A small form, apparently lacking puncta between the large central granules (Grönblad, Croasdale 1971).

403. COSMARIUM RARISSIMUM WILLIAMSON

Illustrations. Figs.7, 8 (Williamson 1996).

Samples. SA: 380.

Note. Cells of this taxon occurred in the shallow pool in the Little Karoo. About 12 cells were seen but all had very constant features. The semicells are triangular, the sinus being moderately deep with a wide isthmus. The basal angles are narrowly rounded, the lateral margins being indistinctly undulate and

converging at an angle of about 45° to apices which are narrow and always retuse. In front view the central parts of the semicells are devoid of projections but within the lateral margins are 2-3 low rounded granules sometimes with two more slightly nearer the middle of the semicell. The cell wall is covered in pores (punctae), and there is one central pyrenoid in each semicell.

The side view is very unusual for the cells look somewhat oblong with a moderate, widely-open constriction with the apices deeply retuse and appearing almost bilobed. Across the width of the semicells there are both straight and curved rows of rounded granules, the curved rows of more or less following the contours of the deeply retuse apices. In the vertical view the semicells are broadly elliptic with convex poles showing small undulations. Across the poles are two rows of small granules. Because of these unique characteristics which are unlike those of any other desmid it is proposed as a new species.

Longitudo 39.3-45.0 µm, *latitudo* 37.7-42.7 µm, *isthmus* 20.0-24.0 µm, *apices* 6.0-9.0 µm, *crassitudo* 21.5-24.5 µm, *cellulae* 1.0-1.08 longiores quam latae sed interdum latiores quam longae.

A sample of the original material has been deposited with the National History Museum, London (Williamson 1996).

404. COSMARIUM RECTANGULARE GRUN.

- VAR. RECTANGULARE

- F. RECTANGULARE

Illustrations. Fig.28, c (Fritsch 1918).

Samples. RSA: 39 (rare), **120** (rare).

Note. *Forma apicibus interdum leviter retusis, membrana laevi. Long., 20.0 µm; lat., 15.0 µm; lat. isthm., 3.0-4.5 µm.*

A small form, which appears rather as an extreme conditions of the forms of *C. perpusillum* West. Messrs. West (Alg. Centr. Afr., Journ. Bot., xxv, 1896, p.379, Tab.361, fig.14) have described a var. *africanum* of *C. rectangulare*, which is, however, proportionally longer (Fritsch 1918).

Forma apicibus in medio leviter retusis. Long. cell., 22.7 µm; lat., 16.0-17.0 µm; lat. isthm., 5.5 µm.

This is the form described by Fritsch (Ann. of the S. Afr. Mus., ix, pt.7, 1918, p.555, fig.28, c) from the Cape. The end and side views were those characteristic of the typical form of *C. rectangulare*. The retuse apex was a constant feature in all the individuals seen (Hodgetts 1926).

- VAR. AFRICANUM W. ET G.S. WEST

- F. AFRICANUM W. ET G.S. WEST

Illustrations. Fig.11, G (Fritsch, Stephens 1921).

Samples. RSA: 74 (rather rare).

Note. *Forma accedens, sed apicibus angustioribus (et raro leviter retusis), semicellulis a vertice visis ellipticis. Long. cell., 24.0-33.0 µm; lat. cell., 18.0-20.0 µm; lat. isthm., 5.0-6.0 µm.*

These specimens approach closely to some of the forms of *C. laeve* Rabenh., to be described below, and it is possible that they would best be regarded as extreme variation of this species. As shown in Fig. 11, G, a and a', the shape is somewhat variable, the angles tending to round off in some specimens. In some cases there was a slight thickening of the membrane at the apex, and as a rare feature the latter appeared very faintly retuse. The membrane was mostly, but seemingly not always, punctate. The specimens differ both from the type and

from var. *africanum* W. et G.S. West, in the very narrow apex, but even in this respect there was a certain amount of variation.

The form here described is somewhat similar to that recorded from Cape Peninsula (Fritsch 1918, p. 555, fig. 28, c), but has, on the whole, a narrower apex. It also shows some resemblance to forms of *C. granatum* Bréb., described by Borge ("Subfloss. Soetvattensalg. fran Gotland," 'Bot. Notiser,' 1892, p.56, and especially fig. 6) (Fritsch, Stephens 1921).

- VAR. **CAMBRENSE** (TURN.) W. ET G.S. WEST

Illustrations. Pl.21, Fig.2 (Williamson 1994).

Samples. RSA: 341, 391.

Note. Length 32.0 μm ; breadth 24.0 μm ; isthmus 8.5 μm ; ratio of length to breadth 1.33 (Williamson 1994).

- VAR. **HEXAGONUM** (ELFV.) W. ET G.S. WEST

Illustrations. Fig. 18, P, Q (Fritsch, Rich 1938).

Samples. RSA: 199.

Note. *Forma marginalibus lateralibus inferioribus leviter divergentibus.* Long cell., 30.0 μm ; lat., 23.0 μm ; isthm., 6.0-7.0 μm ; crass., 16.0 μm .

Cells about 1¼ times as long as broad, deeply constricted, sinus very narrow with a slightly dilated apex; semicells subhexagonal, the six angles rounded and the wall at these places slightly thickened. Lower lateral margins slightly upwardly divergent. Apex truncate and straight. Side-view of semicell obovate-circular (Fritsch, Rich 1938).

405. **COSMARIUM REGNELLII** WILLE

Illustrations. Fig. 13 (Fritsch, Stephens 1921); Pl.21, Fig.4 (Williamson 1994).

Samples. RSA: 74 (very rare), **199, 328, 358.** – **NAM: 307.**

Note. *Forma angulis lateralibus ca. in media longitudinis semicellulae, marginibus omnibus plus minus retusis, apice lata et exigue retusa.* Long. cell., 15.0 μm ; lat. cell., 12.0 μm ; lat. isthm., 3.0 μm ; crass., 7.0 μm . In front-view this is very much like var. *minimum* Eichler and Gutwinski ('Rozprawy Akad. Umiej. Wydz. Mat.-Przyr. Krakow', ser.2, viii, 1895, p.164, Tab.IV, fig.6), but this variety is described as having an end-view with a slight median inflation. There is also some resemblance with f. *minor* Boldt, and with f. *minima* of *C. sexangulare* Lund.; in the latter, however, the lower parts of the lateral margins are not retuse. It is to be noted that these margins differed somewhat in the specimens examined, especially as regards their degree of divergence; in some cases they were almost subparallel, and as a consequence the degree of projection of the lateral angles also varied considerably (Fritsch, Stephens 1921).

Forma Borge (Alg. fl. Tåkernsee, 1921, p.19, Taf.9, Fig.16). Long., 15.6 μm ; lat., 13.2 μm (Huber-Pastalozzi 1930).

Long. cell., 13.0 μm ; lat., 11.0 μm (Fritsch, Rich 1938).

Length 16.0-17.0 μm ; breadth 15.5 μm ; isthmus 6.0-6.5 μm ; ratio of length to breadth 1.03-1.09 (Williamson 1994).

406. **COSMARIUM REGNESII** REINSCH

- VAR. **REGNESI**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 200, 201.

Note. Long. cell., 10.0 μm ; isthm., 4.0 μm (Fritsch, Rich 1938).

In (Fritsch, Rich 1938) indicated as *Cosmarium regnesi* Reinsch.

- VAR. **MONTANUM** SCHMIDLE

Illustrations. Pl.21, Fig.3 (Williamson 1994).

Samples. RSA: 299. – SWA: 378.

Note. In (Rich 1940) indicated as *Cosmarium regnesi* Reinsch var. *montanum* Schmidle.

Long. cell., 13.0 μm ; lat., 12.0 μm ; isthm., 5.0-6.0 μm (Rich 1940).

In (Rich 1940) indicated as *Cosmarium regnesi* Reinsch var. *montanum* Schmidle.

Length 12.6 μm ; breadth 11.8 μm ; isthmus 5.6 μm ; ratio of length to breadth 1.06 (Williamson 1994).

- VAR. **POLONICUM** (EICHL. ET GUTW.) COMPÈRE

Illustrations. Pl.21, Fig.9 (Williamson 1994).

Samples. RSA: 356.

Note. Length 14.6 μm ; breadth 14.6 μm ; isthmus 5.0 μm ; ratio of length to breadth 1.0 (Williamson 1994).

407. COSMARIUM RENIFORME (RALFS) ARCHER

- VAR. **RENIFORME**

Illustrations. Tab.28, figs.5, 6 (Claassen 1961); Pl.21, Fig.8 (Williamson 1994).

Samples. RSA: 112, 113, 242, 244, 253, 262, 263, 271, 275, 276, 277, 282, 341, 390, 430, 431, 434.

Note. Specimens usually slightly smaller than in the typical form. Length 40.0-46.0 μm ; breadth 38.0-48.0 μm ; breadth of isthmus 13.0-17.0 μm (Claassen 1961).

Length 44.0-45.0 μm ; breadth 38.0-39.5 μm ; isthmus 15.5 μm ; ratio of length to breadth 1.14-1.18 (Williamson 1994).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

- VAR. **COMPRESSUM** NORDST.

Illustrations. Pl.21, Fig.7 (Williamson 1994).

Samples. RSA: 113, 116 (very rare), **210, 211, 341.**

Note. In sample 211 I observed typical specimen (40.0 μm long and 43.0 μm wide) together with very small ones (only 31.0 μm long and 32.5 μm wide with isthmus of 8.0 μm) (Cholnoky 1954b).

408. COSMARIUM REPANDUM NORDST.

- VAR. **MINUS** (W. ET G.S. WEST) KRIEG. ET GERL. 1965, TAF.41, FIG.18

Illustrations. Pl.21, Fig.5 (Williamson 1994).

Samples. RSA: 376.

Note. Length 26.6-28.6 μm ; breadth 20.5-22.5 μm ; isthmus 8.5-9.0 μm ; ratio of length to breadth 1.25-1.3 (Williamson 1994).

409. COSMARIUM RETUSIFORME (WILLE) GUTW.

- VAR. **AFRICANUM** (FRITSCH) KRIEG. ET GERL. 1962, TAF.20, FIG.19

Illustrations. Pl.19, Fig.2 (Williamson 1994).

Samples. RSA: 332, 343.

Note. Length 24.5-28.0 μm ; breadth 19.0-22.4 μm ; isthmus 7.7-8.5 μm ; ratio of length to breadth 1.25-1.3 (Williamson 1994).

410. COSMARIUM RICHIANUM COMPÈRE (SYN.: *COSMARIUM SUBHUMILE* RICH VAR. *REDUCTUM* FRITSCH ET RICH)

Illustrations. Fig. 18, R, S (Fritsch, Rich 1938). Figs.14, 15 (Coesel, van Geest 2009).

Samples. RSA: 199, 200. - BOT: 400 (low cell numbers), 401 (low cell numbers).

Note. *Differt a typo spinis non evolutis.* Long. cell., 10.0 μm ; lat., 11.0-13.0 μm ; isthm., 3.0 μm . Individuals resembling this variety in the absence of spines were observed in the collection from Transvaal examined in 1932, but, in view of their scarcity, were not recorded (Fritsch, Rich 1938).

This small-sized but characteristically shaped desmid species was originally described by Rich (1935) under the name of *Cosmariium subhumile*. The latter name being a later homonym of *C. subhumile* Gutwinski (1890: 68), Compère (1976) renamed it *C. richianum*. *C. richianum* possibly is closely related, if not identical, to *C. sphyridion* W. et G.S. West (1895) described from Madagascar, see also Bourrelly & Couté (1991: pl. 33/11).

C. richianum is only known from some African countries: former Rhodesia (Rich 1935), South Africa (Fritsch, Rich 1938), Mali (Couté, Rousselin 1975) and Chad (Compère 1976, 1977). We found both the typical form, characterized by short spines at the lateral angles (Fig.14) and a form without those spinous protractions (Fig.15) described by Fritsch & Rich (1938) as var. *reductum*, but in our opinion not deserving the status of a separate variety as we encountered several intermediate forms (Coesel, van Geest 2009).

411. COSMARIUM SALISBURII FRITSCH ET RICH

Illustrations. Fig. 12, A-D (Fritsch, Stephens 1921).

Samples. RSA: 198, 200, 203, 204, 205.

Note. *C. mediocre, circa 1/3 plo longius quam latum, profundume constrictum, sinu angusto-lineari introrsum ampliato, pyrenoidibus 2 in quaque semicellula; semicellulae a fronte visae subsemicirculares, angulis inferioribus subrectangularibus, lateribus convexis crenatis, apicibus subruncatis planis in angulum apicalem utrumque cum papillo conico parvo, intra apicem serie verrucarum 7-8, in superficiem semicellulae cum verrucis retusis rotundatis in seriebus transversalibus indistinctis 3 dispositis, granulis 5 circum verrucam unamquamque, membrana minute punctata; semicellulae a latere visae subpyriformes, apicibus leviter rotundatis, lateribus cum verrucis retusis 3 vel 4, intra marginem serie verrucarum similia; semicellulae a vertice visae ellipticae, polis bipapillatis, lateribus undulatis cum verrucis alternantibus, intra marginem serie verrucarum 7 vel 8 et in parte mediana papillo singulo et polos versus cum papillis 2. Zygosporae (immaturae) magnae rotundatae, membrana crassa, margine undulato.* Long. cell., 50.0-59.0 μm ; lat., 38.0-44.0 μm ; isthm., 11.0-13.0 μm ; crass., 30.0-33.0 μm ; diam. zygosp., circa 50.0-60.0 μm .

This highly ornamented species, as seen in front-view (Fig.12, A), bears a series of warts just beneath the apex of the semicell, and on the surface a considerable number of further warts, arranged roughly in three transverse series, and leaving a bare area of variable extent above the isthmus. The warts are, in general, rounded (sometimes slightly oval) and retuse, with a rather small apical depression. Around each wart is a series of 5 small granules regularly disposed, and a few isolated granules may also be found on the part of the semicell above the isthmus; the rest of the membrane is finely punctate. The sides

of the semicells are crenated, the crenations often becoming less marked towards the apex. The latter is quite smooth and almost flat, but at each apical angle there is a small conical papilla.

In the end-view (Fig.12, C) the infra-apical warts are seen as two series extending on either side of the axis joining the poles; there is also evident a central papilla, and near each pole are two papillae one in front of the other. The warts, seen on the surface of the semicell in front-view, appear here along the margin. In side-view (Fig.12, B) the lateral margins show two or three emarginate warts belonging to the three transverse series seen on the face of the semicell in front-view. No mature zygospores were found, so that the undulate outline shown in Fig.12, D may not be typical of the ripe condition.

In certain respects this species recalls *C. elaboratum* W. et G.S. West (West, West 1895, p.69, Pl.VII, fig.15), in which, however, the apex is not plane, and the warts on the surface of the semicell are latching (Fritsch, Rich 1938).

412. COSMARIUM SCHWEICKERDTH CLAASSEN

Illustrations. Tab.29, figs.7, 8 (Claassen 1961).

Samples. RSA: 295.

Note. *Affinis* *C. cucumi* (Corda) Ralfs. *Margo apicalis membranae crenis – binis vel ternis – ornata est; iuxta marginem apicalem bina vel terna granula adsunt conspicua ac sub granulis 3 vel 4 depressiones ellipticae.*

Near *C. cucumis* (Corda) Ralfs (West, West 1905, p.152, Pl.LIX, figs.18-20); but the apical margin has 2-3 crenations, there are 2-3 large granules within the median part of the apex and 3-4 elliptical depressions just below the granules. Cells small, about 1.4 times longer than broad, deeply constricted, sinus narrowly linear; semicells more or less semicircular. Cell wall punctate. Length 38.0-40.0 μm ; breadth 28.0 μm ; breadth of isthmus 10.0-11.0 μm . Named after Prof. Dr. H.G. Schweickerdth, Head of the Department of General Botany, University of Pretoria (Claassen 1961).

413. COSMARIUM SCOPULORUM BORGE

Illustrations. Fig.9, B (Hodgetts 1926), Figs.40-41 (Nyygard 1932).

Sample. RSA: 122 (rare), **176** (very common), **177** (fairly rare), **178** (rare).

Note. *Long. cell., 18.7-22.6 μm ; lat. cell., 16.0-18.0 μm ; lat. isthm., 4.5-5.0 μm .* This resembled those forms of *C. scopulorum*, described by Borge (Beitr. z. Algenfl. v. Schweden, iii, Archiv. f. Bot., Bd.18, No.10, 1923, p.12, t.1, fig.14), which had the apices more or less retuse in the middle (Hodgetts 1926).

Cell small, as a rule a little longer than broad, deeply constricted, sinus narrowly linear, without any dilatation at the apex; semicells broadly hexagonal, angles rounded, upper lateral margins very slightly concave, apex broadly truncate, straight or rounded; side view of semicell subcircular, with a prominent tumour on each side; vertical view elliptic, with a prominent tumour at the middle of each side; ratio of axes (without papilla) 1:1.8-2.0; cell-wall smooth; chromatophore axile with a central pyrenoid. Length 16.0-22.0 μm , breadth 15.0-17.0 μm , thickness 9.0-10.0 μm , breadth of isthmus 4.5-5.5 μm .

Fig.40 shows individuals from Braakpan, where the species was the dominant from the plankton on September 7, 1927. Fig.41 represents an individuals from Barberspan; the specimens were shorter than those from Braakpan, but otherwise the same. Fig.40 shows different forms of cells, *c* and *d* being the characteristic ones, while *a* and *b* are rare. The specimens agree excellently with Borge's description and figure of *C. scopulorum* (Borge, 1923,

p.12, t.1, fig.14), except that the tumour of the semicells as a little more prominent. *C. scopulorum* Borge is very closely allied to the variable species *C. polygonum* Archer (see West, West 1908, p.76, t.72, figs.32-34). Compare also *C. polygonum* Archer var. minus Hieronymus (W. Schmidle, 1898, p.32, t.2, fig.6).

As mentioned above, the species was very common in September in Brakpan, but it was not observed in the samples of February, March, and April 1928. As, however, several specimens were seen in the April samples from Barbespan, it is difficult to pronounce on its periodicity. It is ecologically interesting because it attains so vigorous a development in the natural pans with their occasional high content of mineral salts. Borge found it originally on irrigated rocks under quite different ecological conditions (Nyygard 1932).

414. COSMARIUM SCROBICULATUM FRITSCH ET RICH

Illustrations. Fig.19 (Fritsch, Rich 1930).

Sample. RSA: 149, 151 (not uncommon), **192** (rare).

Note. *C. mediocre*, circ. 1.1-1.2 plo long. quam lat., profundissime constrictum, sinu angusto-lineari ad extremum valde ampliatio; semicellulis a fronte visis rotundato-pyramidatis, apice subanguste truncato, angulis basalibus rotundatis, marginibus lateralibus valde convexis; a latere visis subcircularibus, a vertice anguste ellipticis. Membrana incrassata, dense scrobiculata, scrobiculis rotundatis magnis, ca. 50 in marginem semicellulae, intra marginem plus minus radiatim et concentricè dispositis, in centro semicellulae in series breves verticales (?) ordinatis; pyrenoidibus binis in semicellula unaquaque. Long. cell., 51.0-62.0 μm ; lat., 44.0-51.0 μm ; ist., 14.0-15.0 μm ; crass., 27.0 μm .

At first sight this species shows a superficial resemblance to *C. pearsoni* G.S. West, but it differs in the greater convexity of the lateral margins, the more pronounced truncation of the apex, the thick wall, and especially in the fact that the cells are not granulate, but scrobiculate (Fig.19, a'). It is the last feature that lends this species its special character and serves to distinguish it from most other species of *Cosmarium* having the same form. The only one approaching it is *C. scrobiculosum* Borge (Arkiv f. Bot., I, 1903, p.87, Pl.II, fig.12), but here the cells are of quite a different shape and the scrobiculations not as deeply set in the wall. In *C. scrobiculatum* the outline of the wall, as seen in optical section, is practically altogether smooth. As we have seen no empty cells, we are a little doubtful about the distribution of the scrobiculation over the central part of the semicell (Fritsch, Rich 1930).

415. COSMARIUM SEXANGULARE LUNDELL

- VAR. SEXANGULARE

- F. SEXANGULARE

Illustrations. Tab.25, fig.9 (Claassen 1961).

Samples. RSA: 258, 259.

- F. MINIMA NORDST.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 299.

Note. Long. cell., 12.0-14.0 μm ; lat., 11.0-12.0 μm ; isthm., 3.0-4.0 μm (Rich 1940).

- F. MINUTISSIMA FRITSCH ET RICH

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 91 (rare).

Note. *In aspectu frontali typo similis est, sed multo minor; in aspectu verticali elliptico polis rotundatis. Long. cell., 13.0 µm; lat. cell., 11.0 µm; lat. isthm., 3.5 µm* (Fritsch, Rich 1924).

- VAR. SUBANGULARE FRITSCH

Illustrations. Fig. 28, A, B (Fritsch 1918).

Samples. RSA: 36, 38, 39, 45, 143 (*forma*; common), **162, 173.**

Note. *Magnitudine ca. Dimidio ea typi; semicellulis obscure 7-angulis, lateribus superioribus e marginibus duabus fere rectis et obscure delimitatis constantibus; angulis lateralibus bene demarcatis, rotundatis vel subacutis; apicibus interdum leviter retusis. Long. cell., 18.0-25.0 µm; lat., 15.0-21.0 µm; lat. isthm., 4.0-5.0 µm; crass., 12.0 µm.*

This variety is distinguished by its retuse apex, and especially by the fact that the upper lateral margins consist of two, almost flattened edges, forming a very wide angle with one another. In the former respect it resembles *forma minima* Nordstedt., which it also agreed to some extent in its dimensions; in this form, however, the upper lateral margins are retuse (Fritsch 1918).

Forma apice retuso distincto, sed marginibus lateralibus superioribus non e partibus duabus constantibus. Long. cell., 18.5-20.0 µm; lat., 16.0-18.0 µm; ist., 3.0-4.0 µm; crass., 10.0 µm (Fritsch, Rich 1930).

416. COSMARIM SEXNOTATUM GUTWINSKI

- VAR. SIMPLEX CLAASSEN

Illustrations. Tab.24, figs.8, 9 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis C. secnotato var. tristriato* (Lütkem.) Schmidle, *sed membrana cellulae omnino glabra differt.*

Near var. *tristriatum* (Lütkem.) Schmidle (West, West 1908, p.228, Pl.LXXXVI, figs.8, 9); but the cell wall is smooth and without granules. Sides of semicells convex and 5-crenate, apex truncate and straight. Length 28.0 µm; breadth 22.0 µm; breadth of isthmus 10.0 µm; breadth of apex 11.0-12.0 µm (Claassen 1961).

417. COSMARIUM SMOLANDICUM LUND

- VAR. MAIUS CHOLNOKY

Illustrations. Fig.140 (Cholnoky 1955).

Samples. RSA: 230.

Note. Die gesehenen Exemplare entsprechen der Diagnose wohl tadellos, ihre Abmessungen sind aber beträchtlich grösser, da sie meistens 72.0-78.0 µm lang and - ohne Dorn - 65.0 µm breit waren. Der Dorn ist 4.5 µm lang. Ich habe es nötig gefunden, these charakteristisch abweichenden, grösseren Formen von dem Typus abzutrennen (Cholnoky 1955).

418. COSMARIUM SPECIOSISSIMUM SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 430, 434.

Note. In (Hancock 1973) indicated as *C. speciosissimum* Schm.

419. COSMARIUM SPECIOSUM LUNDELL

- VAR. SPECIOSUM

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 306.

- VAR. **BIFORME** NORDSTEDT

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 119, 123 (very rare), **382**.

Note. *Long.*, 57.0 μm ; *lat.*, 41.0 μm ; *lat. isthm.*, 27.0 μm (Hodgetts 1926).

- VAR. **REDUCTUM** HUBER-PESTALOZZI

Illustrations. Tab.7, Fig.4 (Huber-Pestalozzi 1930).

Sample. RSA: 328.

Note. *Long.*, 41.6 μm ; *lat.*, 31.2-39.0 μm ; *isthmus*, 10.4-13.0 μm (Huber-Pestalozzi 1930).

- VAR. **ROSTAFINSKII** (GUTW.) W. ET G.S. WEST

Illustrations. Pl.22, Fig.4 (Williamson 1994).

Samples. RSA: 347, 365, 399.

Note. Length 39.0-42.0 μm ; breadth 30.0-31.0 μm ; *isthmus* 16.0-16.8 μm ; ratio of length to breadth 1.3; thickness 21.0 μm (Williamson 1994).

- VAR. **SIMPLEX** NORDSTEDT

- F. **SIMPLEX**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 49 (rare).

Note. *Long.*, 36.0-42.0 μm ; *lat.*, 27.0-30.0 μm ; *lat. isthm.*, 12.0-15.0 μm (Fritsch 1918).

- F. **AFRICANUM** CLAASSEN

Illustrations. Tab.26, figs.9, 10 (Claassen 1961).

Samples. RSA: 253.

Note. *A varietate simplici* Nordst. *forma genuinum numero granulorum et cellula apicem versus minus deplanata differt.*

These specimens form a group within the limits of Nordstedt's variety (West, West 1908, p.250, PL.LXXXIX, fig.6); but which nevertheless can be distinguished by the number of granules and less attenuated apices. Margins of semicells crenate, crenations 14-16 (four apical and 5-6 lateral); granulate within the margins, granules in regular radial series, seven granules in each series, basal vertical series of granules absent. Chloroplasts axile, with one pyrenoids each. Length 44.0-48.0 μm ; breadth 26.0-28.0 μm ; breadth of *isthmus* 16.0-18.0 μm (Claassen 1961).

420. COSMARIUM SPHAGNICOLUM W. ET G.S. WEST

Illustrations. Fig.141 (Cholnoky 1955).

Samples. RSA: 237.

Note. Die gesehenen Exemplare weichen gewissermassen vom Typus ab - sie sind 18.0 μm lang, 13.0 μm breit mit einem *Isthmus* von 10.0 μm - so dass ich es für nötig halten musste, eins der gesehenen Exemplare auf der Fig.141 darzustellen (Cholnoky 1955).

421. COSMARIUM SPHALEROSTICHUM NORDST.

Illustrations. Fig.39 (Cholnoky 1954b).

Samples. RSA: 212, 213.

Note. After W. and G.S. West we recognize this species as "alpine". In fact it seems to be \pm typical steno- and acidobiontical but eurymesothermic (Cholnoky 1954b).

422. COSMARIUM SPORTELLA BRÉB.

- VAR. SIMPLEX F.E. FRITSCH

Illustrations. Fig.14 (Fritsch, Stephens 1921).

Samples. RSA: 71, 72, 73.

Note. *Cellulis a fronte visis apici laevi, lenissime convexo vel truncato vel lenissime retuso; a vertice visis late ellipticis, inflatione mediana nulla; membrana cum granulis sparsis non punctulata, sine tumore centrali. Long. cell., 48.0-50.0 µm; lat. cell., 39.0-42.0 µm; lat. isthm., 10.0-12.0 µm, crass., 24.0-26.0 µm.*

This variety, apart from the slightly larger dimensions, differs from the type mainly in the absence of the central granulated tumour in front- and end-views. Since this tumour is developed to a very variable extent in the type itself, it is possible that no sharp limit could be drawn between it and the new variety (Fritsch, Stephens 1921).

423. COSMARIUM STEPHENSII RICH

Illustrations. Fig.9, B-D (Rich 1932), Fig.16, F, G (Fritsch, Rich 1938).

Sample. RSA: 192, 198, 200, 203, 204.

Note. *C. magnum, ca. 1/5 plo long quam lat., profunde constrictum, sinu plerumque angusto-lineari, leviter ampliatio; semicellulis a fronte visis subhexagono-ellipticis, C. achondroides similibus, in media parte latioribus, angulis basalibus et apicalibus rotundatis, margine levi, membrana scrobiculata, infra apicem cum tuberculis ritundatis paucis; a vertice visis semicellulis late ellipticis, a latere visis sub-circularibus; pyrenoidibus duobus in quaque semicellula. Long., 58.0-63.0 µm; lat., 47.0-53.0 µm; ist., 14.0-17.0 µm; crass., 34.0-36.0 µm.*

This species resembles *C. achondroides* G.S. West, but has only two pyrenoids per semicell, and possesses tubercles which recall those of *C. bewsii* Fritsch et Rich (it differs, however, from the latter species in many respects) (Rich 1932).

Long. cell., 60.0-70.0 µm; lat., 40.0-60.0 µm; isthm., 15.0-20.0 µm; crass., 32.0-41.0 µm. This species was described from the Welervreden West Pan (Transvaal) in 1932, but in that material the markings could not be clearly discerned. The surface is covered with scrobiculations, each of which is seated in the middle of a polygonal areolation. A short distance below the apex of each semicell, as seen in front-view, are two blunt knobs more or less symmetrically placed; the three shown in Fig.9, B of the earlier record are due to misinterpretation. The position of the knobs is well seen in the end-view (Fig.16, G), which also shows that the wall of the semicell is strongly thickened over the middle part of each face. There are two pyrenoids in each semicell. In the presence of the two blunt processes beneath the apex of the semicell this species resembles *C. mamilliferum* Nordst. var. *madagascariense* W. et G.S. West (Fritsch, Rich 1938).

424. COSMARIUM STRIOLATUM (NÄG.) ARCH.

- VAR. NORDSTEDTII (MÖBIUS) KRIEGER (SYN.: *COSMARIUM GLYPTODERMUM* W. ET G.S. WEST)

Illustrations. Figs.112, 113 (Grönblad, Croasdale 1971); Figs.28-42 (Claassen, Eicker 1985); Pl.22, Fig.1 (Williamson 1994).

Samples. RSA: 317, 356. - NAM: 305, 307. - SWA: 378.

Note. Long., 83.0-94.0 μm ; lat., 52.0-57.0 μm (1.5-1.65x); isthm., 40.0-45.0 μm ; with 21-26 granules on the margin of the semicell (Grönblad, Croasdale 1971).

Length 90.0-101.0 μm ; breadth 61.0-68.0 μm ; isthmus 41.0-45.0 μm ; ratio of length to breadth 1.48-1.52. This is a difficult desmid to study using light microscopy because of the complex cell wall structure. The valuable paper by Claassen, Eicker (1985) reinforces the case for using SEM preparations, especially for desmids of this type (Williamson 1994).

425. COSMARIUM SUBAURICULATUM W. ET G.S. WEST

- VAR. SUBAURICULATUM

Illustrations. Fig.56 (Grönblad, Croasdale 1971); Pl.22, Fig.2 (Williamson 1994).

Samples. RSA: 295, 334. – NAM: 302, 307.

Note. Long., 49.0-52.0 μm ; lat., 47.0-53.0 μm ; isthm., 30.0-35.0 μm . R. Grönblad also suggested "*C. monodii* Bourr." for one of these plants, but *C. monodii* is more than twice as large, with an open sinus (Grönblad, Croasdale 1971).

Length 51.0-52.0 μm ; breadth 51.0-52.0 μm ; isthmus 32.0 μm ; ratio of length to breadth 1.0; thickness 33.6 μm . Cell wall densely punctate (Williamson 1994).

- VAR. BOGORIENSE (BERN.) BOURRELLY

Illustrations. Fig.57, 140 (Grönblad, Croasdale 1971); Pl.22, Fig.6 (Williamson 1994).

Samples. RSA: 382, 383. - NAM: 304, 307.

Note. Long., 47.0-51.0 μm ; lat., 48.0-50.0 μm ; isthm., 32.0 μm . Although the type has three teeth at the base of each lateral margin, Skuja (1949, p.118, 25: 7, 8) shows a form like ours with only two. In the type the wall is widely punctate or scrobiculate which R. Grönblad's sketch does not show (but the photograph does) (Grönblad, Croasdale 1971).

Length 49.0 μm ; breadth 47.6 μm ; isthmus 36.5 μm ; ratio of length to breadth 1.02; thickness 35.0 μm . Cell wall with large pores or scrobiculations (Williamson 1994). In (Williamson 1994) was not pointed sampling places.

426. COSMARIUM SUBBROMEI SCHMIDLE

- VAR. SUBBROMEI

Illustrations. Fig.29, *a-f* (Fritsch 1918).

Sample. RSA: 42, 43, 48.

Note. *Formae diversae*, pro parte ad *C. quadrum* Lund. et *C. conspersum* Ralfs accedens.

The reference of the specimens in the above samples to *C. subbromei* Schmidle is based solely on the end-view and the character of the granulation. As far as the shape in front-view of these specimens is concerned, they might be referred to *C. quadrum* Lund., *C. conspersum* Ralfs or even *C. margaritatum* (Lund.) Roy et Biss., since individuals showing the shape characteristic of these species, on one or both semicells, were always to be found (Fig.29, *a-d*). These three species are, however, all distinguished by having an end-view without a trace of median inflation, whereas all types of cell-form shown in Fig.29 had an end-view with a slight median enlargement; in fact, although large numbers of individuals were examined, all showed this character quite distinctly. It may be mentioned that the end-view was, in general, much more like that shown by

Messrs, West in Fig.11 (West, West 1912, Pl.C) that that depicted by Schmidle (Beitr. z. Algenfl. d. Schwarzwald. u. Rheineb., Ber. naturf. Ges. Freiburg i. B., vii, 1893, p.104, Tab.V, figs.22-24). A peculiar form of end-view, with flattened poles, only noticed in connection with a front-view of the *consersum*-type, is seen in Fig.29, e”.

As regards the granulation, the granules were, in the vast majority of cases, of the fine type figured by Schmidle and Messrs. West. In sample **48**, however, occasional individuals with a coarser granulation, more like that of *C. quadrum* Lund., were observed; some of these individuals also showed reduction of the granulation in the middle of the apex, such as is characteristic for this species. In correspondence with the larger size of the specimens (*cf.* below), the granules were more numerous than in Schmidle’s or Messrs. West’s forms. Moreover they covered practically the whole surface of the semicells in a uniform manner. In general they were arranged in concentric series, (Fig.29, a), as in Messrs. West’s specimens, although occasional individuals showed them in more or less obvious vertical series.

These diverse forms may be enumerated as follows:

(a) Forma *typica* (Fig.29, a, e): Long., 48.0-52.0 μm ; lat., 47.0-50.0 μm ; lat. isthm., 14.0-15.0 μm ; crass., 22.0-24.0 μm . Dimensions of individual specimens: 48.0x49.0, 52.0x48.0, 50.0x47.0, 51.0x50.0, 48.0x48.0, 50.0x50.0 μm .

(b) Forma *pseudo-quadrum* (Fig.29, b, d, e’): Long., 48.0-51.0 μm ; lat., 44.0-49.0 μm ; lat. isthm., 13.0-15.0 μm . Dimensions of individual specimens: 48.0x48.0, 51.0x50.0, 48.0x49.0, 48.0x44.0 μm .

(c) Forma *pseudo-consersum* (Fig.29, c, e’, e’’) : Long., 47.0 μm ; lat., 48.0 μm ; lat. isthm., 14.0 μm .

In view in the fact than a large percentage of the individuals showed a shape in front-view very similar to that of *C. quadrum* Lund. (including even a faintly retuse apex in some cases, Fig.29, d), the question arises as to whether *C. subbromei* Schmidle, would not better be regarded as a variety of *C. quadrum* Lund., with several forms. It may be well, however, to await further observations before arriving at a definite conclusion on this point (Fritsch 1918).

- VAR. **PSEUDO-PEARSONI** FRITSCH

Illustrations. Fig.30 (Fritsch 1918).

Samples. RSA: 33, 35.

Note. *Differt a typo cellulis ca. 1¹/₅ plo longioribus quam latis, semicellulis avato-pyramidatis, lateribus convexis et convergentibus, apice indistincte truncato, granulis parvis numerosis in seriebus confertis concentricis ordinatis; a vertice visis ellipticis, polis late rotundatis, inflatione mediana distincta subacuta. Long., 50.0-60.0 μm ; lat., 43.0-50.0 μm ; lat. isthm., 12.0-15.0 μm .*

This variety shows considerable resemblance to *C. pearsoni* G.S. West (Freshw. Alg. Percy Sladen Mem. Exped., Ann. S. Afr. Museum, ix, 1912, p.87, Pl.I, fig.42) and the name is intended to bring out this fact. It differs from this species (a) in the end-view, which is practically that typical for *C. subbromei*; (b) in the somewhat coarser granulation; and (c) in the fact that the granules are arranged in obvious concentric series. Moreover the individuals are smaller. The variety may also be compared with *C. botrytis* Menegh., *C. radiosum* Wolle and *C. intermedium* Delp. (Fritsch 1918).

427. COSMARIUM SUBCONNATUM CLAASSEN

Illustrations. Tab.26, figs.14, 15 (Claassen 1961).

Samples. RSA: 254.

Note. *A latere visa affinis C. connato* Bréb. *truncato* West, *sed a fronte visa cellulis plus deplanatis et pyramidalibus distincta.*

In lateral view, this species resembles the front view of *C. connatum* Bréb. var. *truncatum* West (West, West 1908, p.26, Pl.LXVII, fig.18); but it has rounded apices; the semicells in front view are somewhat truncate-pyramidate. Cells of medium size, about 1.1-1.3 times longer than broad, moderately constricted, sinus very widely open with an obtuse apex; semicells transversely subelliptic with a broad base, apex flattened. Cell wall punctate with two series of minute punctae on each side of the isthmus. Side view of semicell subovate. Chloroplasts containing two pyrenoids each. Length 42.0-66.0 μm ; breadth 34.0-56.0 μm ; breadth of isthmus 24.0-38.0 μm (Claassen 1961).

428. COSMARIUM SUBCOSTATUM NORDST.

- VAR. SUBCOSTATUM

- F. SUBCOSTATUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 115, 116 (rare).

Note. *Long.*, 35.0-36.0 μm ; *lat.*, 28.8-30.0 μm ; *lat. isthm.*, 9.0-11.0 μm . Chloroplast with two pyrenoids (Hongetts 1926).

- F. MINOR W. ET G.S. WEST

Illustrations. Fig.38 (West 1912).

Samples. RSA: 5 (among other algae, with zygospores), **6, 12, 14, 113** (very rare), **114** (very rare), **115** (very rare), **116** (very rare), **120** (very rare), **121** (very rare), **322, 328**.

Note. *Zygosporae globosae, verrucis truncatis (ad marginem 9 visis) obsessa, verruca unaquaque cum granulis 7 circa spinam brevem centralem.* *Long. Cell.* 26.0-28.0 μm ; *lat.* 20.5-23.0 μm ; *lat. isthm.* 7.0-8.0 μm ; *crass.* 13.0-14.0 μm ; *diam. zygosp. sine verruc.* 24.0 μm , *cum verruc.* 30.0-32.0 μm .

This small form was first described from Angola in 1897, but has since been shown to have a wide geographical distribution, especially in the tropics. No zygospores of the species have previously been observed (West 1912).

Long., 25.0-26.0 μm ; *lat.*, 18.6-21.0 μm ; *lat. isthm.*, 6.0 μm . Chloroplast with one pyrenoid (Hodgetts 1926).

Long., 20.8 μm ; *lat.*, 16.0 μm (Huber-Pestalozzi 1930).

- VAR. BECKII (GUTW.) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 305.

- VAR. WARMBADIANUM CLAASSEN

Illustrations. Tab.25, figs.12-14 (Claassen 1961).

Samples. RSA: 276.

Note. *Differt typo speciei dispositione et numero granulorum in membrana.*

This differs from the typical form (West, West 1908, p.236, PL.LXXXVII, figs.3-5) in the number and arrangement of the granules. Sides of semicells convex and crenulate, with about two small entire crenulations near the basal angles and 3-5 emarginate (or bigranulate) crenulations on the rest of the lateral margin; apex truncate and with a few small undulations; within the margin minutely granulate, granules radially and concentrically disposed; opposite each of three crenulations at the base of the semicell is a series of three granules, the two series next to margin opposite the next crenulation binate and the series nearest the centre single, the first series next to the margin opposite the following

two crenulations binate and the second and third series single; next to the apex two series of two granules each; in the centre, above the isthmus with a granulated tumour, granules in three vertical series of three each. Length 32.0-36.0 μm ; breadth 27.0-30.0 μm ; breadth of isthmus 10.0-12.0 μm ; breadth of apex 12.0-13.0 μm (Claassen 1961).

429. COSMARIUM SUBCRENATUM HANTZSCH

- VAR. SUBCRENATUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 35, 39, 40, 41, 48, 60, 65, 198, 299.

Note. Long., 28.0-38.0 μm ; lat., 25.0-30.0 μm ; lat. isthm., 7.0-11.0 μm (usually about 9.0 μm). In some of the individuals the apical undulations were rather indistinct (Fritsch 1918).

Long. cell., 24.0-30.0 μm ; lat. cell., 18.0-25.0 μm ; lat. isthm., 7.0-10.0 μm (Fritsch, Stephens 1921).

Long. cell., 40.0 μm ; lat., 25.0-26.0 μm ; isthm., 12.0 μm ; crass., 15.0 μm . The lateral margins and the apex of the semicells are provided with 4 crenations within each of which lies a binate granule. The central granules are ill-defined, rather as in Pl.LXXXVI, fig.15 of West (West, West 1908) (Fritsch, Rich 1938).

Long. cell., 23.0-24.0 μm ; lat., 20.0-23.0 μm ; isthm., 11.0 μm . Sides 5-crenate, apex 4-crenate (Rich 1940).

- VAR. DIVARICATUM WILLE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 210.

430. COSMARIUM SUBCUCUMIS SCHMIDLE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. Long., 46.8 μm ; lat., 28.6 μm ; isthmus, 10.4 μm (Huber-Pestalozzi 1930).

431. COSMARIUM SUBDANICUM WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. Smaller than type, long., 13.0 μm ; lat., 13.0 μm (Huber-Pestalozzi 1930).

432. COSMARIUM SUBMONOMAZUM RICH

Illustrations. Fig.7, A-D (Rich 1932).

Sample. RSA: 192 (rather common).

Note. *C. subparvum*, paene tam latum quam longum, profunde constrictum, sinu angusto-lineari; semicellulis a fronte visis truncato-pyramidatis, angulis basalibus rotundatis, apice leviter deplanato, marginibus ubique undulatis, undulationibus ca. 20 in ambitu semicellulae cum verruca deplanata interdum emarginata intra undulationem unamquamque; semicellulis supra isthmum cum tumore inconspicuo granulo singulo centrali et granulis 8 periphericis munito praeditis. A latere visis semicellulis obovatis, apice leviter deplanato, cum seriebus verrucarum duabus e basi ad apicem divergentibus. A vertice visis semicellulis elongato-hexagonalibus granulo magno centrali utrobique, sinebus duabus verrucarum inter polos praeditis. Long., 34.0-40.0 μm ; lat., 31.0-39.0 μm ; ist., 8.0-10.0 μm ; crass., 18.0-20.0 μm .

The individuals observed were mostly so closely covered with mucilage that it was difficult to ascertain the exact nature of the granulation and ornamentation. This species differs from *Cosmarium monomazum* Lund. in the nature of its central granule; it also differs in the more pyramidal shape of the semicells (Rich 1932).

433. COSMARIUM SUBPROTUMIDUM NORDSTEDT

Note. In sample 74 there occurred numerous *Cosmaria* diverging more or less markedly from *C. subprotumidum* proper, as described and figured for instance in Messrs. West's monograph. It has not proved possible to discriminate between these different *Cosmaria* and, although the extreme forms are sufficiently distinct from *C. subprotumidum*, they are connected with it by a whole series of transitional forms (Fig.15). All of these forms agree to a more or less marked extent in certain respects which constitute points of difference from the typical *C. subprotumidum*. These common features are as follows.

Special granules are not developed in the central part of the semicell, although now and again slightly larger ones are found in this region. This feature is connected with a weaker differentiation of the central tumour – a fact which is very obvious in the side- and end-views (Fig.15). In a few cases there appears to be a semicircular bare area between the marginal and central granules of the semicell, as seen in front view – an approximation to the condition found in the type – although the central granules are not larger than the others. As a rule, however, the entire semicell is uniformly granulated, the granules being arranged in more or less well-marked concentric series and often also in radiating series, although the arrangement is always more or less irregular in the centre of the semicell. In all the specimens, lastly, the apex appears smooth and truncate, an occasional appearance of undulation (as in Fig.15, VI and VIII) being due to the presence of three to four granules just within the margin.

It may be noticed that W. West (Freshw. Alg. W. Ireland, Journ. Linn. Soc., Bot., xxix, 1891, p.157, Pl.XXIV, fig.21) has described a form of *C. subprotumidum* with more scattered granules and weakly differentiated central granules (*cf.* also Messrs. West's monograph, A monograph of British Desmidiaceae, Vol.III, 1908, p.232, Pl.LXXXVI, fig.22), and such a form helps to link up the specimens here described with typical *C. subprotumidum*; it would be interesting to know the character of the side- and end-views of this form, since they would presumably show reduction of the central tumour. The form described by Schmidle as *C. occultum* would differ from all these in the fact that granules are altogether wanting in the middle of the semicell, and it is significant that Schmidle's rather poor figure (Engler's Bot. Jahrb., xxxii, 1902, Tab.1, fig.25) shows a relatively slight tumour in end- and side views.

The specimens in sample 74 that come nearest to *C. subprotumidum* are shown in Fig.15, VIII, IX, and X (IX having the same sort of end- and side-views as VI). Such specimens are generally of rather small dimensions: long., 21.0-22.0 μm (rarely as much as 27.0 μm , or even 30.0 μm , the greatest length noted); lat., 18.0-19.0 μm (rarely up to 25.0 μm); lat. isthm., 5.0-6.0 μm ; crass., 14.0-15.0 μm . They agree more or less with the type in the shape of the semicells (especially Fig.15, VIII and X), in the rectangular basal angles, and in the fact that the upper converging parts of the sides are provided with two hollows with a median crest which is retuse or even emarginate, whilst the lower part of the sides are variously crenated. VIII is perhaps the specimen which approximates most closely in these respects, whilst X is characterized by sides which are more markedly subparallel

than is usually the case, hand in hand with which appears to go the development of the tumour nearer the middle of the semicell, as seen in side-view. IX approximates somewhat towards var. *gregorii* in the bigranulate character of the crenations.

Somewhat more divergent forms are shown in Fig.15, VII and XI; these are characterized by a rather pronounced delimitation of the apex of the semicell as a kind of square-edged apical protuberance, due to the upper hollow being deeper than usual – a feature which is also indicated in IX. VII is further distinguished by the absence of crenations on the lower parts of the lateral margins; its dimensions were: long., 25.0-28.0 μm ; lat., 22.0 μm ; lat. isthm., 6.0 μm ; side- and end-views, as in VI. XI is characterized by a tendency towards equalisation of the crenations on the lower and upper parts of the sides (*cf.* especially the right-hand side of the semicell), although the upper ones are still larger than the lower ones.

These two specimens lead over on the one hand to that that shown in Fig.15, VI, on the other hand to those depicted in Fig.15, I-V. The specimen VI resembles VII, except that the apex is not so sharply delimited. The median crest on the upper part of the lateral margins is still well marked though not always retuse, but the crenations on the lower parts of the sides are feeble. The dimensions were: long., 28.0-30.0 μm ; lat., 24.0 μm ; lat. isthm., 6.0 μm ; crass., 14.0-15.0 μm . Specimens of this kind were also seen with minute granules or teeth on the lateral crenations, similar to those in Fig.15, IX.

The forms VI, VII, and XI differ from those in Fig.15, VIII-X, in that they tend to show a gradual convergence of the lateral margins, beginning a little way above the base of the semicell. This feature is clearly indicated in IX.

The remaining forms (Fig.15, I-V) show this convergence to a more marked extent, and this is accompanied by an increasing equalisation of the crenations on the lateral margins (*cf.* var. *simplicius* Schmidle, Hedwigia, xxxiv, 1895, p.77, Tab.I, fig.10). Specimen III is most like *C. subprotumidum*, but has two crests instead of one on the upper parts of the lateral margins; in IV and V, whilst the upper crenations are still the larger, they are rounded like the lower ones and not retuse; in II the distinction between the lower and upper crenations is but feebly indicated, whilst the extreme condition is reached in specimen I, with a very regular convergence of the lateral margins and practically uniform crenation.

These individuals, with converging lateral margins and a tendency towards uniform crenation, are the largest of the series, although connected with the smaller ones by specimen VI. Their dimensions are: long., 30.0-33.0 μm ; lat., 24.0-29.0 μm (usually 27.0-29.0 μm , only specimen II being as narrow as 24.0 μm); lat. isthm., 6.0-6.5 μm ; crass., 15.0-18.0 μm . The granules of these larger specimens are more numerous and apparently somewhat smaller than those of the others, whilst the central tumour is on the average less strongly developed – in fact, in some cases it is practically unrecognisable in side-view (Fig.15, V).

It appears that two main types are concerned, viz. (a) a larger one (average length, 30-33 μm), with more or less convex lateral margins gradually converging from the base of the semicell to the apex, and rather numerous lateral crenations which are equal or subequal (Fig.15, I, II, V), and (b), a smaller one (average length, 21-22 μm), with the lower parts of the lateral margins subparallel, and a pronounced larger, generally retuse, crest on the upper parts of the lateral margins (Fig.15, VII-X). Transitions to type (b) are afforded by specimens III and IV, whilst transitions to type (a) are seen in VI and XI. It must be realised that there is no question of any sharp demarcation, however; if occasion had offered

for the presentation of still more numerous figures, a complete series of transitions could have been shown.

It would seem to be best to include all these specimens in a subspecies *simplex*, characterised by feeble development of the central tumour, which lacks all special granulations, by uniform and generally concentric granulation of the entire semicells, and by a smooth truncate apex. I would include in this subspecies the form, described by W. West (*cf.* above), and also *C. occultum* Schmidle. Brief diagnoses are given in the following:

COSMARIUM SUBPROTUMIDUM NORDST. SUBSP. **SIMPLEX** F.E. FRITSCH

Differ a typo tumore centrali parvo sine granulis majoribus vel distincte dispositis; granulis in tota superficie semicellularum aequalibus plerumque concentricis; apicibus semicellularum planis truncatis. Long. cell., 21.0-33.0 µm; lat. cell., 18.0-29.0 µm; lat. isthm., 5.0-6.5 µm; crass., 14.0-18.0 µm (Fig.15).

Var.(α), forma minor angulis basalibus rectangularibus, magniribus lateralibus superioribus convergentibus crista mediana retusa vel etiam emarginata munitis, marginibus inferioribus varie crenatis subparallelis. Long. cell., 21.0-22.0 µm (raro usque 27.0 µm, vel etiam 30.0 µm); lat. cell., 18.0-19.0 µm (raro usque 25.0 µm); lat. isthm., 5.0-6.0 µm; crass., 14.0-15.0 µm. Hac varietas ad typum appropinquat (Fig.15, VIII-X).

Formae apicibus plus minus distincte delimitatis, crenis in parte inferiore marginium lateralium parum efformatis (Fig.15, VI, VII, XI). Pro parte ad var. β accedens.

Forma W. West, Freshw. Alg. W. Ireland, Journ. Linn. Soc., Bot., xxix, 1891, p.157, Pl.XXIV, fig.21.

var. β, forma major marginibus lateralibus plus minus convexis, a basi ad apicem gradatim convergentibus, crenis marginium lateralium frequentioribus aequalibus vel subaequalibus. Long. cell., 30.0-33.0 µm; lat. cell., 27.0-29.0 µm (raro 24.0 µm); lat. isthm., 6.0-6.5 µm; crass., 15.0-18.0 µm. Hac varietas a typo plus discedit (Fig.15, I, II, V).

Forma marginibus lateralibus superioribus cristis retusis vel truncatis duabus (Fig.15, III).

Forma crenis superioribus marginium lateralium majoribus (Fig.15, IV).

Var. occultum (Schmidle), 1902 (Engler's Bot. Jahrb., xxxii, 1902, Tab.1, fig.25), *forma minor marginibus lateralibus convergentibus, apicibus paullo protrusis leniter undulatis; marginibus lateralibus superioribus crista mediana paullo emarginata munitis; in media semicellula granulis nullis. Long. cell., 22.0 µm; lat. cell., 20.0 µm.*

A curious abnormality observed among these forms of *C. subprotumidum* is shown in Fig.15, A (Fritsch, Stephens, 1921).

SUBSP. SIMPLEX FRITSCH

Var. α. Long., 19-24 µm; lat., 18-21 µm; ist., 4.5 µm. Sample 165 (rare).

Var. β. Forma marginibus lateralibus superioribus cristis truncatis duabus (Fritsch, Trans. Roy. Soc. S. Afr., ix, 1921, p.42, fig.15, III). *Long. cell., 24.0-32.0 µm; lat., 22.0-28.0 µm; ist., 6.0-8.0 µm; crass., 14.0 µm. Samples 131 (rare), 144 (common), 145 (common), 146 (common), 161 (rare).*

Forma crenis superioribus marginium lateralium majoribus (Fritsch, Trans. Roy. Soc. S. Afr., ix, 1921, p.42, fig.15, IV). *Long. cell., 24.0-32.0 µm; lat., 20.0-28.0 µm; ist., 5.0-6.0 µm; crass., 14.0 µm. Sample 132 (rather rare).*

Forma Fritsch, Trans. Roy. Soc. S. Afr., ix, 1921, p.42, fig.15, II *similis*; *long. cell.*, 26.0-34.0 μm ; *lat.*, 22.0-29.0 μm ; *ist.*, 6.0-8.0 μm . Sample **165** (rare).

In sample **131** specimens were seen with a well-marked median protuberance bearing distinct granules definitely arranged in a number of concentric series, but these granules were no larger than the others found on the surface of the semicell, nor were they separated by a smooth area from the intramarginal granulation, the two being quite continuous (Fritsch, Rich 1930).

- VAR. **SUBPROTUMIDUM**

Illustrations. Fig.16, B (Fritsch, Stephens 1921); Figs.1, 2, 3, 4 (Williamson 1995).

Sample. RSA: 74 (very rare), **165** (rare), **299, 380**.

Note. The typical form of this desmid was very rare in the present material, and even the few specimens observed did not altogether agree with the description and figures of in Messrs. West's monograph, the basal angles in front-view being less markedly rectangular, and the tumour, though well marked, not quite so prominent in the side- and end-views. The tumour bore three rows of granules, the middle one consisting of four, the side ones of three. The dimensions were: *Long. cell.*, 27.0 μm ; *lat. cell.*, 24.0 μm ; *lat. isthm.*, 6.0 μm ; *crass.*, 16.0 μm .

It seems that this species is widely distributed in Africa, and that it is subject to considerable variation (Fritsch, Stephens 1921).

Long. cell., 22.0-24.0 μm ; *lat.*, 21.0 μm ; *isthm.*, 6.0 μm ; *crass.*, 13.0-14.0 μm . An abnormality similar to that observed in Kentani (Fritsch, Stephens 1921, p.41) and in Griqualand West (Fritsch, Rich, not recorded) was present (Rich 1940).

Although widely distributed over various continents especially in mesotrophic waters it is a relatively uncommon desmid which can be easily confused with *Cosmarium subcostatum* Nordst (1876) or its var. *minus* (W. et G.S. West) Först. both of which have semicells of a truncate-pyramidal shape and rather similar granular ornamentation. *C. subprotumidum* however is distinguished by having more trapeziform semicells and almost rectilinear apices which appear distinctly produced.

In sample **380**, cells of *C. subprotumidum* were abundant together with frequent but mostly detached zygospores, although occasionally found still adhering to empty semicells. The zygospore is globular with 9-12 conical spines arranged around the periphery. 6-7 minute granules encircle the raised base of each spine. Diameter with spines 28.0-34.6 μm , without spines 21.0-25.0 μm .

Comparison should be made with the zygospore of *C. subcostatum* Nordst. f. *minor* W. et G.S. West illustrated in G.S. West (1912). This figure apart from shorter spines, appears almost identical to the specimens now under examination, while the dimensions of the zygospore reported by G.S. West (diameter without spines 24.0 μm , with spines 30.0-32.0 μm) agree exactly with those mentioned above. It is not without significance that S. West's specimens of *C. subcostatum* f. *minor* were found in the upper Karoo, near Papkuil and Gansfontein, the material having been collected by Prof. H.H.W. Pearson between November 1908 and July 1909 during the Percy Sladen Memorial Expedition in S.W. Africa 1908-19011. A search of desmid zygospore illustrations has not revealed any with features similar to those described either by G.S. West or from this sample. Samples of the author's material and drawings were sent for

confirmation to other leading specialists who agreed that the taxon was indeed *C. subprotumidum*, but to differentiate it from *C. subcostatum* is not easy and requires careful study. Undoubtedly in the past there has been confusion between the two taxa. Fritsch and Stephens (1921) in referring to *C. subprotumidum* from Africa comment on its variability, and say that even when the typical form of the desmid was seen it did not altogether agree with the description and figures in W. and G.S. West's monograph, while in Grönblad, Scott and Croasdale (1968. p.19) some disagreement amongst the authors about the assignment of *C. subcostatum* is mentioned, Scott apparently having called the desmid *C. subprotumidum* Nordst. var. *gregorii* (Roy et Biss.) W. et G.S. West.

It is not unusual for zygospores of *Cosmarium* to bear a close resemblance to others of the genus and it is quite possible that the zygospore figured by G.S. West (1912) does indeed belong to his *C. subcostatum* f. *minor* and although the drawing is small the desmid certainly resembles *C. subcostatum*, and yet because of the similarity to zygospore of *C. subprotumidum* the author is not entirely satisfied that West's identification was correct. More zygospores of both species need to be accurately examined before the doubts are resolved (Williamson 1995).

- VAR. **GREGORII** (ROY ET BISS.) W. ET G.S. WEST

Illustrations. Fig.2, *D-F* (Rich 1940); Pl.22, Fig.7 (Williamson 1994).

Sample. RSA: 28, 32 (?) , 41, 299, 341, 343, 351, 356, 390, 392. - NAM: 307.

Note. Long., 21.0-24.0 μm ; lat., 21.0-22.0 μm ; lat. isthm., 6.0-7.0 μm . Typical specimen closely resembling Fig.24 in Messrs. West's monograph (Fritsch 1918).

Long. cell., 22.0-27.0 μm ; lat., 20.0-23.0 μm ; isthm., 6.0 μm ; crass., 12.0-13.0 μm . Lateral crenations distinctly bigranulate. Marginal granules conical in form (Rich 1940).

Length 20.0-25.0 μm ; breadth 18.5-22.0 μm ; isthmus 5.7-7.7 μm ; ratio of length to breadth 1.06-1.13; thickness 11.5-14.7 μm (Williamson 1994).

434. COSMARIUM SUBREINSCHII SCHMIDLE

- VAR. **SUBREINSCHII**

Illustrations. Fig. 17, *D* (Fritsch, Rich 1938).

Samples. RSA: 201, 201, 204.

Note. Long. cell., 19.0-21.0 μm ; lat., 13.0-15.0 μm ; isthm., 3.0 μm . This species is characterized by its sinuous lateral margins. Some semicells in front-view show a single crenation on each side, while others show faint indications of a second. The side-view of the semicell is narrowly elliptic.

Certain resemblances are shown to *C. dubium* Borge and to *C. subimpressulum* Borge, but these have not got the general square shape of the semicells which distinguishes *C. subreinschii* (Fritsch, Rich 1938).

- VAR. **OCELLATUM** W. ET G.S. WEST

Illustrations. Fig. 17, *E* (Fritsch, Rich 1938).

Samples. RSA: 198, 200.

Note. Long. cell., 19.0-25.0 μm ; lat., 15.0-17.0 μm ; isthm., 4.0-6.0 μm . There is only one crenation on each side, and the apex is broadly truncate (Fritsch, Rich 1938).

435. COSMARIUM SUBSPECIOSUM NORDST.

- VAR. **SUBSPECIOSUM**

Illustrations. Pl.22, Fig.5 (Williamson 1994).

Sample. RSA: 340.

Note. Length 49.0 μm ; breadth 35.7 μm ; isthmus 12.6 μm ; ratio of length to breadth 1.37; thickness 22.4 μm (Williamson 1994).

- VAR. **VALIDIUS NORDST.**

Illustrations. Pl.23, Fig.1 (Williamson 1994); Pl.5, 1 (Williamson 2000).

Sample. RSA: 332, 341, 385, 390, 392, 394. - NAM: 307.

Note. Length 63.0-72.0 μm ; breadth 47.0-55.0 μm ; isthmus 17.0 μm ; ratio of length to breadth 1.3-1.4; thickness 34.0 μm (Williamson 1994).

436. COSMARIUM SUBTUMIDUM NORDST.

- VAR. **BORGEI KRIEG. ET GEITL.**

Illustrations. Figs.75, 76 (Grönblad, Croasdale 1971).

Sample. RSA: 430, 434. - NAM: 304, 306.

Note. *Forma.* Long., 28.0-30.0 μm ; lat., 22.5-24.0 μm (1.24-1.25x); isthm., 7.0-8.5 μm ; crass., circa 17.0 μm . This plant seems closest to var. *borgei* in its rounded apex and rather thick end view, but it resembles the type in its more pyramidal semicells. R. Grönblad did not suggest a name (Grönblad, Croasdale 1971).

- VAR. **CIRCULARE BORGE**

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 159, 164 (rather rare).

Note. *Long. cell.*, 23.0-28.0 μm ; *lat.*, 21.0-25.0 μm ; *ist.*, 6.0-7.0 μm ; *crass.*, 13.0 μm .

Some of the individuals showed a fairly well-marked fluttering of the apex in front-view, but the side- and end-views were quite like those figured by Borge (Arkiv f. Bot., I, 1903, p.97, Tab.III, fig.22) (Fritsch, Rich 1930).

Swaziland (orig.).

- VAR. **KLEBSII W. ET G.S. WEST**

Illustrations. Fig.42 (Nyygard 1932).

Sample. RSA: 183 (only 1-3 specimens were observed), **244.**

Note. Length of cells 30.0 μm , breadth 24.0 μm , thickness 14.0 μm , breadth of isthmus 7.0 μ , and breadth of apices 9.0 μm . W. and G.S. West (West, West 1905, p.193, t.63, figs.21-23) do not give the measurements for the apices. To judge from their figures, the apices of *C. subtumidum* Nordst., are about as broad as the cell; in var. *klebsii* they are distinctly smaller than half the breadth of the cell, so that it is evident that the present individuals should be referred to var. *klebsii* (Nyygard 1932).

- VAR. **MINOR STRØM**

Illustrations. Figs.77 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. Long., 17.0 μm ; lat., 12.5 μm (1.36x); isthm., 5.0 μm . Our plant is relatively a little longer than Strøm's (1920, p.136, 2: 4a, 4b, 14) and a little smaller, but otherwise fits quite well. H. Croasdale does not agree with Krieger and Gerloff (1962, p.25) in their placing of this under *C. depressum* (Näg.) Lund. var. *planctonicum* Reverdin. The latter is relatively much shorter, with a truncate apex. R. Grönblad suggested "*C. granatum* Bréb. forma" and "*C. laeve* Rabenh." (Grönblad, Croasdale 1971).

- VAR. **THERONII** CLAASSEN

Illustrations. Tab.27, fig.9 (Claassen 1961).

Samples. RSA: 271, 296.

Note. *Affinis C. subtumido var. klebsii* (Gutw.) W. et G.S. West, *sed cellulis triplo maioribus, membrana cellulae densis punctis distincta, sinu foras aperto differt.*

Near var. *klebsii* (Gutw.) W. et G.S. West; but differs in the cells being about thrice the size of var. *klebsii*, and in having an open sinus and a densely punctated cell wall. Cells very large, about 1.2-1.4 times as long as broad, deeply constricted, sinus open; semicells broadly pyramidate with truncate apices, basal angles rounded. Cell wall very densely punctate, with a thickening at the apex of each semicell. Each chloroplast with two pyrenoids. Length 141.5-148.0 μm ; breadth 104.0-124.0 μm ; breadth of isthmus 42.0-44.0 μm ; breadth of apices 40.0-43.5 μm . Named after Mr. J.E. Theron of Rietfontein 288, near Nylstroom (Claassen 1961).

437. **COSMARIUM SUBUNDULATUM** WILLE

- VAR. **MINOR** FRITSCH ET RICH

Illustrations. Fig.20 (Fritsch, Rich 1930).

Sample. RSA: 145, 146 (common).

Note. *Differt a typo magnitudine minore, cellula minus profunde constricta, isthmo latiore; semicellulis crassioribus, a vertice visis paene subcircularibus polis protrusis; chromatophoris axilibus pyrenoide singulo; a latere visis quam in typo. Long. cell., 32.0-36.0 μm ; lat., 21.0-24.0 μm ; ist., 14.0-15.0 μm ; crass., 16.0-20.0 μm .*

This variety is especially distinguished by its end-view and the single pyrenoid in the chloroplast (Fritsch, Rich 1930).

438. **COSMARIUM SUCCISUM** WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. Colorless. Indicated as *Cosmarium succisum* West var. nova (Huber-Pestalozzi 1930).

439. **COSMARIUM SULCATUM** NORDST.

- VAR. **SULCATUM**

Illustrations. Fig. nostr.7, E-G (Rich 1932); Pl.23, Fig.2 (Williamson 1994).

Sample. RSA: 192, 328, 338.

Note. *Forma* with some thickened angles. Long., 41.6 μm ; lat., 33.8 μm ; isthmus, 7.8 μm (Huber-Pestalozzi 1930).

Although the majority of individuals measured agreed with the dimensions given by W. et G.S. West (West, West 1895, p.57), some were found a little larger. Long., 36.0-44.0 μm ; lat., 30.0-36.0 μm ; ist., 8.0-10.0 μm ; crass., 21.0 μm . The angles of the semicells often appeared to be slightly thickened; the walls were scrobiculate. The side-view was not observed. This species resembles certain forms of *Cosmarium pseudoprotuberans* Kirchn.; it has, however, two pyrenoids in each semicell (Rich 1932).

Length 50.0-57.0 μm ; breadth 39.0-45.0 μm ; isthmus 8.5-12.5 μm ; ratio of length to breadth 1.2-1.33; thickness ca. 28.0 μm .

There was a large population of this desmid in the dam at Kenneth Stainbank Nature Reserve, Durban when first visited in October 1988 and always present since that time.

The morphae within this prolific population show considerable variability with features which could cause it to be assigned to *C. sulcatum* Nordst., *C. sulcatum* var. *compressum* Rich (my Pl.23, Fig.5), *C. sulcatum* var. *africanum* Borge, *C. pseudosulcatum* var. *polynodosum* Bourrelly et Couté (1991) or even *C. pseudoprotuberans* Kirchn. Some forms of which bear a close resemblance. The author cannot place this taxon with confidence and feels that the group mentioned above requires further careful investigation (Williamson 1994).

- VAR. AFRICANUM BORGE

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328, 329.

- VAR. COMPRESSUM RICH

Illustrations. Fig.2, G (Rich 1940).

Samples. RSA: 299.

Note. *Sinus pro longitudine majore quam ad typus clausus; cellulae depressae, ad perpendiculum directus complanatae, videuntur.* Long. cell., 40.0-44.0 μm ; lat., 31.0-40.0 μm ; isthm., 9.0-11.0 μm ; crass., 24.0-25.0 μm .

The semicells in front view are widest across the middle, and the apex is truncate; in both these respects there is a resemblance to *C. sulcatum*, but the sinus is closed for a longer distance, thus giving the cells a more (horizontally) compressed appearance. The surface is scrobiculate, and there are two pyrenoids in each semicell. The chloroplasts are axile with radial extensions. In his original description Nordstedt ("De Algis aquae dulcis et de Characeis ex insulis Sandvicensibus", 1878, p.13) gives no dimensions, and is not sure about the number of pyrenoids.

In some of the forms, presumably belonging to this variety (long. cell., 36.0-37.0 μm ; lat., 30.0-32.0 μm ; isthm., 7.0-9.0 μm), there is a distinct resemblance to *C. subprotumidum* Nordst., especially to Taylor's figure of this species ("The Freshwater Algae of Newfoundland", Michigan Acad. of Sci., vol.xix, 1934, pl.1, fig.3), and there is also an agreement in dimensions (Rich 1940).

440. COSMARIUM SYNTHLIBOMENUM WEST

- VAR. AFRICANUM HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 327.

Note. Long., 9.1 μm ; lat., 1.4 μm ; smaller than type variety (Huber-Pestalozzi 1930).

441. COSMARIUM TATRICUM RACIB.

- VAR. NOVOZELANDICUM NORDST. 1887, p.161; 1888, p.56, PL.6:6

Illustrations. Pl.16, Fig.6 (Williamson 1994).

Sample. RSA: 332, 333, 341, 363, 390.

Note. Length 31.0-48.0 μm ; breadth 15.5-26.0 μm ; isthmus 11.0-17.5 μm ; ratio of length to breadth 1.6-2.0 (Williamson 1994).

442. COSMARIUM TAXICHONDRUM P. LUNDELL

- VAR. **PENTACHONDRUM** (BOURR.) COESEL ET VAN GEEST (SYNONYMS: *COSMARIUM PSEUDOTAXICHONDRUM* NORDST. VAR. *PENTACHONDRUM* BOURR., *COSMARIUM TAXICHONDRUM* P. LUNDELL VAR. *SUDANESE* GRÖNBLAD ET A.M. SCOTT)

Illustrations. Fig.17 (Coesel, van Geest 2009).

Sample. BOT: 400, 415.

Note. When comparing the original illustrations, it is quite clear that *Cosmarium taxichondrum* var. *sudanense* (Grönblad and al. 1958) should be considered identical to the somewhat earlier described *C. pseudotaxichondrum* var. *pentachondrum* (Bourrelly 1957). The taxon in question is characterized by two subapical granules/tubercles and a transversal series of three big tubercles just below. In our opinion however, on account of that characteristic, it is closer affiliated to *C. taxichondrum* as originally described by Lundell (1871) than to *C. pseudotaxichondrum* as described by Nordstedt (1877).

C. taxichondrum var. *pentachondrum* is known from but a few African countries, i.e., Mali (Bourrelly 1957, Couté, Rousselin 1975) and Sudan (Grönblad and al. 1958). The pictures of this taxon by Bourrelly & Couté (1991: pl. 33/1, 2) from Madagascar are atypical and illustrate that there are transitions to other varieties of *C. taxichondrum* (Coesel, van Geest 2009).

443. COSMARIUM TENUE ARCH.

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 302.

444. COSMARIUM TETRAGONUM (NÄG.) ARCHER

- VAR. **TETRAGONUM**

- F. **TETRAGONUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 299.

Note. In (Rich 1940) indicated as *Cosmarium tetragonum* Näg.

Long. cell., 36.0 µm; lat., 33.0 µm (Rich 1940).

- F. **PUNCTATA** HODGETTS

Illustrations. Fig.10, *F* (Hodgetts 1926).

Samples. RSA: 120 (very rare).

Note. *Forma ad var. davidsonii* (Roy et Biss.) W. et G.S. West, *accedens*, *sed membrana punctata instructa*.

Long. cell., 30.0 µm; lat. cell., 20.6 µm; lat. isthm., 11.0 µm; crass., 15.0 µm.

This agreed exactly in shape with the var. *davidsonii*, but was rather smaller in dimensions, and the cell-wall was uniformly punctate. The punctulations are scattered in the centre of the semicells (in front view), but tend to have a slight radial arrangement towards the periphery (Hodgetts 1926).

- VAR. **BIPAPILLATA** EICHLER

Illustrations. Fig. nostr. 16, *C* (Fritsch, Rich 1924); Pl.4, 1 (Williamson 2000).

Samples. RSA: 91 (rather rare), **336, 241, 386, 392.**

Note. Long. cell., 34.0-37.0 µm; lat. cell., 19.5-24.0 µm; lat. isthm., 5.0 µm.

Several of the semicells were more rectangular than is the case with those figured by Eichler (Pamiet. Fyzyogr. Warszawa, xiv, 1896, Dział iii, Tab.III, fig.17) and thus approached nearer to the type (Fig.16, *C, a*). The lateral undulations are rather more marked than in the type, both in our and Eichler's specimens, and

occasional individuals showed a very faint undulation of the apex. Eichler's form should probably have varietal value.

Borge (Bot. Notiser, 1913, p.20, Tab.I, fig.17) has described and figured a form of var. *lundellii* Cooke, which would seem more appropriately referred to var. *bipapillata* Eichler; it agrees with the latter in all essential respects, whilst it does not show the protracted apex of the former. There can be little doubt that forma *tatrica* Raciborski (Pamiet. Akad. Umiej. Krakow, xvii, 1890, p.80, Pl.V, fig.11), is a form of this variety in which the papillae were poorly developed or absent. Cf. also *C. trilobulatum* Reinsch var. *basichondrum* Nordst., which would perhaps be better regarded as a form of *C. tetragonum* var. *bipapillata*.

The type has been recorded by Nordstedt from the Cape (Fritsch, Rich 1924).

Length 35.0 μm ; breadth 20.0-21.0 μm ; isthmus 6.0-6.5 μm ; ratio of length to breadth 1.72 (Williamson 1994). In (Williamson 1994) indicated as *Cosmarium tetragonum* (Näg.) Arch. var. *bipapillatum* (Eichl.) Fritsch et Rich, but in (Fritsch, Rich 1924) it is indicated as *Cosmarium tetragonum* (Näg.) Arch. var. *bipapillata* Eichl.

In (Williamson 2000) indicated as *Cosmarium tetragonum* var. *bipapillatum* (Eichl.) Krieg. et Geitl.

- VAR. TRANSVAALENSE CLAASSEN

Illustrations. Tab.26, figs.11, 12 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis C. tetragono* var. *eleganti* (Roy et Biss.) W. et G.S. West, *sed numero undulationum membranae, sculptura eiusdem, et cellula apicem versus minus vel omnino non deplanata differt.*

Near var. *elegans* (Roy et Biss.). W. et G.S. West (West, West 1908, p.20, Pl.LXVI, fig.27); but differs in the number of undulations, in the cell wall sculpture and in the semicells, which are less attenuated towards the apices. Cells about 1.6-1.7 times as long as broad; sides of semicells (including the angles) 7-8-undulate, apex with 8-10 undulations; with a series of three granules within each lateral undulation and a series of five granules within each apical undulation. In each semicell there is one axile chloroplast containing two pyrenoids. Length 44.0-51.0 μm ; breadth 29.0-34.0 μm ; breadth of isthmus 17.0-20.5 μm ; breadth of apices 21.0-32.0 μm (Claassen 1961).

445. COSMARIUM TETRAOPHTHALMUM BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 221, 228, 232, 233, 234.

446. COSMARIUM THWAITESII RALFS

- VAR. ROTUNDATUM KLEBS

Illustrations. Pl.24, Fig.1 (Williamson 1994).

Sample. RSA: 347.

Note. Length 50.0-59.0 μm ; breadth 27.0-32.0 μm ; isthmus 21.0-22.5 μm ; ratio of length to breadth 1.72-1.96; thickness ca. 26.0 μm (Williamson 1994).

447. COSMARIUM TINCTUM RALFS

- VAR. TINCTUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 112, 122, 198, 199, 200, 201, 328.

Note. Long., 10.0 μm ; lat., 8.0 μm ; isthmus, 5.2 μm (Huber-Pestalozzi 1930).

Long. cell., 9.0-11.0 μm ; lat., 8.0-11.0 μm ; isthm., 5.0-8.0 μm ; cras., 5.0-6.0 μm ; zygospor., 8.0x11.0 μm ; 10.0x12.0 μm ; 11.0x13.0 μm . All the individuals seen were colorless, which is unusual, but not unknown, for this species. The characteristic subquadrate zygosporangia, with rounded angles and retuse sides, were common (Fritsch, Rich 1938).

- VAR. **INTERMEDIUM** NORDST.

- F. **MINOR** HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. Long., 8.1 μm ; lat., 8.0 μm ; isthmus, 5.2 μm (Huber-Pestalozzi 1930).

448. **COSMARIUM TRACHYCYRTUM** REINSCH

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 430.

449. **COSMARIUM TRACHYPLEURUM** LUND.

- VAR. **NATALENSIS** FRITSCH ET RICH

Illustrations. Fig.18, I-J (Fritsch, Rich 1924).

Sample. RSA: 91 (rare).

Note. *Var. major, angulis basalibus subquadratis, spinis bene efformatis, paucis in margines laterales, pluribus intramarginalibus et sparsis in totam superficiem semicellulae, apice truncato sine spinis sed spinis intramarginalibus munito. Aspectus lateralis quam in typo, aspectus verticalis non visus. Area centralis granulata supra isthmum incerta. Long. cell., 67.0-77.0 μm ; lat. cell., 48.0-57.0 μm ; lat. isthm., 14.0-16.0 μm ; crass., 37.0 μm .*

This should be compared with var. *spinosum* W. et G.S. Smith (Trans. Linn. Soc., Bot., v, 1895, p.66, Pl.VII, fig.17), from which it differs in its much larger dimensions and in the presence of pronounced spines just within the apex of the semicell (Fig. 18, D). Very few of the spines are situated on the margins, the majority forming a well-defined outer and a less regular inner series within the margins. As we saw no empty semicells, it has been impossible to make out clearly the details of the central granulated area (Fritsch, Rich 1924).

- VAR. **PSEUDONATALENSIS** CLAASSEN

- F. **PSEUDONATALENSIS**

Illustrations. Tab.27, fig.7 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis C. thacypleuro var. natalensi* Fritsch et Rich, *sed hic spinarum vel maxima pars in margine sita, quum in Fritschii et Richii varietate aliquantulum introrsum ab margine absit.*

This differs from var. *natalensis* Fritsch et Rich (F.E. Fritsch and F. Rich, Trans. Roy. Soc. of S. Afr., Vol.XI, Part 4, 1924, p.349, fig.18, I-J) in having pronounced spines on the margins and about three series of spines within the margins. Length 60.0-64.0 μm (with spines 67.0-69.0 μm); breadth 48.0-51.5 μm (with spines 56.0-57.0 μm); breadth of isthmus 18.0-19.0 μm (Claassen 1961).

- F. **IRREGULARE** CLAASSEN

Illustrations. Tab.27, fig.6 (Claassen 1961).

Samples. RSA: 259.

Note. *Dentes temere dispositi. Semicellula dentibus ternis sub margine apicali glabro munita est.*

In these specimens the spines are irregularly disposed, and there are three spines just within the apical margin, which is smooth. Length 58.0-59.0 μm ; breadth 44.0-47.0 μm ; breadth of isthmus 16.0-17.0 μm (Claassen 1961).

- VAR. **SPINOSUM** W. ET G.S. WEST

Illustrations. Fig.95 (*forma 1*), 96 (*forma 2*) (Grönblad, Croasdale 1971).

Samples. NAM: 305 (*forma 2*), **307** (*forma 1*), **430**.

Note. "*Forma 1*". Long., 42.0-46.0 μm ; lat., 42.0-44.0 μm ; isthm., 13.0-14.0 μm . A form with 9 central granules, with puncta between them, and 7-8 sharp granules on each margin (Grönblad, Croasdale 1971).

"*Forma 2*". Long., 42.0 μm ; lat. without spines, 38.0 μm ; isthm., 15.0 μm . Differs in having the face of the semicell ornamented with sharp granules, uniform in size and rather evenly distributed in about 10 vertical and 5 horizontal rows. In addition there is one larger supraisthmial granule. West's variety (1895, p.66, 7: 17), as well as typical *C. trachypleurum*, have normally a central ornamentation of larger flat granules. However, this was R. Grönblad's choice, and Scott and Prescott (1958, p.52, 13:12) and Thomasson (1960, p.18, 7: 24) show forms somewhat like ours. There seems to be no other species into which it fits better, and H. Croasdale hesitates to create a new species from a single face view (Grönblad, Croasdale 1971).

In (Hancock 1973) indicated as *C. trachypleurum* Lund. var. *spinusum* West.

- VAR. **SUBSPINOSUM** CLAASSEN

Illustrations. Tab.25, fig.10 (Claassen 1961).

Samples. RSA: 275.

Note. *Affinis C. trachypleuro* var. *spinoso* West, *sed differt quod singularum semicellularum media in parte iuxta supra isthmmum quattuor tantum spinulae adsunt.*

The specimens close resemble var. *spinusum* West (G. Nygaard, Trans. Roy. Soc. of S. Afr., Vol. XX, Part 2, 1932, p.142, fig.43; West, West 1895, Pl.7, fig.17) except that the median tumour contains only four granules. The shape of the semicells in front view has a greater resemblance to the figure by Nygaard than to the type illustrated by Messrs. West. Length 42.0-42.5 μm ; breadth 32.5-34.0 μm ; breadth of isthmus 12.0-13.0 μm ; breadth of apices 16.0-18.0 μm (Claassen 1961).

450. COSMARIUM TRANSVAALENSE FRITSCH ET RICH

Illustrations. Fig. 13, *F-H* (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 204.

Note. *C. submediocre, circa 1¹/₅ plo longius quam latum, profunde constrictum, sinu angusto-lineari, pyrenoidibus 2 in quaque semicellula; semicellulae a fronte visae subsemicirculares, angulis basalibus subrectangularibus, lateribus marginalibus 5-crenatis, apice plano truncato, angulis apicalibus cum membrana leviter incrassata, intra apicem verrucis 4, in superficiem semicellulae verrucis similibus pluribus in series indistinctas transversas dispositis, membrana glabra; semicellulae latere visae subquadratae, papillis rotundatis pluribus in superficiem; semicellulae a vertice visae ellipticae, margine crenato in media parte cum verrucis deplanatis vel emarginatis 3, papillis rotundatis pluribus in superficiem.* Long. cell., 30.0-36.0 μm ; lat., 22.0-28.0 μm ; isthm., 5.0-8.0 μm ; cras., 16.0-21.0 μm .

The actual apex of the semicell is smooth and truncate.

The apical angles have a somewhat thickened membrane and the sides of the semicells are provided with about five rounded crenations. Just within the apex, as seen in front-view, are four warts, and on the face the semicells are somewhat subquadrate, while the end-view is elliptical. The markings in all aspects are rather variable.

There is not much general resemblance to any described species of *Cosmarium*. The side-view is rather like that of *C. mamillatum* Borge ("De Algen der erstern Regnellischen Expedition: II. Desmidiaceen", Arkiv för Bot., 1, 1903, p.99, Tab.III, fig.28), but the front- and end-views of this species are markedly different. It may also be compared to *C. ceratophorum* Lütkem. and *C. burkillii* West (Fritsch, Rich 1938).

451. COSMARIUM TRILOBULATUM REINSCH

- VAR. TRILOBULATUM

- F. TRILOBULATUM

Illustrations. Fig.40 (Cholnoky 1954b).

Sample. RSA: 87 (rare), 91 (common), 211, 213, 222, 236, 253, 296,

327.

Note. *Forma lobis apicalibus latioribus, marginibus lateralibus inferioribus interdum subretusis. Long. cell., 19.0-21.0 μm; lat. cell., 11.0-13.0 μm; lat. lob. apic., 8.0-11.0 μm; lat. isthm., 2.0-3.0 μm* (Fritsch, Rich 1924).

Long., 20.8 μm; lat., 13.0 μm (Huber-Pestalozzi 1930).

In addition to the typical cells smaller ones were observed (5.18 μm long, 17.5 μm wide, with isthmus of 5.0 μm), one of which shown on Fig.40 (Cholnoky 1954b).

- F. MAJOR HUBER-PESTALOZZI

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. Long., 31.2 μm; lat., 23.4 μm; isthmus, 7.8 μm (Huber-Pestalozzi 1930).

452. COSMARIUM TUMIDUM LUND.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 295.

453. COSMARIUM UNDULATUM CORDA

- VAR. CRENULATUM (NÄG.) WITTR. (= *EUASTRUM CRENULATUM* NÄG.)

Illustrations. Fig.nostr.11, A (Fritsch, Stephens 1921).

Sample. RSA: 74 (rare).

Note. *Long. cell., 21.0-22.0 μm; lat. cell., 16.0-17.0 μm; lat. isthm., 6.0 μm.*

The dimensions are rather less than those given in Messrs. West's Monograph, but Nordstedt ('Oefvers. K. Vet.-Akad. Foerhandl.,' Stokholm, 1872, No.6, p.32) has already recorded specimens of this variety measuring 24.0 μm in length and 20.0 μm in breadth (Fritsch, Stephens 1921).

In Mpumalanga soils (orig.).

454. COSMARIUM UNGERIANUM (NÄG.) DE BARY

- VAR. BOHEMICUM LÜTKEM.

- F. MINUS WILLIAMSON

Illustrations. Pl.23, Fig.6 (Williamson 1994).

Sample. RSA: 358.

Note. Differs from the variety only in having smaller dimensions. Length 30.0-31.0 μm ; breadth 27.0-29.0 μm ; crass. 17.5-18.5 μm . This should be carefully compared with *Cosmarium pseudoinsigne* Prescott, which although having a similar shape lacks both the central arrangement of granules and the granule on each side of the isthmus. Those granules on or within the upper lateral margin are also not so prominent (Williamson 1994).

455. COSMARIUM VENUSTUM (BRÉB.) ARCH.

- VAR. EXCAVATUM (EICHL. ET GUTW.) W. ET G.S. WEST

Illustrations. Fig.81 (Grönblad, Croasdale 1971); Pl.23, Fig.4 (Williamson 1994).

Sample. RSA: 367. - NAM: 305.

Note. In (Grönblad, Croasdale 1971) indicated as *Cosmarium ?venustum* (Bréb.) Arch. var. *excavatum* (Eichl. et Gutw.) W. et G.S. West.

Forma. Long., 22.0 μm ; lat., 14.5 μm (1.5x); isthm., 9.0 μm . A small form with one extra undulation on each side. R. Grönblad seemed sure of this identification. H. Croasdale doubts it because of the extra undulation. Except for the rounded upper angles it looks more like *Euastrum elobatum* (Lund.) Roy et Biss. Scott and Prescott (1961, p.26, 14: 1) named a var. *oculatum* of this species with an ocellus like ours, but the outline of their plant is quite different, being more like var. *simplex* Krieger. Without an end view a sure determination is impossible (Grönblad, Croasdale 1971).

Length 28.0-31.5 μm ; breadth 19.6-21.0 μm ; isthmus 5.6-6.2 μm ; ratio of length to breadth 1.38-1.5; thickness 12.5-14.6 μm . A forma where the maximum breadth of the semicell is above the median horizontal axis. In vertical view there are no tumours but a deep V-shaped pore penetrates the cell wall (Williamson 1994).

- VAR. MINUS (WILLE) KRIEG. ET GEITL.

Illustrations. Fig.82 (Grönblad, Croasdale 1971).

Sample. RSA: 328. - NAM: 305.

Note. Long., 19.5 μm ; lat., 14.3 μm . Indicated as *Cosmarium venustum* Bréb. f. *minor* Wille (Huber-Pestalozzi 1930).

In (Grönblad, Croasdale 1971) indicated as *Cosmarium ?venustum* (Bréb.) Arch. var. *minus* (Wille) Krieg. et Geitl.

Long., 21.5 μm ; lat., 15.0 μm (1.43x); isthm., 4.0 μm . Without an end view this cannot be identified surely. R. Grönblad commented: "cf. *Euastrum dubium* var. *tritium* W. et G.S. West?/*Cosmarium*?". To H. Croasdale it has more the appearance of a *Cosmarium* than a *Euastrum* and seems in face view very like *C. cambricum* Cooke et Wills f. *minor* Turner (1892, p.70, 10: 15) which Krieger and Gerloff (1965, p.201) include under *C. venustum* var. *minus* (Grönblad, Croasdale 1971).

456. COSMARIUM VEXATUM WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 133 (rare), **134** (rare), **135** (rare), **136** (rare), **137** (rare), **142** (rare), **153** (rare), **159** (rather common), **160** (rare), **162** (rare), **163** (rare), **164** (rather common), **168** (rare), **169** (rare).

Note. *Forma a vertice visa in media parte minus distincte inflata.* Long. cell., 41.0-50.0 μm ; lat., 33.0-42.0 μm ; ist., 10.0-12.0 μm ; crass., 21.0-28.0 μm ; lat. apic., 15.0-18.0 μm .

Some of the specimens agreed in their front-view altogether with fig.4 or 5 in Messrs. West's monograph (West, West 1908, p.187, Pl.XCII), but – more especially in sample **164** – a number showed a distinct protrusion of the apex, like that seen in a form described by Borge (Algenfl. Tåkernsees, 1921, p.20, Pl.II, fig.19). The end-view was often characterized by a less marked development of the median protuberance than in the type (Fritsch, Rich 1930).

457. COSMARIUM VIRIDE (CORDA) JOSH.

- F. MINUS WEST

Illustrations. Absent is literature on South African desmids.

Sample. RSA: 237, 238.

458. COSMARIUM VITIOSUM SCOTT ET GRÖNBLAD

Illustrations. Fig.99 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. Long., 32.0 μm ; lat., 27.0 μm ; isthm., 9.0 μm . Our plant is a little smaller than the type (Scott, Grönblad, 1957, p.24, 9: 1-3), but otherwise it agrees very well (Grönblad, Croasdale 1971).

459. COSMARIUM VOGESIACUM LEMAIRE

- VAR. **BIPUNCTATUM** (BÖRGES.) FÖRSTER 1982, TAF.29, FIG.1

Illustrations. Pl.23, Fig.3 (Williamson 1994).

Sample. RSA: 356.

Note. Length 20.4 μm ; breadth 19.0 μm ; isthmus 7.0 μm ; ratio of length to breadth 1.7 (Williamson 1994).

460. COSMARIUM WATERBERGENSE CLAASSEN

Illustrations. Tab.26, figs.1-7 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis C. holmiensi* Lund., *sed membrana haud undulata differt.*

Near *C. holmiense* Lund. (West, West 1908, p.1, Pl.LXV, figs.1, 2); but differs in having renulations. Cells rather small, about 1.5-1.8 times longer than broad, deeply constricted, sinus narrowly linear; semicells broadly pyramidate with a flattened apex, basal angles rounded. Cell wall punctate. Length 35.0-39.0 μm ; breadth 20.0-26.5 μm ; breadth of isthmus 8.0-9.5 μm ; breadth of apex 12.0-14.0 μm (Claassen 1961).

Note to genus *Cosmarium* Corda ex Ralfs

In article of P.F. Reinsch (1878) was described member of genus under name "*Cosmarium*, spec. nov." *C. e minimis, diametro transversali duae partes diametri longitudinalis, semicellulis subtrapezics, basi se adtingentibus, margine terminali recto, diametri transversalis dimidio paulo minus, angulis basilibus rotundatis, cytodermate laevi; isthmi latitudo triens diametri transversalis. Longit. 0.0168 mm, latit. 0.0112 mm, forma major, longit. 0.0196 mm, latit. 0.0153 mm. Inter Sirogyram. In sample 3, Pl.VI, figs.10, 11. Inter Spirogyram. Hoc Cosmarium jacet inter formam typicam Cosmarii hammerii (Reinsch, Act. Senckenb., Tab.3, B, figs.1-8) et formas minores Cosmarii meneghini Brébisson (Reinsch 1878).*

In article of F. Rich (1932), we think, was mistakenly published non right number of sample for *Cosmarium taxichondrum* Lund. var. *subundatum* Boldt. We are not sure, but think that this species was observed in sample **192** (rare). It

was long., 24.0-32.0 μm ; lat., 25.0-26.0 μm ; ist., 6.0-7.0 μm ; crass., 16.0 μm (Rich 1932).

Species of genus which not identified were occurred in following **samples**:
RSA: 379, 427, 430. – NAM: 303, 305, 307.

COSMOCLADIUM BRÉBISSON

461. COSMOCLADIUM CONSTRICTUM ARCH.

Illustrations. Absent in literature on Southern African desmids.

Samples. **RSA: 192** (rare).

Members of this genus which not identified to the species level were occurred in following samples: **RSA: 430.**

XANTHIDIUM EHRENBERG EX RALFS

462. XANTHIDIUM BREVISPINUM FRITSCH

Illustrations. Fig.31 (Fritsch 1918).

Samples. **RSA: 23** (very rare).

Note. *X. subparvum*, ca. tam longum quam latum, profunde constrictum, sinu angusto-lineari, extremo vix ampliato. Semicellulae late trapeziformes, angulis inferioribus late rotundatis, angulis superioribus acutis (utrisque serie spinarum 3 instructis); lateribus convexis convergentibus, superne fere rectis vel interdum concavis (serie spinarum 3 vel plurium ad angulum lateralem instructis); apicibus truncatis rectis; semicellis intra angulum basalem spinis parvis 3-5 et intra apicem spinis parvis diverse dispositis (plerumque in medio et intra angulum superiorem utrumque) instructis; prope media semicellula area diverse scrobiculata. A vertice visae subrhoemboideae, polis latis rotundatis seriebus tribus spinarum 3 instructis, ad medium utrobique valde incrassatae spina bifurcata mutinae; a latere visae? Long., 42.0 μm ; lat. max. sine acul., 42.0 μm ; lat. apic., 27.0 μm ; lat. isthm., 12.0 μm ; crass., 23.0 μm .

I have unfortunately been unable to obtain a side-view of this species, but it is sufficiently different from those hitherto described to warrant the establishment of a distinct form. In general shape the semicells are not unlike those of *X. antilopaeum* (Bréb.) Kütz., but they differ from them in the very short spines, in their rather different arrangement, and in the end-view; cf. also *X. mayori* G.S. West (Contrib. To our knowl. Freshw. Alg. Columbia, Mem. Soc. neuchâteloise d. Sc. Nat., v, 1914, p.1041, Pl.XXII, fig.41) (Fritsch 1918).

463. XANTHIDIUM CONCINNUM ARCH.

- VAR. CONCINNUM

Illustrations. Absent in literature on Southern African desmids.

Sample. **RSA: 192, 200** (rather rare).

Note. *Forma.* Only a very few specimens of this small *Xanthidium* were observed. The spines were longer than in the type. Long., 9.0 μm ; lat. sine sp., 10.0 μm (Rich 1932).

Long. cell., 10.0 μm ; lat., 9.5 μm (Fritsch, Rich 1938).

- VAR. BOLDTIANUM W. WEST

Illustrations. Fig.115 (Grönblad, Croasdale 1971).

Sample. **NAM: 307.**

Note. *Forma.* Long., 10.8 μm ; lat. without spines, 11.5 μm ; with spines, 16.0 μm ; isthm., 3.7 μm . Our plant falls about midway between the species and var. *boldtianum*. It differs from the species in its larger size and longer lateral angles; it differs from var. *boldtianum* in the presence of a single minute spine at the apical angle (Grönblad, Croasdale 1971).

464. XANTHIDIUM CRISTATUM BRÉB.

- VAR. CRISTATUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 430.

- VAR. DELPONTEI ROY ET BISS.

- F. LAEVIS CLAASSEN

Illustrations. Tab.29, fig.12 (Claassen 1961).

Samples. RSA: 298.

Note. *Differt a varietate delpontei et membrana cellulae omnino glabra et quod spinulae supra isthmum desunt.*

A form in which the semicells are entirely destitute of a thickened or scrobiculated central area; the shape of the semicells differ slightly from the typical form (West, West 1912, p.74, Pl.CXI, fig.5). Length 72.0 μm (with spines 90.0-94.0 μm); breadth 68.0 μm (with spines 80-88 μm); breadth of isthmus 15.5 μm (Claassen 1961).

- VAR. TRANSVAALENSE CLAASSEN

Illustrations. Tab.28, figs.7-10 (Claassen 1961).

Samples. RSA: 258, 259.

Note. *Affinis var. delpontei Roy et Biss., sed cellulis multo angustioribus differt. Formae intermediae non visae.*

The differs from var. *delpontei* in the narrower semicells. Cells about 1.25-1.5 times longer than broad; each tumour above the isthmus with a circle of 7-10 small spines; in some specimens there may be a spine in the centre of the circle. Length 48.0-56.0 μm ; breadth 38.0-44.0 μm ; breadth of isthmus 16.0-18.0 μm ; length of spines 8.0-12.0 μm (Claassen 1961).

465. XANTHIDIUM HELENAE HUBER-PESTALOZZI

Illustrations. Tab.4a-d (Huber-Pestalozzi 1930).

Sample. RSA: 327.

Note. Long. and lat., 26.0-32.0-39.0 μm (without spines); long., 23.4 μm , lat., 26.0 μm (without spines); spines, 5.2 μm (Huber-Pestalozzi 1930).

466. XANTHIDIUM MICRACANTHUM GRÖNBLAD ET A.M. SCOTT

- VAR. MICRACANTHUM

Illustrations. Figs.42, 43 (Coesel, van Geest 2009).

Samples. BOT: 402 (in low cell numbers).

Note. *Xanthidium micracanthum*, described by Grönblad and al. (1958) from Sudan is a small-sized desmid that might be classified as a *Cosmarium* species as well, for in its characteristics it is a bit intermediate between those two genera. Despite the fact that *X. micracanthum* is quite remarkable in its appearance and it hardly can be confused with any other desmid species the record by Grönblad and al. (1958.) was the only one that could be traced.

Cell dimensions in our material are somewhat smaller than those stated in Grönblad and al. (1958). i.e., cell length 28.0-31.0 μm , cell breadth 26.0-28.0 μm (Coesel, van Geest 2009).

- VAR. **ANGUSTATUM** COESEL ET VAN GEEST

Illustrations. Figs.44, 45 (Coesel, van Geest 2009).

Samples. BOT: 402 (in small cell numbers), **411** (in small cell numbers).

Note. Differs from the nominate variety by narrower cells, semicells that are about rectangular in outline (instead of cuneate) with deeply concave sides, and by a reduced cell wall ornamentation. Cell length 26.0-27.0 μm , cell breadth 17.0-19.0 μm . *Type:* our fig. 44. *Type locality:* water-course near Chief's Island (sample **402**), P.F.M. Coesel, 3 October 2006, plankton collection # 2006.44 in the Amsterdam University herbarium (Coesel, van Geest 2009).

467. XANTHIDIUM MOGOLENSE (CHOLNOKY) LEVANETS, COMB. NOV. (BASIONYM: *HOLOCANTHUM MOGOLENSE* CHOLNOKY 1954, ÖSTERREICHISCHEN BOTANISCHEN ZEITSCHRIFT, BAND 101, HEFT 1/2, P.135, FIG.44).

Illustrations. Fig.44 (Cholnoky 1954b).

Samples. RSA: 214, 216.

Note. Semicells from apical view typically ovoid, outline shape is unavailable and quite irregular with spines. Some of these spines are branched. The isthmus is narrow and deep. The length of the cells without spines 22 μm , breadth 22-24 μm , isthmus 7-7.5 μm (Cholnoky 1954b).

468. XANTHIDIUM SANSIBARENSE (HIERON.) SCHMIDLE

Illustrations. Fig.19, *D-F* (Fritsch, Rich 1938).

Sample. RSA: 198, 200, 203.

Note. *Forma major.* Long. cell., 100.0-110.0 μm ; lat., 68.0-87.0 μm ; isthm., 21.0 μm ; crass., 52.0-60.0 μm ; diam. verruc., 5.0-6.0 μm ; altit., 3.0-4.0 μm ; long. spin., ad 24.0 μm .

These specimens considerably larger than those previously recorded. Apart from the characteristic paired spines situated at the lateral and apical angles of the semicells, there is a series of warts just within the margin of the semicell, 4 beneath the apex, 3 within the superior lateral and about 3 within the inferior lateral margins. The warts in general have a truncate or even slightly emarginate apex, but occasional ones within the lateral margins may be produced into a small prominence. The lateral angles occasionally bear 3 spines. The face of the semicell is devoid of ornamentation, but the entire membrane is finely punctate. The side- and end-views show that the membrane is strongly thickened over the middle of the semicell, but this is not apparent in the front-view (Fritsch, Rich 1938).

469. XANTHIDIUM SMITHII W. ARCHER

- VAR. **CRUCENSIS** DÜRRSCHM.

Illustrations. Pl.27, Fig.4 (Williamson 1994); Pl.5, 5 (Williamson 2000).

Sample. RSA: 367, 368.

Note. Length 43.5-51.8 μm (+spines); 36.4-44.0 μm (-spines); breadth 43.5-51.0 μm (+spines); 34.0-40.0 μm (-spines); isthmus 13.5-15.5 μm ; thickness 24.0-31.0 μm (Williamson 1994).

Length+spines 46.2 μm , without spines 40.0 μm , breadth+spines 43.9 μm , without spines 33.8 μm , isthmus 13.8 μm , thickness+spines 29.3 μm , without spines 23.0 μm .

An apology is offered for the erroneous description of this taxon as *X. variable* (Nordst.) W. et G.S. West var. *crucensis* Dürrschm. in Williamson (1994) (Williamson 2000).

470. XANTHIDIUM SUBTRILOBUM W. ET G.S. WEST

- VAR. **AFRICANUM** (SCHMIDLE) GRÖNBLAD ET SCOTT IN GRÖNBLAD, PROWSE AND SCOTT

Illustrations. Pl.27, Fig.1 (Williamson 1994).

Sample. RSA: 375.

Note. Length 87.8 μm (+processes); 60.0 μm (-processes); breadth 75.8 μm (+processes); 53.6 μm (-processes); isthmus 15.5 μm ; thickness 35.0 μm (Williamson 1994).

Members of this genus which not identified to the species level were occurred in following samples: **RSA: 430, 434.**

STAURODESMUS TEILING

471. STAURODESMUS LEPTODERMUS (LUND.) TEIL.

Illustrations. Pl.25, Fig.1 (Williamson 1994).

Samples. RSA: 344, 356.

Note. Length 51.0-56.0 μm (+processes); 44.0 μm (-processes); breadth 43.0-55.0 μm (+processes); isthmus 19.0-20.0 μm (Williamson 1994).

472. STAURODESMUS LOBATUS (BÖRG.) BOURR.

- F. MAIOR (FRITSCH ET RICH) TEIL.

Illustrations. Pl.17, Fig.1 (Williamson 1994).

Samples. RSA: 375.

Note. Length 133.0 μm ; breadth 88.0 μm ; isthmus 30.0 μm ; ratio of length to breadth 1.51; thickness 4.0 μm . Somewhat larger than previously reported (Williamson 1994).

473. STAURODESMUS OBSOLETUS (HANTZSCH) TEILING

Illustrations. Pl.18, Fig.3 (Williamson 1994).

Samples. RSA: 338, 360, 362.

Note. Length 45.0-52.0 μm ; breadth 49.0-55.5 μm ; isthmus 18.5-24.0 μm ; ratio of length to breadth - 1.1 broader than long; thickness 23.0-24.0 μm (Williamson 1994).

474. STAURODESMUS SUBULATUS (KÜTZ.) THOM.

- VAR. **SUBAEQUALIS** (W. ET G.S. WEST) THOM.

Illustrations. Pl.25, Fig.3 (Williamson 1994).

Samples. RSA: 350.

Note. Length 33.0-35.0 μm ; breadth 53.0-66.6 μm (+processes); 35.0-38.0 μm (-processes); isthmus 8.2-10.0 μm (Williamson 1994).

ARTHRODESMUS BRÉBISSON EX RALFS

In article of Fritsch (1918) this genus indicated as *Arthrodesmus* Ehrenberg.

475. ARTHRODESMUS BIFIDUS BRÉB.

- VAR. **INIQUISPINOSUS** HUBER-PESTALOZZI

Illustrations. Tab.7, Fig.5 (Huber-Pestalozzi 1930).

Samples. RSA: 198, 201, 328.

Note. Long. without spines, 10.4 μm ; long. with spines, 13.0 μm ; lat. without spines, 11.7 μm ; lat. with spines, 16.0 μm ; isthmus, 5.5 μm ; long. of biggest spines, 2.0 μm ; long. shorter spines, 1.0-1.3 μm (Huber-Pestalozzi 1930).

In (Fritsch, Rich 1938) indicated as var. *inaequispinosum* Huber-Pestalozzi. Long. cell., 8.0-9.5 μm ; lat. (sine spin.), 9.0-10.0 μm ; isthm., 3.0 μm .

The cells are small, about as long as wide and deeply constricted; the sinus is widely open. The sides diverge upwards and the apex is slightly concave, terminating laterally in an upturned spine; the lateral angles are produced to form an almost horizontal spine; the lateral angles are produced to form an almost horizontal spine, longer than the apical ones. Vertical view elliptic, with one straight spine at each rounded pole. Previously recorded for the Knysna Forest (Fritsch, Rich 1938).

476. ARTHRODESMUS CONVERGENS EHRENB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192.

477. ARTHRODESMUS EUBULATUS KÜTZING

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 430.

478. ARTHRODESMUS INCUS (BRÉB.) HASSALL

- VAR. INCUS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 52 (very rare).

Note. Long. cell. sine spin., 18.0 μm ; lat. cell. sine spin., 15.0 μm ; crass., 9.0-10.0 μm (Fritsch 1918).

- VAR. RALFSII W. ET G.S. WEST

- F. SUBHEXAGONA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 116 (very rare).

Note. Long. cell., 16.0 μm ; lat. cum spin., 20.0 μm ; long. spin., 3.5 μm (Hodgetts 1926).

479. ARTHRODESMUS MUCRONULATUS NORDST.

Illustrations. Fig.20, A (Fritsch, Rich 1938).

Samples. RSA: 198, 201.

Note. *Forma.* Long. cell., 34.0-36.0 μm ; lat. (sine spin.), 43.0-45.0 μm ; isthm., 12.0 μm . This desmid shows some resemblance to *Xanthidium subhastiferum* West, but differs from it in possessing two pyrenoids in each semicell, in the greater relative breadth, in the possession of a punctate membrane, and in a different arrangement of the spines (Fritsch, Rich 1938).

In Fritsch and Rich article (1938) also indicated sample which can be **203** or **204**.

480. ARTHRODESMUS QUIRIFERUS W. ET G.S. WEST

- VAR. EVOLUTUS FRITSCH ET RICH

Illustrations. Fig.20, C (Fritsch, Rich 1938).

Samples. RSA: ? (Fritsch, Rich 1938).

Note. *Differt a typo magnitudine minore, isthmo elongato concavo, dente minuto in angulum basalem unumquemque semicellulae.* Long. cell., 12.0 μm ; lat. cum proc., 24.0 μm ; isthm., 4.0 μm .

The concave isthmus is more elongated than in the type and each lateral angle of the semicell is provided with a slight projection. This variety is decidedly smaller than any form of *A. quiriferus* hitherto described (Fritsch, Rich 1938).

In Fritsch and Rich article (1938) did not indicated sample but present information about occurrence of cells (very rare).

481. ARTHRODESMUS RALFSII W. WEST

- VAR. BREBISSONII (RACIB.) G.M. SMITH 1924, P.130, 85: 14-16

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: ? (Grönblad, Croasdale 1971).

Note. Long., 33.0 μm ; lat. without spines, 30.0-35.0 μm ; with spines, 72.0-76.0 μm ; isthm., 7.0-8.0 μm ; spines, 14.0-26.0 μm . Out plants are a little large. This is R. Grönblad's name, but he added "*Stauroidesmus glaber* var. *limnophilus* sec. Teiling" (1967, p.559, 14: 7-14), which seems also correct for the followers of Teiling, of which H. Croasdale is one (Grönblad, Croasdale 1971). Number of sample in article (Grönblad, Croasdale 1971) did not indicated.

482. ARTHRODESMUS SUBULATUS KÜTZ.

- VAR. SUBULATUS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (rare).

Note. *Forma* Lemmermann, Brandenburgische Algen V, 1914, Algologische Beiträge, xii, xiii, fig.15. Long, slightly divergent spines (Rich 1932).

- VAR. SUBAEQUALIS G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (rare).

- VAR VALIDUS (W. ET G.S. WEST) FRITSCH ET RICH (SYN.: *ARTHRODESMUS INCUS* (BRÉB.) HASS. VAR. *VALIDUS* W. ET G.S. WEST)

Illustrations. Fig.20, *D, E* (Fritsch, Rich 1938).

Samples. RSA: 198, 202, 205.

Note. *Differt a typo magnitudine paullo minore, spinis apicalibus valde divergentibus. Zygospora globosis, membrana laevi.* Long. cell. (sine spin.), 23.0-26.0 μm ; lat. (sine spin.), 22.0-25.0 μm ; isthm., 7.0-8.0 μm ; crass., 14.0 μm ; long. spin., 20.0 μm ; diam. zygosp., 26.0-27.0 μm .

This variety differs from the type in being a little smaller, and in possessing markedly divergent spines. It agrees exactly with the type in the shape of the semicells and the possession of a globose zygospora with a smooth wall.

In vegetative characters there is nothing to distinguish this variety from *Arthrodesmus incus* (Bréb.) Hass. var. *validus* W. et G.S. West, except for slightly smaller dimensions. *A. incus* has a zygospora which is provided with short spines, and the discovery of a smooth zygospora in this variety warrants its removal from *A. incus* and reference to *A. subulatus* (Fritsch, Rich 1938).

483. ARTHRODESMUS THERONII CHOLNOKY

Illustrations. Fig.35 (Cholnoky 1954b).

Samples. RSA: 214-216, 218.

Note. This species related to the *A. subulatus* Kg., but different from it. The cells are without spines, 30.0-35.0 μm long, 35.0 μm wide, 16.0-20.0 μm thick, length of four spikes is 12.0-20.0 μm . The isthmus is 12.0 μm wide. The chromatophore in each semicell contains a pyrenoid. The cell is surrounded by irregular and radiating structured gelatinous sheath about 20.0-25.0 μm thick.

The radial structure is visible very clearly (phase contrast microscope) (Cholnoky 1954b).

484. **ARTHRODESMUS TRIANGULARIS** LAGERH.

- VAR. **TRIANGULARIS**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 105 (rare).

Note. *Long. cell.*, 19.0 μm ; *lat. cell. c. spin.*, 39.0 μm (Fritsch, Rich, 1924).

- VAR. **TRIQUETRA** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 199.

Note. *Long. cell.*, 16.0 μm ; *lat. (cum spin.)*, 32.0 μm ; *isthm.*, 4.0-5.0 μm . The vertical view is triangular with retuse sides. In some cases the spines in front-view are directed upwards. The membrane is smooth (Fritsch, Rich, 1938).

485. **ARTHRODESMUS TRISPINATUS** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 200 (rare), 204.

Note. *Long. cell. (sine spin.)*, 14.0 μm ; *lat.*, 15.0 μm ; *isthm.*, 12.0 μm . The three spines on each side of the semicell are not all in the same plane, as has been noticed by Deflandre ("Additions à la Flore Algologique es environs de Paris", Bull. Soc. Bot. France, lxxi, 1924, p.916). The latter author gives no dimensions for the form observed by him (Fritsch, Rich, 1938).

STAURASTRUM MEYEN EX RALFS

486. **STAURASTRUM ALTERNANS** BRÉB.

Illustrations. Fig.13, A (Hodgetts 1926); Fig.21, C-E (Fritsch, Rich 1930); Fig.118 (Grönblad, Croasdale 1971).

Samples. RSA: 14 (on wet mud), 91 (not uncommon), 112 (very rare), 113 (very rare), 114 (very rare), 115 (very rare), 116 (very rare), 168 (rare), 299, 300, 327. - NAM: 307.

Note. *Forma angulis leviter subrotundioribus*; *long* 26.0 μm ; *lat.* 22.0 μm ; *lat. isthm.* 9.5 μm (West 1912).

Long. cell., 32.0-34.0 μm ; *lat. cell.*, 30.0-31.0 μm ; *lat. isthm.*, 9.0-10.0 μm .

The majority of the individuals failed to show the customary twisting at the isthmus, resulting in alternation of the two semicells when seen in end-view. A doubtful zygospore was found, but the empty semicells were intermingled with débris and their specific identity could not be established. The spore in question was globose, 30.0 μ in diameter, and covered with short spines, the surface being areolate. It did not show the forked spines mentioned in Ralfs's description of the zoospore (Brit. Desm., 1848, p.133), but, as Messrs. West have pointed out (West, West 1912, p.172), there is some doubt as to whether Ralfs really found the zoospore of this species (Fritsch, Rich 1924).

Forma angulis non alternantibus. In the shape of the semicells, and the granulations of the cell-wall, this agrees with *S. alternans*, but the angles of the two semicells were always superposed. The alternation of the semicells in this desmid is of no specific importance (according to West, West 1912, p.170, t.126, figs.8, 9) (Hodgetts 1926).

Forma semicellulis non alternantibus. *Long.*, 20.0 μm ; *lat.*, 18.0-19.0 μm ; *ist.*, 7.0 μm .

Except for the non-alternation of the semicells, the specimens were in all respects typical (Fig.21, C-E). The same sample contained small individuals of *Cosmarium papkuilense* G.S. West, which has a front-view very similar to that of *Staurastrum alternans* (cf. Fig.21, A). Individuals were found in which one semicell in end-view appeared oblong like that of *Cosmarium papkuilense*, whilst the other was triangular, as in *Staurastrum alternans* (Fig.21, D). It would thus seem probable that *Cosmarium papkuilense* as a non-staurastroid form of *Staurastrum alternans* (Fritsch, Rich 1930).

Long. cell., 21.0-22.0 μm ; lat., 22.0-24.0 μm ; isthm., 5.0-6.0 μm . Sinus open and acute-angled (Rich 1940).

Long., 29.0 μm ; lat., 32.0-33.0 μm ; isthm., 11.5 μm (Grönblad, Croasdale 1971).

Drakensberg, Mpumalanga (orig.).

487. STAURASTRUM AMERICANUM (W. ET G.S. WEST) SMITH

- VAR. ELABORATUM FRITSCH ET RICH

Illustrations. Fig.21, B (Fritsch, Rich 1938).

Samples. RSA: 201, 205.

Note. *Semicellulis apice plus minus convexo, verruca emarginata vel bidentata utriusque in parte basali brachiorum semicellulae.* Long. cell sine proc., 20.0-22.0 μm ; lat. cum. proc., 60.0-70.0 μm ; isthm., 6.0-7.0 μm .

This biradiate form does not seem hitherto to have been described. The individuals were rare and we have been in some difficulty in arriving at final decision regarding them. They would, however, appear to constitute an elaboration of the type of *S. grallatorium* Nordst., and in particular of var. *americanum* W. et G.S. West ("On Some North American Desmidiaceae", Trans. Linn. Soc. (Bot.), v, 2 ser., 1896, p.265, fig.15) which Smith ("The Phytoplankton of the Muskoka Region, Ontario", Trans. Wisconsin Acad. Sci., 20, 1922, p.351) regards as separate species. There is considerable resemblance to the var. *longiradiatum* G.M. Smith ("The Phytoplankton of the Muskoka Region, Ontario", Trans. Wisconsin Acad. Sci., 20, 1922, p.352, Tab.XI, figs.10, 11), but the apex and sinus in our specimens are more elaborate as a result of the development of an emarginate or bidentate process on each side of the basal parts of the arms. The latter terminate in 2 or 3 teeth (Fritsch, Rich 1938).

488. STAURASTRUM ANATINUM COOKE ET WILLS.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 204, 205.

Note. Long. cell., 40.0 μm ; lat. cum proc., 70.0 μm ; isthm., 14.0 μm (Fritsch, Rich 1938).

489. STAURASTRUM AVICULA BRÉB.

- VAR. SUBARCUATUM (WOLLE) WEST

Illustrations. Absent in literature on Southern African desmids

Sample. RSA: 329.

Note. Forma. Spines are very short, sides in the vertical view straight (not concave). Long., 20.8; lat., 20.8 μm (Huber-Pestalozzi 1930).

490. STAURASTRUM BARBARICUM CLAASSEN

Illustrations. Tab.30, figs.10, 11 (Claassen 1961).

Samples. RSA: 241.

Note. *Affinis St. caffrorum* Claassen sed differt quod depressio in margine apicali deest, porro supra isthmum tantum una series spinularum adest sculpturaque membranae etiam differt.

This is near *St. caffrorum* Claassen; but differs in having no cavity in the apical margin, and in the cell wall sculpture. Cells small, about 1.3-1.4 times as long as broad, deeply constricted, sinus open; semicells more or less quadrangular in vertical view, with a single series near the base, apical margin and angles furnished with spines. Length 28.0 μm ; breadth 20.0-21.5.0 μm ; breadth of isthmus 7.0 μm (Claassen 1961).

491. STAUASTRUM BIBRACHIATUM REINSCH

- VAR. BIBRACHIATUM

Illustrations. Pl.25, Fig.7 (Williamson 1994).

Samples. RSA: 350.

Note. Length 30.8 μm (+processes); 12.2 μm (-processes); breadth 30.8 μm (+processes); isthmus 4.8 μm (Williamson 1994).

In (Williamson 1994) indicated as *Staurastrum bibrachiatum* Reinsch emend. Grönbl. et Scott 1955.

- VAR. CYMATIUM W. ET G.S. WEST

Illustrations. Fig.45 (Nyygard 1932).

Samples. RSA: 177 (only 1-3 specimens were observed), **178** (only 1-3 specimens were observed).

Note. Length without processes 12.5 μm , with processes 49.0 μm , breadth with processes 47.5 μm , breadth of isthmus 5.5 μm . The appearance of this variety is very characteristic and, to judge from the records, it is extremely rare (Nyygard 1932).

492. STAUASTRUM BIDENTULUM GRÖNBLAD (SYNONYM: STAUASTRUM ORBICULARE RALFS VAR. DENTICULATUM NORDSTEDT)

Illustrations. Fig.36 (Coesel, van Geest 2009).

Samples. BOT: 400-418.

Note. *Staurastrum bidentulum* is better known under the name of *S. orbiculare* var. *denticulatum*. However, we agree with Grönblad (1945) that it does not show much resemblance with *S. orbiculare* as conceived by Ralfs (1848). Our material collected in the Okavango Delta was marked by a coarsely punctate cell wall. This is contrary to Nordstedt's (1870) characterization, i.e. '*membrana subtilissime punctata*', but SEM pictures by Couté, Tell (1981) and Tell, Couté (1993) present pronounced pore fields indeed.

S. bidentulum (usually as *S. orbiculare* var. *denticulatum*) is known from (sub)tropical regions in North and South America, Asia, Australia and Africa. From Africa, there are records by Bourrelly (1957), Rino (1971) and Compère (1977). Also *S. zahlbruckneri* var. *africanum*, described by Fritsch, Rich (1938) from South Africa and recorded by Bourrelly, Couté (1991) from Madagascar most likely should be accounted *S. bidentulum* (Coesel, van Geest 2009).

493. STAUASTRUM BOHLINIANUM SCHMIDLE

- VAR. CAPENSE HODGETTS

Illustrations. Fig.13, B (Hodgetts 1926).

Samples. RSA: 112, 113, 115, 116.

Note. Var. *semicellulis a fronte visis late campanulatis, apicibus leviter convexis; membrana granulis in seria circa 10 verticles digestis ornata; a*

vertice visis apicibus granulatis; processibus spinis brevibus 4 vel 5 praeditis. Long. cell., 20.0-21.6 µm; lat. cum spin., 20.0-25.0 µm; lat. isthm., 5.3-7.0 µm.

This variety has less elliptic semicells than the type, and the granules are rather less numerous, although in similar vertical series; and the apex of the semicell is granulate (Hodgetts 1926).

494. STAUSTRUM BRACHIOPROMINENS BOERG.

- VAR. ARCHERIANUM BOHLIN

Illustrations. Fig.21, A (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200.

Note. *Forma minor, brachiis pro ratione longioribus, margine inferiori semicellulae evidenter convexo. Long. cell., 18.0-19.0 µm; lat. cum proc., 44.0-58.0 µm; isthm., 5.0-6.0 µm.*

The cells have but a slight constriction, which usually appears as a notch. The basal part of the semicell is inflated and has a convex margin. Two emarginate verrucae are inserted just below the apex, while the long processes are slender and slightly divergent, with seven or eight denticulations, and three small apical spines. The vertical view is fusiform or oblong and biradiate.

The differences from var. *archerianum* are only slight. The cells are smaller, and the processes relatively longer. In the inflation of the basal parts of the semicells is resembles *S. asperatum* Grönl., which is smaller and, at present, only known to be triradiate. There is also appreciable resemblance to *S. dimazum* (Lütkem.) Grönl., but this has a more complex ornamentation (Fritsch, Rich 1938).

495. STAUSTRUM BREISSONII ARCH.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 327.

Note. Long., 39.0 µm; lat., 36.4 µm (Huber-Pestalozzi 1930).

496. STAUSTRUM BREVISPINUM BRÉB.

- VAR. BREVISPINUM

- F. BREVISPINUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 192 (rare), 201, 430.

Note. Long., 29.0 µm; lat., 26.0 µm; ist., 9.0-10.0 µm (Rich 1932).

Rather small form (Fritsch, Rich 1938).

- F. MINIMA LÜTKEM.

Illustrations. Tab.7, Fig.6 (Huber-Pestalozzi 1930).

Sample. RSA: 328.

Note. Long., 18.2-20.0 µm; lat. without spines, 20.0-22.6 µm (with spines 23.0-24.8 µm); isthmus, 7.2 µm (Huber-Pestalozzi 1930).

- VAR. MASOGANUM CLAASSEN

Illustrations. Tab.29, figs.19, 20 (Claassen 1961).

Samples. RSA: 290.

Note. *Affinis St. brevispino var. obverso W. et G.S. West, sed sinu latiore et cellularum e vertice visarum lateribus undulatis neque concavis differt.*

This variety is near var. *obversum* W. et G.S. West (West, West 1912, p.148, Pl.CXXIII, fig.7); but the sinus is broader, and the sides in vertical view are undulate and not concave. Cells small, slightly shorter than broad, deeply constricted, sinus open; semicells more or less fusiform, each apical angle

furnished with a short spine. Vertical view of cell triangular, sides 3-undulate. Cell wall smooth. One pyrenoid per chloroplast. Length 26.0 μm ; breadth 28.0 μm ; breadth of isthmus 8.0 μm (Claassen 1961).

497. STAURASTRUM CAFFRORUM CLAASSEN

Illustrations. Tab.30, figs.7-9 (Claassen 1961).

Samples. RSA: 241.

Note. *Inter speciesdescriptas nulla affinitas obvia. Semicellulae e vertice visae plus minusve quadratae, margo apicalis depressione praeditus, quae spinis brevibus circumdata est. Supra isthmum duae series spinularum adsunt et anguli apicales semicellularum etiam spinulis muniti.*

Cells small, about 1.2 times as long as broad, deeply constricted, sinus open outwards; semicells subelliptic, more or less quadrangular in vertical view, apical margin with a cavity in the median part, margin of cavity furnished with short spines; above the isthmus in each semicell are two series of small spines, apical angles furnished with spines. Length 24.0 μm ; breadth 20.0 μm (greatest – fig.7) and 16.0 μm (smallest – fig.9); breadth of isthmus 8.0 μm (Claassen 1961).

498. STAURASTRUM CALEDONENSE G. HUBER

Illustrations. Tab.2, Figs.7-10 (Huber-Pestalozzi 1929).

Sample. RSA: 320.

499. STAURASTRUM CAPENSE HODGETTS

Illustrations. Fig.14, A, B (Hodgetts 1926).

Sample. RSA: 122 (very rare).

Note. *S. mediocre, diametro $1\frac{1}{4}$ - $1\frac{1}{3}$ plo longioribus, profunde constrictum; semicellulis late oblongo-trapeziformibus, lateribus leviter convexis divergentibusque, angulis superioribus rotundatis et leviter productis, apicibus valde convexis; a vertice visae triangularibus, angulis rotundatis, lateribus leviter convexis; membrana granulis magnis rotundatis, circa angulos concentricè dispositis ornata. Long. cell., 38.0-40.0 μm ; lat., 29.0-32.0 μm ; lat. isthm., 13.0 μm .*

The shape of the cells in front view (Fig.14, A) strongly resembles certain species of *Cosmarium*, especially *C. repandum* Nordst. (West, West 1908, p.53, t.69, fig.30), and also certain forms of *C. biretum* Bréb. The latter species has a forma *triquetra* Bréb. (West, West 1912, p.28, t.101, fig.9), which, however, differs widely from present species. It may also be compared with *S. kozlowskii* Racib. ("Desmid. Zebrane przez Dr. E. Ciastonia," Rozpr. Wydz. Matem.-przy. Akad. Umiej. Krakow, xxii, 1892, p.387, t.7, fig.9) (Hodgetts 1926).

500. STAURASTRUM CLEPSYDRA NORDST.

- VAR. **OBTUSUM** NORDST. (SYN.: *STAURASTRUM PACHYRHYNCHUM* NORDST. FORMA BORGE)

Illustrations. Fig. nostr.10, A-D (Rich 1932).

Sample. RSA: 192 (common), **203, 204.**

Note. *Forma, Borge, Die von Dr. A. Löfren in São Paulo gesammelten Süßwasser-algen, 1918, Tab.IV, fig.11. The dorsal margin is almost straight, and the cell-wall only slightly thickened at the angles. Long., 25.0-32.0 μm ; lat., 23.0-30.0 μm ; ist., 5.0-6.0 μm . An abnormal individual is shown in Fig.10, B (Rich 1932).*

Long. cell., 20.0 μm ; lat., 23.0 μm (Fritsch, Rich 1923).

501. STAUSTRUM CONNATUM ROY ET BISS.

- VAR. **WARMBADIANUM CLAASSEN**

Illustrations. Tab.31, figs.23, 24 (Claassen 1961).

Samples. RSA: 275.

Note. *Affinis St. connato var. americano* W. et G.S. West, *sed differt et semicellulis latioribus brevioribusque et quod a vertice visa latera concaviores sunt.*

This closely resembles var. *americanum* W. et G.S. West (W. and G.S. West, North American Desmidiaceae, Trans Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.16, fig.7); but the semicells are shorter and broader, and the sides in vertical view are more concave. Length 20.0-22.0 μm ; breadth 22.0-23.0 μm ; breadth of isthmus 6.0-7.5 μm (Claassen 1961).

502. STAUSTRUM COSMARIOIDES NORDST.

Illustrations. Pl.3, 8 (Williamson 2000).

Samples. RSA: 384.

Note. Cells in this moderate population often appeared slightly asymmetric (Williamson 2000).

503. STAUSTRUM CREMATUM CLAASSEN

Illustrations. Tab.31, figs.21, 22 (Claassen 1961).

Samples. RSA: 280, 283, 287.

Note. *Affinis St. elliptico* West, *sed membrana cellulae crenata differt.*

Near *St. ellipticum* West (West, West 1912, p.138, Pl.CXIX, fig.7); but the cell wall is crenated. Cells small, about 1.2 times as long as broad, deeply constricted, sinus widely open; semicells triangular in vertical view. Length 24.0-25.0 μm ; breadth 20.0-20.5 μm ; breadth of isthmus 9.0-10.0 μm (Claassen 1961).

504. STAUSTRUM CREMATUM (NÄG.) DELP.

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

Note. "*Forma* Krieger, 1932" (R. Grönblad) (Grönblad, Croasdale 1971).

505. STAUSTRUM CURVATUM WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 200 (rare), 201.

Note. Long. cell. sine proc., 28.0 μm ; lat. cum proc., 34.0 μm ; isthm., 5.0-6.0 μm (Fritsch, Rich 1938).

506. STAUSTRUM CUSPIDATUM BRÉB.

- VAR. **CUSPIDATUM**

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 192, 198, 199, 201, 328.

Note. Long., 18.2 μm ; lat. without spines, 15.6 μm ; long. spines, 3.0 μm ; isthmus lat., 5.0 μm ; isthmus long., 2.6-3.0 μm (Huber-Pestalozzi 1930).

Long. cell., 19.0-24.0 μm ; lat. cum spin., 25.0-35.0 μm ; isthm., 4.0-5.0 μm ; diam. zygosp. sine spin., 21.0 μm .

In some cells the spines were converging, in others almost parallel (Fritsch, Rich 1938).

- VAR. **DIVERGENS NORDST.**

Illustrations. Fig.21, D, E (Fritsch, Rich 1938).

Sample. RSA: 198, 203, 205.

Note. *Forma.* Long. cell., 15.0-18.0 μm ; isthm., 3.0-4.0 μm . The form present was very small, with markedly divergent spines and an elongated isthmus. Vertical view triangular, with concave sides (Fritsch, Rich 1938).

507. STAUSTRUM CYCLACANTHUM W. ET G.S. WEST

- VAR. AFRICANUM CROASD.

Illustrations. Fig.132 (Grönblad, Croasdale 1971).

Sample. NAM: 307.

Note. A variety differing from the species in that the verrucae of the apical ring are more irregular and elaborate, mostly emarginate, in units of 2 or 3; and the verrucae at the origin of the processes are small, emarginate, marginal in vertical view, and the node at the base of the semicell bears an interrupted series of 6 short spines, not granules, which gives a unique appearance in the isthmial view, each widely spaced pair of spines being opposite the body (not process) of the semicell; there are also a few spines or granules below each process; and the apical verrucae do not extend out onto the process; and finally, the processes are relatively shorter, the cell being 1.5-1.75 times as broad as long. The closest relative is probably *S. floriferum* W. et G.S. West (1896b, p.267, 18: 1) from which it differs in its converging processes which are spinose also on the lower surface and end in 4 (not 3) spines, and have marginal verrucae at their origin. For discussion of these species see Thomasson (1960, p.26) (Grönblad, Croasdale 1971).

508. STAUSTRUM DEJECTUM BRÉB.

- VAR. PATENS NORDST.

Illustrations. Fig.44 (Nyygard 1932).

Sample. RSA: 180 (only 1 specimen was observed), **188** (January, very rare), **207**. - **NAM: 307.**

Note. The specimen observed agrees very well with Nordstedts figure (O. Nordstedt, 1881, p.39, t.4, fig.16), except that the spines are longer, viz. 5-6 μ , and that the sinus is rounded at the apex. Length 26.0 μm , breadth 24.0 μm , breadth of isthmus 7.0 μm (Nyygard 1932).

Forma. The spines are divergent (Rich 1932).

Forma. Observed only during period December 1927 to May 1928 (very rare), and December 1928 to April 1929 (very rare) (Schuurman 1932).

509. STAUSTRUM DICKIEI RALFS

- VAR. DICKEI

Illustrations. Tab.31, figs.7, 8 (Claassen 1961).

Samples. RSA: 284, 296, 430.

Note. Spine on apical angle straight or slightly incurved (Claassen 1961).

- VAR. MAXIMUM W. ET G.S. WEST

- F. MAXIMUM

Illustrations. Fig. nostr.10, *E, F* (Rich 1932).

Sample. RSA: 192 (rather rare).

Note. *Forma.* The size is intermediate between that found by the Wests for var. *maximum* in Madagascar and the same variety in North America, and the cell-wall is more closely punctate than in Madagascar form. The spines are rather long (about 9.0 μ) and convergent; the tips not recurved. Long., 50.0-60.0 μm ; lat. sine spin., 56.0-60.0 μm ; ist., 11.0-13.0 μm (Rich 1932).

- F. **LONGISPINA** FRITSCH ET RICH

Illustrations. Fig.21, C (Fritsch, Rich 1938).

Sample. RSA: 198, 199, 200, 201.

Note. *Forma longispina*. Long. cell., 33.0-38.0 μm ; lat. sine spin., 29.0-32.0 μm ; long. spin., 9.0 μm ; isthm., 10.0 μm . The spines are about twice as long as in the type and converge to a marked extent. The end-view is triangular, with slightly concave sides. The membrane is punctate (Fritsch, Rich 1938).

- VAR. **RHOMBOIDEUM** W. ET G.S. WEST

Illustrations. Fig.116 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 25.0 μm ; lat. without spines, 27.0 μm ; with spines, 35.0 μm ; isthm., 8.0 μm . A little small but very characteristic in shape, with the straight lower margins and with the evenly convex apical margin of the semicell merging into the converging spines (Grönblad, Croasdale 1971).

510. **STAURASTRUM DILATATUM** EHRENB.

- VAR. **DILATATUM**

Illustrations. Tab.30, figs.1-6; Tab.31, figs.14-16 (Claassen 1961).

Sample. RSA: 192 (very rare), **237, 240, 241, 248, 253, 254, 258, 261, 263, 265, 268, 270, 271, 277, 289, 290, 291, 295, 296, 299, 300, 327, 328, 430.** – **NAM: 305.**

Note. Long., 26.0 μm ; lat., 26.0 μm . In sample **328** was *forma minor*, long., 18.2 μm ; lat., 18.2 μm (Huber-Pestalozzi 1930).

Long. cell., 22.0-30.0 μm ; lat., 24.0-28.0 μm ; isthm., 8.0-9.0 μm (Rich 1940).

Sinus less widely open than in the type and all the specimens observed were triangular in vertical view. The Rietfontein and Mosdene specimens are slightly larger than the other specimens. Length 24.0-40.0 μm ; breadth 20.0-36.0 μm ; breadth of isthmus 5.0-12.0 μm (Claassen 1961).

Western Cape, Magaliesberg, Drakensberg, Mpumalanga, Orange Free State, North-West Province, KwaZulu Natal (orig.).

- VAR. **HIBERNICUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 306.

511. **STAURASTRUM DIPTILIUM** NORDST.

- VAR. **MOSSAMBICUM** (SCHMIDLE) GRÖNBL. ET SCOTT IN GRÖNBLAD, PROWSE ET SCOTT 1958, P.39, 20: 290-292

Illustrations. Fig.122 (Grönblad, Croasdale 1971).

Samples. NAM: 305, 306.

Note. Long. without spines 11.0 μm ; with spines 19.0 μm ; lat. without spines 13.0 μm ; with spines 19.0 μm ; isthm., 8.0 μm . This is R. Grönblad's determination. He adds that his figure is poor and that his plant titled (Grönblad, Croasdale 1971).

512. **STAURASTRUM DISPUTATUM** EHRENB. (SYN.: *STAURASTRUM DILATATUM* EHRENB. VAR. *INSIGNE* RACIB.)

- VAR. **ANNULATUM** RICH

Illustrations. Fig.3, A-B (Rich 1940).

Samples. RSA: 300.

Note. *Semicellulae in parte basali fere brevae-cylindriformae. Granuli in series quarter circa angulos dispositi, cum circulo granulorum circa 24 supra isthmum proximo. A vertice visis 4-radiantae.*

The arms of one semicell alternate with those of the other, as often happens in *Staurastrum*. It resembles both var. *extensum* (Borge) W. et G.S. West (West, West 1912, p.177) and var. *sinense* (Lütkem.) W. et G.S. West, but is larger, and the ring of about 24 granules just above the isthmus marks it out from all other forms that have been described (Rich 1940).

- VAR. *SINENSE* (LÜTKEM.) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

513. *STAURASTRUM DOIDGEI* FRITSCH ET RICH

Illustrations. Fig.21, *F, G* (Fritsch, Rich 1938).

Sample. RSA: 199 (rare).

Note. *S. parvum cosmariiforme, paullo latior quam longum, profunde constrictum, sinu angusto-lineari extremo ampliato, chromatophora singula, pyrenoide 1 in quaque semicella; semicellulis a fronte visis late ellipticis, angulis basalibus late rotundatis, membrana granulis pro parte emarginatis longitudinaliter dispositis oblecta, in parte centrali laevi; semicellulis a vertice visis triangularibus, angulis obtusis fere truncatis, lateribus valde concavis, granulis in processibus et intra margines laterales transverse et longitudinaliter dispositis. Long. cell., 27.0 µm; lat., 29.0-31.0 µm; isthm., 7.0 µm.*

This is seemingly a new type among the cosmarioid *Staurasta*. There is some resemblance in the end-view to *S. maamense* Arch., but the front-view is altogether different (Fritsch, Rich 1938).

514. *STAURASTRUM EXCAVATUM* W. ET G.S. WEST

Illustrations. Fig. nostr., 22, *E* (Fritsch, Rich 1938); Tab.32, fig.7 (Claassen 1961).

Sample. RSA: 198, 203, 289, 296.

Note. Long. cell., 10.0 µm; lat., 48.0-53.0 µm; isthm., 5.0-6.0 µm. This species is characterized by the excavate apex and the slightly divergent and slender arms which show several series of denticulations. The form here recorded is a little shorter than the type and hence has a more depressed appearance (Fritsch, Rich 1938).

Length 12.0 µm; breadth 10.0 µm; length of arms 12.0-20.0 µm; breadth of isthmus 6.0 µm (Claassen 1961).

515. *STAURASTRUM EXIGUUM* REINSCH

Illustrations. Pl.VI, figs.15, 16 (Reinsch 1878).

Sample. RSA: 4.

Note. *S. minimum, tam longum quam latum, sinu acutangulo; semicellulis ellipticis, margine terminali aequaliter curvato, angulis acutiusculis subrtundatis, e vertice visis trigonis marginibus lateralibus subrectis et leviter repandis, angulis (plerumque) alternantibus obtusis, verruculis in seriebus dispositis. Latitudo isthmi dimidio diametri transversalis paulo minor. Longit. 0.0196 mm, latit. 0.0196 mm. Hoc Staurastrum, quod speciem propriam putarem, inter S. punctulatum et formas minores S. margaritacei jacens differt a primo angulis gracilioribus truncatis (non rotundatis), a margaritaceo dimensionibus minoribus ac angulis integris (non aculeolais). Eandem speciem*

observavi prope Erlangem; specimina ab hoc loco dimensionibus paululo majoribus sinu paulo profundiore et latiore (Reinsch 1878).

516. STAURASTRUM FISSUM W.B. TURN.

Illustrations. Fig.13, C (Rich 1932).

Sample. RSA: 192.

Note. Forma. These individuals differed from the type only in their divergent processes; in Turner's figures (The Freshwater Algae of East India, 1892, fig.24, *a, b*) the processes are horizontal (Rich 1932). The Fig.13, C has been placed close to that of *St. tohopekaligense* to show the resemblance between the two in the shape of semicells (Rich 1932).

517. STAURASTRUM FLORIFERUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 302, 307 (*forma*).

Note. Forma (in **307**) (Grönblad, Croasdale 1971).

518. STAURASTRUM FRANCONICUM REINSCH

Illustrations. Fig.3, C, D (Rich 1940).

Sample. RSA: 299 (very rare).

Note. Forma nov. Long. cell. (sine proc.), 16.0-17.0 μm ; lat. (cum proc.), 18.0-20.0 μm ; isthm., 6.0-7.0 μm . This is very small *Staurastrum* with four arms, each ending in two or three teeth. The sinus consist of a minute excavation in the middle of the cell; the apex and lateral margins are nearly straight. In one individual there was observed a minute tooth at the lower and of the lateral margin on each side. It shows certain resemblances to *S. rectangulare* Borge and *S. zonatum* Borge.

S. franconicum is not at all well known. The original drawings of Reinsch ("Die Algenflora des mittleren Theiles von Frankau", 1867, pl.xii, fig.3) are not very satisfactory, and I cannot find any figures that have been published since his time. Wolle ("Desmids of the United States", 1884, pl.xlii, figs.47-50) gives drawings of *S. pusillum* Wolle, a species which he describes as being very like *S. franconicum*, but differing from it in being somewhat smaller and having four instead of five processes, very important differences.

S. pusillum seems to me in no way to differ from Reinsch's diagnosis of *S. franconicum*, and I do not feel this species can stand. The form described by Wolle were all granular, but I have failed to see any granules in those now under investigation (Rich 1940).

519. STAURASTRUM FÜLLEBORNEI SCHMIDLE

- VAR. FÜLLEBORNEI

Illustrations. Fig. nostr.11, F, G (Rich 1932).

Sample. RSA: 192 (very rare).

Note. This handsome *Staurastrum* is evidently the same as that described by Schmidle from Nyasa, though differing slightly from his figures (Algen, insbesondere solche des Plankton, aus dem Nyassa-See und seiner Umgebung; Engler's Bot. Jahr., xxxii, 1902, Tab.II, figs.10, 10a). There are twice as many verrucae in the apices circle as there are arms. I did not notice the small processes above the isthmus, but then only two or three individuals were seen. Long., 48.0 μm ; lat. cum proc., 50.0 μm ; lat. sine proc., 30.0 μm ; ist., circa 20.0 μm (Rich 1932).

- VAR. **CORONATUM** THOM.

Illustrations. Pl.25, Fig.2 (Williamson 1994).

Sample. RSA: 356.

Note. *Facies* 6. Length 51.6 μm ; breadth 75.0 μm (+ processes); isthmus ca. 22.0 μm (Williamson 1994).

In (Williamson 1994) indicated as *Staurastrum fuellebornii* Schmidle f. *coronatum* Thom. *facies* 6.

520. **STAUSTRUM FURCATUM** EHRENB.

- VAR. **FURCATUM**

- F. **RICHAE** CROASD. (INCLUDING *STAUSTRUM FURCATUM FORMA* IN RICH 1932, P.175, 11: A-C)

Illustrations. Fig.11, A-C (Rich 1932); Fig.24, C-E (Fritsch, Rich 1938); Tab.32, figs.3-6 (Claassen 1961); Fig.133 (Grönblad, Croasdale 1971).

Sample. RSA: 192 (rare), **289, 290, 298**. – **NAM: 307**.

Note. *Forma* (Fig.11, A-C). In addition to the type, individuals were present in the same sample possessing a simple spine on the ventral margin of the semicell just below the lateral process. Long. sine proc., 22.0-28.0 μm ; lat. cum proc., 26.0-39.0 μm ; sine proc., 18.0-20.0 μm ; ist., 8.0-10.0 μm (Rich 1932).

Forma minor. Long. cell., 17.0-20.0 μm ; lat. cum proc., 34.0-36.0 μm ; isthm., 10.0-11.0 μm .

The vertical view was often quadrangular (Fig.24, E). As pointed out by Carter (West and al. 1923, p.176), *S. furcatum* is closely allied to *S. senarium* (Ehrenb.) Ralfs, which appears as more elaborate development of the type seen in the former.

Forma Rich (1932, p.175, fig.11, A-C). This is characterized by the presence of a simple spine on the ventral margin of the semicell (Fritsch, Rich 1938).

Processes all stout and widely bifurcate, with one additional downwardly directed spine above the isthmus under each lateral process. Long. without spines, 22.0-28.0 μm ; with spines, 42.0 μm ; lat. without spines, 18.0-23.0 μm ; with spines 26.0-40.0 μm ; isthm., 8.0-13.0 μm . Our plant is so similar to the one shown by Rich (1932, p.175, 11: A-C) from South Africa, that it seems that the two could best be united into one form. Two other forms are known showing this extra spine: one from Newfoundland "*S. furcatum* var.?" (Taylor 1935a, p.191, 36: 11) with slender not wholly hollow processes, with a single spine; and one from Japan: *S. furcatum* var. *iyaense* Hinode (1962a, p.35, 3: 98, 99) with two spines (Grönblad, Croasdale 1971).

521. **STAUSTRUM FURCIGERUM** BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 213.

522. **STAUSTRUM GALPINII** CLAASSEN

Illustrations. Tab.29, figs.15-17 (Claassen 1961).

Samples. RSA: 290, 295.

Note. *Affinis* *St. rotulae* Nordst., *sed differt quod semicellula 7 tantum brachiis et margo apicalis 7 papillis est paraeditus*.

Near *St. rotula* Nordst. (W. and G.S. West, North American Desmidiaceae, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.18, fig.11); but each semicell has only seven arms, and the apical margin is furnished with seven papillae. Cells of medium size, about 1.75-2.2 times longer than broad, sinus

widely open; semicells with seven slightly incurved arms, each arm containing four small spines at the apex, sides crenate with a circle of spines around each crenation (not clear in some specimens); apical margin furnished with seven emarginate projections. Chloroplasts with one central pyrenoid each. Length 38.0-44.0 μm (with papillae 46.0-50.0 μm); breadth 18.0-25.0 μm (with arms 56.0-64.0 μm); breadth of isthmus 10.0-13.0 μm . Named after Mr. E.A. Galpin of Mosdene, Naboomspruit (Claassen 1961).

523. STAUSTRUM GEMELLIPARUM NORDST.

- VAR. **GEMELLIPARUM**

Illustrations. Pl.25, Fig.5 (Williamson 1994).

Samples. RSA: 341, 390.

Note. Length 28.0 μm (+processes); 22.5 μm (-processes); breadth 26.6 μm (+processes); isthmus 11.2 μm (Williamson 1994).

- VAR. **AFRICANUM** CLAASSEN

Illustrations. Tab.32, figs.1, 2 (Claassen 1961).

Samples. RSA: 290.

Note. *A typo speciei differt quod circulis intimus 6 brachiorum propius mediam cellulae partem dispositus est.*

This closely approaches the typical form (W. and G.S. West, The Freshwater Algae of Ceylon, Trans. Linn. Soc. London, Ser.2, Vol.VI, 1901-1902, Pl.21, fig.25); but in vertical view, the inner circle of six arms is nearer to the axis of the cell. Cells small, about 1.4 times as long as broad, deeply constricted, sinus open; semicells more or less elliptical, furnished with six short arms near the base and another six near the apical margin, apices of arms emarginate. Vertical view of semicell triangular, with two arms on each angle and a circular series of six arms within the margin, angles truncate. Each chloroplast containing one central pyrenoid. Length 24.0 μm (with arms 30.0 μm); breadth 17.0 μm (with arms 24.0 μm); breadth of isthmus 9.0 μm (Claassen 1961).

524. STAUSTRUM GLABRUM (EHR.) RALFS

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 328.

Note. Long., 18.5 μm ; lat. without spines., 18.2 μm ; at apex, 13.0 μm ; isthmus lat., 3.9 μm ; isthmus long., 3.0 μm ; spines, 6.5-7.8 μm (Huber-Pestalozzi 1930).

525. STAUSTRUM GRACILE RALFS

- VAR. **GRACILE**

Illustrations. Fig.131 (*forma*) (Grönblad, Croasdale 1971).

Samples. RSA: 28 (rare), **29** (rare), **32** (rare), **33** (rare), **51** (rare), **202, 325, 326.** – **NAM: 301** (*forma*), **305** (“small”).

Note. Long., 36.0 μm ; lat. *cum proc.*, 60.0 μm ; lat. *sine proc.*, 20.0 μm ; lat. *isthm.*, 12.0 μm (Fritsch 1918).

Diam. zygosp. *sine spin.*, circa 30.0 μm ; *cum spin.*, circa 75.0 μm . The zygospores, present in one sample, were spherical and provided with numerous spines possessed of a swollen base and divided into 3 bifurcate branchlets at the apex (Fritsch, Rich 1938).

Forma (*ad var. nanum* Wille *accedent*). Long., 28.0 μm ; lat. with spines, 38.0 μm ; isthm., 8.0 μm . For this plant R. Grönblad suggested “*S. margaritaceum* (Ehrenb.) Menegh. cf. Grönblad (1956, p.32, fig.145-147, 152-

159". H. Croasdale does not believe that this African form, and also most Grönblad's 1956 forms belong to *S. margaritaceum* because the cells are considerable broader than long, the processes are too slender, and the body of the cell is apparently unornamented. *S. gracile* is a much over-loaded species, but still seems more appropriate for this form than *S. margaritaceum* (Grönblad, Croasdale 1971).

In sample **305** - "small" (R. Grönblad) (Grönblad, Croasdale 1971).

- VAR. NANUM WILLE

Illustrations. Fig.3, *E, F* (Rich 1940).

Samples. RSA: 299.

Note. *Forma nov.* Long. cell., 28.0-30.0 μm ; lat., 31.0-35.0 μm ; isthm., 8.0-9.0 μm . The apex is convex, and there are six arms (Rich 1940).

526. STAURASTRUM HAGMANNI GRÖNBLAD

Illustrations. Fig.41 (Coesel, van Geest 2009).

Samples. See information in the end of the note to this species.

Note. *Staurastrum hagmannii* is an inconspicuous but yet characteristic species. It may be readily recognized by the linear series of denticulations running over the dorsal side of the processes. Grönblad (1945) described *S. hagmannii* from the Brazilian Amazon region. Other records from Brazil by Bicudo, Ungaretti (1986), Giani, Pinto-Coelho (1986) and Bicudo, Martins (1989) clearly refer to other species. The record, on the contrary, by Thérézien (1989) from the Bolivian Amazon is a reliable one. The only record outside of South America is by Bourrelly, Couté (1991) from Madagascar. As the specimen pictured from Madagascar slightly deviated from Grönblad's original description, particularly in apical view, Bourrelly, Couté (1991) specified it as a '*forma*'.

Because of the morphological variability found in our Okavango material interconnecting the pictures by the above-mentioned authors, we have no reason to distinguish any infraspecific taxon. It was encountered in some samples from Chief's Island (**BOT: 400-411**) and Mohango (**NAM: 420, 421**), particularly in sample **400** (Coesel, van Geest 2009).

527. STAURASTRUM HEXACERUM WITTR.

- VAR. HEXACERUM

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 329.

Note. Indicated as *Staurastrum hexacerum* (Ehr.) Wittr. (?) (Huber-Pestalozzi 1930).

- VAR. REDUCTUM HODGETTS

Illustrations. Fig.13, *C* (Hodgetts 1926).

Samples. RSA: 119. – NAM: 305.

Note. *Var. processibus brevibus, extremitatibus dentibus nullis instructis.* Long. cell., 28.0-32.0 μm ; lat., 23.0-28.0 μm ; lat. isthm., 7.0 μm .

This variety is characterized by the short processes, and by the acute granules being no longer at the ends of the processes than elsewhere. The processes of the two semicells were always superposed (Hodgetts 1926).

In (Grönblad, Croasdale 1971) indicated as *Staurastrum hexacerum* (Ehrenb.) Wittr.

528. STAURASTRUM HEXAGONALE FRITSCH

Illustrations. Fig.32 (Fritsch 1918).

Samples. RSA: 24, 31.

Note. *S. subparvum*, circiter $1\frac{1}{3}$ plo longius quam latum, modice constrictum, sinu acutangulo late aperto. Semicellulae transverse hexagonae, angulis lateralibus leviter productis, angulis omnibus plus minus rotundatis; apicibus rectis truncatis; marginibus lateralibus superioribus fere rectis, marginibus lateralibus inferioribus rectis vel leviter concavis. A vertice visae tri-vel quadrangulares, angulis rotundatis, lateribus plus minus concavis. Membrana in parte centrali semicellularum laevis, sed angulis granulis parvis rotundatis, concentrice dispositis, munitis, iis in apice anguli utrisque paullo majoribus, plus minus acutis, etiam dentiformibus. Long., 33.0-36.0 μm ; lat., 25.0-30.0 μm ; lat. isthm., 10.0-12.0 μm ; crass., 19.0-20.0 μm .

This species is characterized by the hexagonal shape of the semicells in front view. In this respect it differs markedly from the nearly allied *S. punctulatum* Bréb. Other points of distinction are: (a) The more marked rounding of the ends and the concavity of the sides in end-view; (b) the absence of granules from the central part of the semicells; (c) the tooth-like character of the granules at the ends; and (d) the proportionally greater length. In outline it bears some resemblance to *S. angulosum* Schmidt (which, however, I only know from the inadequate figures in Migula, Kryptogamenfl., vi, 1907, Tab. XXVII, B, fig. 2), and to *S. subamoenum* Maskell (Trans. New Zealand Inst., xxi, 1888, p. 22, fig. 37), from both of which it however differs in important respect. Compare also *S. tristichum* Efv. (Fritsch 1918).

529. STAURASTRUM HIRsutUM (EHRENB.) BRÉB.

Illustrations. Pl. 4, 2 (Williamson 2000).

Sample. RSA: 327, 386.

Note. *Forma.* Long., 33.8 μm ; lat., 26.0 μm (Huber-Pestalozzi 1930).

In (Williamson 2000) indicated as *Staurastrum hirsutum* (Ehrb.) ex Bréb. in Ralfs.

530. STAURASTRUM INCOSNSPICUUM NORDST.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 201 (rather rare), **205.**

Note. A small form. Long. cell. sine proc., 10.0 μm ; lat. sine proc., 6.0 μm ; cum proc., 17.0 μm (Fritsch, Rich 1938).

531. STAURASTRUM INFLEXUM BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 303.

532. STAURASTRUM JONSONII W. ET G.S WEST

- VAR. *ALTIOR* FRITSCH ET RICH

Illustrations. Fig. 22, A, B (Fritsch, Rich 1938).

Sample. RSA: 202 (rather rare), **205.**

Note. *Differt a typo magnitudine majore, verrucis apicalibus emargibatis haud tridentatis infra apicem dispositis, marginibus lateralibus semicellulae fere parallelis; semicellulis a vertice visis triradiatis, interdum biradiatis.* Long. cell., 54.0-64.0 μm ; lat. cum. proc., 128.0-164.0 μm ; isthm., 11.0-12.0 μm .

One of the characteristic of the species, the slight enlargement of the semicell above the isthmus upon which a pair of granules is borne, is well seen in Fig. 22, A; in some individuals, however, the granules on this basal enlargement

ware lacking. The apical warts do not occupy the actual margin, but are placed just within it; they are, moreover, flattened or emarginate, and not tridentate as in the type. The individuals are usually triradiate, and the long arms are provided with numerous series of denticulations. The lateral margins of the semicells are longer than in the type, straight above the basal inflation and practically parallel. G.M. Smith ("Phytoplankton of the Inland Lakes of Wisconsin", pt.ii, Madison, Wisconsin, 1924, Pl.XVIII, fig.4) has figured individuals which resemble ours in the last two respects.

The only triradiate variety of the species hitherto described is var. *triradiatum* Smith ("Phytoplankton of the Inland Lakes of Wisconsin", pt.ii, Madison, Wisconsin, 1924, p.139, Pl.XVIII, figs.5-7), in which the semicells differ in shape from those here recorded. The specimens may also be compared with *S. subjohnsonii* Rich and *S. longibrachiatum* Gutw. (Fritsch, Rich 1938).

533. STAUSTRUM LAEVE RALFS

Illustrations. Fig.121 (*forma*) (Grönblad, Croasdale 1971).

Sample. NAM: 307 (type and *forma*).

Note. *Forma.* Long. without spines 20.0 μm ; with spines, 23.0 μm ; lat. without spines, 15.0 μm ; with spines 24.0 μm ; isthm., 9.5 μm . A form differing in the semicells having more erect sides and being provided with a supraisthmial spine; in vertical view it differs in the body wall being convex between the paired spines. Unfortunately in R. Grönblad's sketches the face- and vertical views do not wholly agree. He called this plant "*S. sp. ad S. contectum* Turner". It might also be compared to *S. engleri* Schmidle (1898, p.56, 4: 13) from Africa, which could probably be included in *S. laeve* (Grönblad, Croasdale 1971).

534. STAUSTRUM LAEVISPINUM BISS.

- VAR. **ABBREVIATA** FRITSCH ET RICH

Illustrations. Fig.22, *C. D* (Fritsch, Rich 1938).

Sample. RSA: 200, 201, 203.

Note. *Differt a typo brachiis brevioribus latioribus obtusis, isthmo angustiori.* Long. cell., 24.0-27.0 μm ; lat., 25.0-32.0 μm ; isthm., 6.0 μm .

This variety differs from the type in the shorter and relatively broader arms of the semicells which are bluntly rounded at the ends where the membrane is slightly thickened. The isthmus, too, is narrower and rather more elongate, in this respect approaching *S. sublaevispinum* W. et G.S. West. The membrane is quite smooth. A single zygospore was observed; it was spherical, and furnished with rather long spines. The zygospore of the type is a yet unknown (Fritsch, Rich 1938).

535. STAUSTRUM LAPPONICUM GRÖNBLAD 1927, P.29, 2: 106, 107

Illustrations. Fig.119 (Grönblad, Croasdale 1971).

Sample. NAM: 305.

Note. Long., 31.0 μm ; lat., 33.0 μm ; isthm., 12.0 μm (Grönblad, Croasdale 1971).

536. STAUSTRUM LEPTOCLADUM NORDST.

- VAR. **CORNUTUM** WILLE

Illustrations. Fig. nostr.13, *F* (Rich 1932); Fig.23, *A* and *a* (Fritsch, Rich 1938); Tab.32, fig.8 (Claassen 1961).

Sample. RSA: 192 (May), **198, 199, 298.** – **NAM: 305, 307.**

Note. G.M. Smith (Ecology of the Plankton Algae in the Palisades Interstate Park, 1924, p.103) gives reasons, based on his experience with the Alga in Ontario, New York, and Wisconsin, for including this variety in the type. Grönblad, however, considers that the two should be separate (Beitrag zur Kenntniss der Desmidiaceen Schlesiens, 1926, p.29). The processes in the present sample have not the upward and outward inclination depicted in G.M. Smith's figures but are at first almost horizontal, then curved gracefully towards the isthmus, and, finally, slightly upwards at the tips, more like West's figure (West, West 1895, v, Pl.IX, figs.12 and 13). Long., 35.0-38.0 μm ; lat. cum proc., 84.0-120.0 μm ; ist., 6.0-8.0 μm ; crass., 10.0-12.0 μm (Rich 1932).

Forma brachiis fere horizontalibus. Long. cell., 37.0-44.0 μm ; lat. sine proc., 10.0 μm ; cum proc., 100.0-120.0 μm ; isthm., 6.0-8.0 μm ; crass., 15.0 μm .

The individuals of this form are a little larger than those recorded by the Wests from Madagascar, but agree closely with those originally described by Wille. The long arms end in two divergent teeth, and are not markedly upturned as is commonly the case in this variety (Fritsch, Rich 1938).

These specimens are larger than the typical form (West, West 1895, Pl.9, figs.12, 13; F.Rich, Trans. Roy. Soc. of S.Afr., Vol.XX, Part 2, 1932, p.175, fig.13, F). Length 38.0-41.0 μm ; breadth 11.0-14.0 μm (with processes 72.0-108.0 μm); breadth of isthmus 8.0-9.0 μm (Claassen 1961).

- VAR. **SIMPLEX** FRITSCH ET RICH

Illustrations. Fig. nostr.23, B (Fritsch, Rich 1938).

Sample. RSA: 199, 202, 204, 205, 205 (common).

Note. Differt a typo cellulis brevioribus, apice in media parte elevato subdeplanato, membrana semicellulae supra isthmum laevi, parte basali semicellulae latiore. Long. cell., 25.0-29.0 μm ; lat. cum proc., 80.0-110.0 μm ; isthm., 10.0 μm ; crass., 14.0 μm .

The body of the cell is more like that of var. *cornutum* Wille than that of the type as figured by Nordstedt (1887, fig.57), since it is proportionately broader and shorter; moreover, it is devoid of the characteristic markings above the isthmus which are found both in the type and in var. *cornutum*. The biradiate end-view closely resembles that of the form above described, but in front-view the long arms are seen to be not so gracefully curved. The teeth of the upper margin of the processes are more markedly developed than on the lower. The apex of the semicell is distinctly elevated and flattened, with two short subapical spines inserted one on each side, as in var. *cornutum*.

In the shape of the apex there is a resemblance to *S. americanum* (W. et G.S. West) G.M. Smith (Fritsch, Rich 1938).

537. STAURASTRUM LEPTODERMUM LUND.

- VAR. **IKAPOAE** W. ET G.S. WEST

Illustrations. Fig.12, D-F (Rich 1932).

Sample. RSA: 192.

Note. *Forma minor* (Fig.12, D-F). Some individuals resembled Lütkenmüller's *forma minor* of *St. leptodermum* (Desmidiaceen aus den Ningpo Mountains in Central China, 1900, figs.30, 31) in shape but were much smaller. The end-view showed the slight bulge in the middle of each side which is present in var. *ikapoae* and not in the type; I can, therefore, only consider it a form of this variety. Long., 20.0-26.0 μm ; lat. cum spin., 20.0-30.0 μm ; ist., 10.0-11.0 μm (Rich 1932).

- VAR. **SUBCORNICULATUM** RICH

Illustrations. Fig.12, A-C (Rich 1932).

Sample. RSA: 192 (rather rare).

Note. *S. mediocre*, tam long. quam lat., paullo constrictum, sinu aperto subrectangulari: semicellulis late subcuneatis, e basi lata gradatim dilatatis, lateribus leviter convexis, apice levissime convexo, angulis superioribus divergentibus obtusis, spino brevi munitis. A vertice visis triangularibus, lateribus paene rectis. Membrana aequaliter punctata. Long. cell. Sine protub., 39.0-44.0 μm ; c. protub., 43.0-48.0 μm ; lat., 37.0-44.0 μm ; lat. ist., 18.0-20.0 μm ; long. spin. ca., 3.0 μm .

It is difficult to know whether to refer this variety to *St. leptodermum* or *St. corniculatum* as it shows resemblances to both. It differs slightly from the figures of any described form or variety of *St. corniculatum* Lund. though agreeing somewhat with the description of var. *spinigerum* West; it differs from the latter in its punctate wall, its dimensions, and in being more deeply constricted. It is very near *St. leptodermum* var. *ikapoeae* (Schmidle) W. et G.S. West, but, again, its walls are punctate and it is more deeply constricted; its upper angles, further, are more definitely produced. It recalls *St. unguiferum* Turner, but that has the processes directed upwards and inwards instead of outwards as in the present instance. On the whole it seems best to consider it a new variety of *St. leptodermum* (Rich 1932).

538. STAURASTRUM LIBELTHI RACIB.

- F. MAJOR BOURRELLY 1957, P.1085, PL.14

Illustrations. Pl.27, Fig.3 (Williamson 1994).

Sample. RSA: 375.

Note. Length 54.0 μm (+processes); 35.0 μm (-processes); breadth 54.0 μm (+processes); isthmus 17.5 μm . *Staurastrum tohopekaligense* var. *robustum* Scott et Prescott (1961) seems very similar and in the author's view should be considered synonymous with the above (Williamson 1994).

539. STAURASTRUM LONGIRADIATUM W. ET G.S. WEST

- VAR. **ELEVATUM** FRITSCH ET RICH

Illustrations. Fig.23, C (Fritsch, Rich 1938).

Sample. RSA: 198, 199.

Note. Differt a typo brachiis longioribus, horizontalibus vel leviter divergentibus, apice semicellulae elevato deplanato vel truncato. Long. cell., 24.0-28.0 μm ; lat., 76.0-93.0 μm ; isthm., 7.0-8.0 μm . This variety resembles var. *subnudum* G.S. West ("The Algae of the Yan Yean Reservoir", Journ. Linn. Soc. (Bot.), xxxix, p.1, 1909, p.73, Pl.VI, fig.23) in the features presented by the basal parts of the semicells, but the processes are proportionately longer, and the apex of the semicell distinctly elevated, the raised portion being flattened and almost truncate. The end-view is biradiate (Fritsch, Rich 1938).

540. STAURASTRUM LUNATUM RALFS

- FACIES 2 VAR. **LUNATUM**

Illustrations. Pl.4, 3 (Williamson 2000).

Sample. RSA: 386-388.

Note. A modest population of this has been found at the same site on three occasions. The cells are biradiate with an acute widely-open sinus, the cell wall is ornamented with minute rounded-conical granules arranged in radial rows

around the angles from which a minute mucro protrudes horizontally, never upwards.

Dimensions: length 38.5-44.0 μm ; breadth+mucro 37.8-46.7 μm ; isthmus 11.0-13.0 μm ; thickness 21.0-22.0 μm , length/breadth c. 1.0, sometimes slightly broader than long.

A biradiate variety of *St. lunatum* was described as var. *ovale* by Grönblad (1942), and this is certainly close to these specimens although the granulation is not as fine and the dimensions are less.

In front view the cells also resemble *St. acutum* Bréb. although again the dimensions are less and the granulation is different. Another taxon with which it should be compared is *St. lunatum* var. *planctonicum* W. et G.S. West (Williamson 2000).

In (Williamson 2000) indicated as: (?) *Staurastrum lunatum* Ralfs fac. 2 var. *lunatum*.

- FACIES **BIRADIATUM** WILLIAMSON

Illustrations. Pl.26, Fig.2 (Williamson 1994).

Sample. RSA: 336.

Note. Length 38.5-44.0 μm ; breadth 37.8-46.7 μm ; isthmus 11.0-13.0 μm ; thickness 20.0-21.0 μm ; ratio of length to breadth ca. 1.0 or slightly broader than long.

A constant population of this desmid has been present on wet rocks near Inchanga (sample **336**) from January 1987 to September 1991. At the lateral angles of the semicells there is usually a small mucro although this can be absent on some cells. The apices are either slightly retuse, perhaps depending on the exact alignment of the cell in the microscope's optical axis. In front view the semicells have curved rows of pores arranged around the lateral angles, whilst in vertical view the pores in the centre of the apices are often missing or at least are much sparser. In side view the semicells are globose. Biradiate forms of this desmid have been previously described and illustrated by Grönblad (1942) as the var. *ovale* but in accordance with Teiling's recognition of variability in the radiation of *Staurastrum* species in particular, the name of this desmid should be changed to facies *biradiatum* (Williamson 1994).

541. STAURASTRUM MANFELDTII DELP.

- VAR. **MANFELDTII**

Illustrations. Fig.125 (Grönblad, Croasdale 1971).

Sample. RSA: 192 (rather rare). – **NAM: 304.**

Note. Long., 40.0-45.0 μm ; lat. cum proc., 56.0-90.0 μm ; ist., 10.0-11.0 μm . This species closely resembles *St. sebaldi* Reinsch var. *ornatum* Nordst. but has not such a convex apex and is smaller. The individuals here noticed showed the irregularity in the apical verrucae which was originally described for the Italian specimens but, according to West and al. 1923 (p.115), was not observable in the British specimens (Rich 1932).

Long., 38 μm ; lat. with processes, 60 μm ; isthm., 9 μm . R. Grönblad figure is not very complete, and he did not attempt to name this plant, but the combination of the body walls of the semicell being parallel in the lower portion, with a cluster of granules below each process, and the processes being relatively short, horizontal and strongly ornamented points to this species (Grönblad, Croasdale 1971).

- VAR. **AFRICANUM** HODGETTS

Illustrations. Fig. 14, C, D (Hodgetts 1926).

Sample. RSA: 112 (very rare), **113** (very rare), **115** (very rare), **116** (very rare).

Note. *Var minor quam forma typica, processibus brevioribus; semicellulis annulo granulorum circa basin praeditis. Long. cell., 33.0-33.5 µm; lat. cum proc., 36.0-38.0 µm; lat. isthm., 8.6 µm.*

The front view of this variety (Fig.14, C) much resembles the type, but has shorter processes, and there is a ring of granules round the somewhat swollen base of each semicell. It can be compared with the var. *annulatum* W. et G.S. West ("Alg. N. Ireland," Trans. Roy. Irish Acad., xxxii, sec.B, pt.1, 1902, p.56, t.1, figs.30, 31), which, however, has a double ring of granules round the base of the semicells, and also has longer processes. The present variety is also much smaller than either the type or the var. *annulatum* (Hodgetts 1926).

- VAR. ANNULATUM W. ET G.S. WEST

Illustrations.

Sample. RSA: 192.

Note. Long., 42.0-43.0 µm; lat. cum proc., 60.0-70.0 µm; ist. ca., 9.0 µm (Rich 1932).

542. STAUSTRUM MARGARITACEUM EHRENBERG

Illustrations. Pl.VI, figs. 13, 14 (Reinsch 1878).

Sample. RSA: 4.

Note. Longit. 0.0278 mm, latit. 0.0393 mm. Anguli in cornulis producti sicut in speciminibus Europaeis, furcati aculeolati; in dimensionibus cum speciminibus trionis Erlangensibus maxime consentiunt (Reinsch 1878).

543. STAUSTRUM MATTIEI CLAASSEN

Illustrations. Tab.31, figs.25-27 (Claassen 1961).

Samples. RSA: 258.

Note. Nulla affinitate notata. Cellulae parva, aliquanto latiores quam longiores, sinu foras aperto, membrana spinulis praecipue in angulis apicalibus praedita, semicellula e vertice visa lateribus concavis triangulata.

Cells small, slightly shorter than broad, deeply constricted, sinus open. Vertical view of semicell triangular, sides concave. Cell wall furnished with short spines, mainly on the apical angles. Length 17.5-26.0 µm; breadth 19.5-28.0 µm; breadth of isthmus 6.0-14.0 µm; length of spines 3.0-4.0 µm (Claassen 1961).

544. STAUSTRUM MESIANUM CLAASSEN

Illustrations. Tab.31, figs.3, 4 (Claassen 1961).

Samples. RSA: 284.

Note. Cum sp. *St. sungemmulato* W. et G.S. West congruit quod semicellulis sena brachia sunt, quae tamen glabra sunt, spinula utrimque ad basin tantum praedita.

Near *St. subgemmulatum* W. et G.S. West (West, West 1985, Pl.8, dig.34) in that each semicell contains six arms, but the arms are smooth and furnished with a small spine on each side at the base. Cells moderately constricted, sinus open; semicells with six gradually attenuated arms, with four small spines at the apex of each arm. Cell wall smooth. Each chloroplast with one pyrenoid. Length 28.0-29.0 µm; breadth 20.0-21.0 µm (with arms 43.0-44.0 µm); breadth of isthmus 10.0-12.0 µm. Named after the late Prof. Dr. M.G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria (Claassen 1961).

545. STAUSTRUM MOGOLENSE CHOLNOKY

Illustrations. Fig.45 (Cholnoky 1954b).

Samples. RSA: 214.

Note. Semicells are trapeziformis, the smaller side is formed by the isthmus. The side lines are slightly curved outward, the crest line arched. In end-view cells are triangular, with a long spines on the ends of the semicells, in side-view turned back towards the isthmus. The cell wall smooth. Length 19.0 μm , width - without thorns 18.0 μm , isthmus 3.0 μm , length of the spine 3.0-5.0 μm (Cholnoky 1954b).

546. STAUSTRUM MUCRONATUM RALFS

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

547. STAUSTRUM MURICATUM (BRÉB.) RALFS

Illustrations. Pl.26, Fig.1 (Williamson 1994).

Sample. RSA: 336, 367.

Note. Length 42.0-29.0 μm ; breadth 33.6-37.8 μm ; isthmus 13.5-17.0 μm ; ratio of length to breadth 1.25-1.3 (Williamson 1994).

548. STAUSTRUM MUTICUM BRÉB.

- F. MINOR RABENH. (SYN.: *STAUSTRUM MUTICUM* BRÉB. VAR. *DEPRESSUM* NORDST.)

Illustrations. Fig.24, A, B (Fritsch, Rich 1938).

Sample. RSA: 199, 200, 329.

Note. Long., 19.5 μm ; lat., 18.2 μm (Huber-Pestalozzi 1930).

Long. cell., 19.0-21.0 μm ; lat., 24.0-30.0 μm ; isthm., 4.0-5.0 μm . The form here figured has more markedly depressed semicells than any that have hitherto been recorded. Note the proportion of width to length (Fritsch, Rich 1938).

549. STAUSTRUM OKAVANGICUM COESEL ET VAN GEEST

Illustrations. Figs.38-40 (Coesel, van Geest 2009).

Sample. See end of the note to this species.

Note. Cells slightly longer than broad, deeply constricted. Sinus narrowly open at the apex, abruptly widening to the extremity. Semicells in frontal view cup-shaped with convex apex, the subapical angles produced with short, upwardly directed processes. Processes at the apex broadly rounded to truncate and furnished with 1-3 minute spines. Cell wall otherwise smooth. Semicells in apical view triradiate with slightly convex sides, the angles produced into capitate processes. Cell length 26.0-30.0 μm , cell breadth 24.0-26.0 μm , breadth of isthmus 8.0-10.0 μm . *Type:* our Fig.39. *Type locality:* water course near Chief's Island (sample **400**), P.F.M. Coesel, 3 October 2006, plankton collection # 2006.42 in the Amsterdam University herbarium.

In frontal view the above-described alga resembles some of the forms described by Scott, Grönblad (1957) from the southeastern United States under the name of *Staurastrum subpygmaeum* var. *spiniferum*. However, in apical view there is a big difference: the angles in our newly described *S. okavangicum* being distinctly capitate versus attenuate in *S. subpygmaeum* var. *spiniferum*. The minute spines on each of the processes, in number ranging from three to one and incidentally even completely reduced, are located in a linear series on the dorsal side. As far as could be traced, *S. okavangicum* has not been found before. In the Okavango Delta it was encountered in some samples from Chief's Island

(**BOT: 400-411**) and Moremi (**BOT: 412-418**), particularly in sample **400** (Coesel, van Geest 2009).

550. STAURASTRUM ORBICULARE RALFS

- VAR. **DEPRESSUM** ROY ET BISS.

Illustrations. Pl.25, Fig.6 (Williamson 1994).

Sample. RSA: 112 (common, and with zygospores), **113, 299, 328, 350.** –
NAM: 307.

Note. *Long. cell.*, 27.0-29.0 μm ; *lat.*, 26.0-27.0 μm ; *lat. isthm.*, 7.5-8.0 μm .
Diam. zygosp. cum spin., 38.4-40.0 μm ; *diam. zygosp. sine spin.*, 28.9-29.0 μm ,
long. spin., 4.0-6.0 μm .

The form of the cell was exactly as figured by W. and G.S. West (West, West 1912, p.158, t.124, figs.17-19), but the cell-wall was either smooth or obscurely punctate. The zygospores were globose, with numerous acute spines. According to Messrs. West, the zygospore of the var. *depressum* has not previously been recorded, but no figure of it is given here since it exactly resembled that of the var. *ralfsii* (West, West 1912, p.156, t.124, fig.16); while the var. *extensum*, according to Messrs. West, also has a similar form of zygospore (Hodgetts 1926).

Long. cell., 24.0 μm ; *lat.*, 24.0-27.0 μm ; *isthm.*, 7.0 μm (Rich 1940).

Length 32.8-35.0 μm ; breadth 29.5-31.0 μm ; isthmus 8.0-9.0 μm ; ratio of length to breadth 1.1.

A zygospore in this sample (**350**) was globular with long spines and a covering of mucilage. Breadth 35.0 μm (+ spines) (Williamson 1994).

In (Williamson 1994) indicated as *Staurastrum orbiculare* (Ehr.) Ralfs var. *depressum* Roy et Biss.

- VAR. **HIBERNICUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

- VAR. **RALFSII** W. ET G.S. WEST

Illustrations. Tab.30, figs.14, 15 (Claassen 1961).

Samples. RSA: 285.

Note. Cells slightly smaller than in the typical form. Length 26 μm ; breadth 21 μm ; breadth of isthmus 7.5-8.0 μm (Claassen 1961).

- VAR. **WATERBERGENSE** CLAASSEN

Illustrations. Tab.31, figs.5, 6 (Claassen 1961).

Samples. RSA: 278, 280, 283.

Note. *Affinis St. orbiculari* var. *hibernico* W. et G.S. West, *sed lateralibus, a vertice visis, concavis differt.*

Near var. *hibernicum* W. et G.S. West (West, West 1912, p.156, Pl.CXXIV, figs.5-9); but differs in that the sides are concave in vertical view. Length 31.0-33.0 μm ; breadth 28.0-30.0 μm ; breadth of isthmus 7.5-9.0 μm (Claassen 1961).

551. STAURASTRUM PARADOXUM MEYEN

- VAR. **PARADOXUM**

Illustrations. Fig.46 (Cholnoky 1954b).

Samples. RSA: 168 (rare), **179** (only 1-3 specimens were observed), **180** (rare), **188, 190, 207, 211, 212.**

Note. *Long. cell.*, 20.0-25.0 μm ; *lat. c. proc.*, 31.0-35.0 μm ; *ist.*, 7.0-8.0 μm (Fritsch, Rich 1930).

In the Potchefstroom Dam sample the sides of the individuals in vertical view were slightly convex as in var. *evolutum* W. et G.S. West, but the present

form is larger, its dimensions agreeing with those of the type. Long., 22.0 μm ; lat. cum proc., 40.0-42.0 μm ; ist., 6.0 μm .

Also present in this sample are forms closely resembling those of var. *longipes* Nordst. (Borge, Schwedisches Süßwassersplakton, 1900, Bot. Notizer, Tab.1, fig.4) (Rich 1932).

Yielded small increases in numbers during December 1927, April to May 1928, December 1928 and May 1929, and was found to be very rare at other times.

1927: July 23, July 30, August 6, August 13, August 20, August 27, September 3, September 10 (temp. 15.5°C, pH=6.8), September 17 (200 cells per 1 c.c., temp. 16.5°C, pH=7), September 24 (200 cells per c.c., temp. 16.2°C, pH=6.2), September 30 (400 cells per c.c., temp. 18.8°C, pH=6.5), October 8 (400 cells per 1 c.c., temp. 17°C, pH=6.4), October 15 (300 cells per 1 c.c., temp. 16°C, pH=6.5), October 22 (temp. 15°C, pH=6.6), October 29 (temp. 16.8°C, pH=6.4), November 5 (temp. 21.5°C, pH=6.3), November 12 (temp. 21°C, pH=6.5), November 19 (200 cells per 1 c.c., temp. 18.5°C, pH=6.4), November 26 (300 cells per 1 c.c., temp. 20.5°C, pH=6.3), December 2 (1600 cells per 1 c.c., temp. 22°C, pH=6.3), December 10 (800 cells per 1 c.c., temp. 21°C, pH=6.3), December 17 (400 cells per 1 c.c., temp. 22°C, pH=6.4), December 24 (200 cells per 1 c.c., temp. 21°C, pH=6.4), December 31 (100 cells per 1 c.c., temp. 22°C, pH=6.5); **1928:** January 7 (temp. 21°C, pH=6.5), January 14 (temp. 20°C, pH=6.2), January 21 (temp. 22°C, pH=6.3), January 28 (temp. 22.5°C, pH=6.4), February 4 (temp. 20°C, pH=6.2), February 11 (temp. 20°C, pH=6.), February 18 (temp. 21.5°C, pH=6.62), February 24 (temp. 21°C, pH=6.7, chloride normality=0.0003, diss. O₂ mgrms./litre=7.5, SO₄ mgrms./litre=60), March 3 (temp. 22.5°C, pH=6.79, chloride normality=0.00025, diss. O₂ mgrms./litre=5.2, SO₄ mgrms./litre=30), March 10 (temp. 21°C, pH=6.79, diss. O₂ mgrms./litre=6.3), March 17 (200 cells per 1 c.c., temp. 20°C, pH=6.86, diss. O₂ mgrms./litre=3.98), March 24 (100 cells per 1 c.c., temp. 20°C, pH=7, diss. O₂ mgrms./litre=5.47), March 31 (100 cells per 1 c.c., temp. 19°C, pH=7, diss. O₂ mgrms./litre=5.01), April 6 (200 cells per 1 c.c., temp. 19.5°C, pH=6.8), April 14 (800 cells per 1 c.c., temp. 19°C, pH=6.86), April 21 (500 cells per 1 c.c., temp. 17°C, pH=6.86), April 28 (400 cells per 1 c.c., temp. 16°C, pH=6.89), May 4 (400 cells per 1 c.c., temp. 16°C, pH=6.89), May 12 (200 cells per 1 c.c., temp. 15°C, pH=6.89), May 20 (100 cells per 1 c.c., temp. 15°C, pH=6.79), May 24 (100 cells per 1 c.c., temp. 14°C, pH=6.79), June 2 (100 cells per 1 c.c., temp. 11.5°C, pH=6.79, chloride normality=0.0003, alk. res. Normality=0.0006, NO₂ mgrms./litre=0.03, NO₃ mgrms./litre=1, P₂O₅ mgrms./litre=0.01, SO₄ mgrms./litre=50, Fe mgrms./litre=3, Mg mgrms./litre=5), June 9 (100 cells per 1 c.c., temp. 11.5°C, pH=6.9), June 16 (old net - 100 cells per 1 c.c., temp. 11°C, pH=6.62; new net - absent), July 26 (400 cells per 1 c.c., temp. 9°C, pH=6.89), August 4 (500 cells per 1 c.c., temp. 9°C, pH=6.89), August 18 (300 cells per 1 c.c., temp. 11°C, pH=7), September 1 (100 cells per 1 c.c., temp. 13°C, pH=7), September 15 (100 cells per 1 c.c., temp. 14°C, pH=6.89), October 6 (200 cells per 1 c.c., temp. 16°C, pH=6.89), November 3 (100 cells per 1 c.c., temp. 19°C, pH=7), December 19 (600 cells per 1 c.c., temp. 22°C, pH=6.89); **1929:** February 2 (new net - 100 cells per 1 c.c., temp. 21°C, pH=6.89), April 6 (500 cells per 1 c.c., temp. 18.5°C, pH=7), May 18 (800 cells per 1 c.c., temp. 14°C, pH=6.89), June (200 cells per 1 c.c., temp. 10°C, pH=6.7) (Schuurman 1932).

This rarely seen species shown from end-view on Fig.46 (Cholnoky 1954b).

North-West Province (orig.).

- VAR. **EVOLUTUM** W. ET G.S. WEST (SYN.: *STAUSTRUM TETRACERUM* (KÜTZ.) RALFS
VAR. *EVOLUTUM* W. ET G.S. WEST)

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 199, 200, 201, 202, 204.

Note. Long. cell., 10.0 μm ; lat. cum proc., 32.0-35.0 μm ; sine proc., circa 8.0 μm ; isthm., 4.0-5.0 μm .

The individuals agreed in dimensions with those found by the Wests in the Orkneys. The cells were usually twisted so that the processes of one semicell alternated with those of the other. In end-view the long slender arms were often curved (Fritsch, Rich 1938).

- VAR. **PARVUM** WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 202.

Note. Long. cell., 13.0 μm ; lat. cum proc., 28.0 μm ; isthm., 5.0-6.0 μm . There were also present a number of forms intermediate between this variety and the type (Fritsch, Rich 1938).

552. *STAUSTRUM POLYMORPHUM* BRÉB.

- VAR. **POLYMORPHUM**

Illustrations. Figs.127, 128 (Grönblad, Croasdale 1971).

Samples. RSA: 299. – NAM: 304, 307.

Note. Long. cell., 23.0 μm ; lat., 22.0-24.0 μm ; isthm., 7.0-8.0 μm . Processes short and stout, slightly incurved, tipped with three spines, and provided with three series of minute denticulations. A small and very variable species, with an almost world-wide distribution (Rich 1940).

Long., 24.0-26.0 μm ; lat. with processes, 27.0-36.0 μm ; isthm., 9.0-10.0 μm . R. Grönblad suggested for one plant (Fig.127) "*S. asterias* Nygaard" (1926, p.232, 6: 62), from which it differs, however, in lack of the characteristic verrucae at the origin of the processes, in the presence of spines at ends of the processes, and in the smaller size. He also said "cf. *S. hexacerum* (Ehrenb.) Wittr. f. *pentagona* Krieger (1932, p.201, 16: 18)" from which it differs in the face view which in our plant shows some slight differentiation into body and processes. For the plant figured in Fig.128 he suggested "*S. margaritaceum* (Ehrenb.) Menegh.?", but H. Croasdale believes that our plant does not belong here because of its greater relative breadth (Grönblad, Croasdale 1971).

- VAR. **CINCTUM** MESSIKOMMER

Illustrations. Figs.129, 130 (Grönblad, Croasdale 1971).

Samples. NAM: 305, 307.

Note. Long., 29.0-31.0 μm ; lat. with processes, 36.0-42.0 μm ; isthm., 10.0-11.0 μm ; 6.0-7.0 angular in vertical view. For the plant shown in Fig.130 R. Grönblad suggested "*S. asterias* Nygaard ex Krieger (1932, p.193)" and he added "cf. also *S. subgemmaulatum* W. et G.S. West 1895, p.76". For the plant shown in Fig.129 he suggested "*S. asterias* Nygaard (1926, p.232)". H. Croasdale believes that these plants are not *S. asterias* because they lack the diagnostic features of the verrucae at the origin of the processes and the lack of terminal spines. Also our plants show a supraisthmial circle of granules, not present in Nygaard's plant. From *S. subgemmaulatum* our plant differs also in the spinose ends of the processes and in the presence of a circle of granules above the isthmus. In appearance it is closest to Messikommer's fig. (1963, p.67, 2: 39) but it is somewhat larger, with more processes (Grönblad, Croasdale 1971).

- VAR. **MUNITUM** W. WEST

Illustrations. Fig.21, *F, G* (Fritsch, Rich 1930), Fig. nostr.11, *D, E* (Rich 1932).

Samples. RSA: 168 (rare), **192** (rare).

Note. *Forma minor*, lateribus e vertice visis interdum paullo concavis. Long. cell., 22.0-24.0 μm ; lat. c. proc., 24.0-26.0 μm ; ist., 8.0 μm .

Our specimens differed in the fact that the end-view often possessed slightly concave sides and that the clear area in the middle of the end-view was not so marked, owing to the series of denticulation around the angles extending further towards the centre, without being more numerous. The same feature was also recognizable in the front view (Fig.21, *F*), in which the apex was either quite flat or even slightly convex (Fritsch, Rich 1930).

Forma minor Fritsch and Rich (Contributions to our Knowledge of the Freshwater Algae of Africa. 7. Freshwater Algae (exclusive of Diatoms) from Griqualand West. *Trans. Roy. Soc. S. Africa*, 1930, **18**, Pt.1, fig.21, *F, G*). In these individuals two bifurcate spines just below the apex were noticeable; they had probably been overlooked in the specimens from Griqualand West where this form first described. Long., 22.0-24.0 μm ; lat. cum proc., 34.0 μm ; ist., 4.0-6.0 μm (Rich 1932).

553. STAUSTRUM PSEUDOGEMMULATUM CLAASSEN

- VAR. PSEUDOGEMMULATUM

Illustrations. Tab.31, figs.9, 10 (Claassen 1961).

Samples. RSA: 253.

Note. *Affinis St. subgemma* W. et G.S. West, sed differt et brachiis leviter incurvatis et quod semicellulis a vertice visis binae sunt granulorum series, quae circuli modo dispositae ternis consistunt granulis. Circulo interiori sex euismodi sunt series, exteriori tamen duodecim.

This differs from *St. subgemma* W. et G.S. West (West, West 1985, Pl.8, fig.34) in having slightly incurved arms and in the cell wall sculpture. Cells small, about 1.6-1.7 times longer than broad, sinus open; semicells with six arms, apex of each arm emarginate. Cell wall, in vertical view of semicell, with two circular series of granules arranged in groves of three granules each, inner circle consists of six groves and outer circle contains 12 groups; and with three circles of granules around each arm. Each chloroplast contains a central pyrenoid. Length 29.0-32.0 μm ; breadth 17.0-19.0 μm (with arms 33.0-34.0 μm); breadth of isthmus 10.0-11.0 μm (Claassen 1961).

- VAR. WARMBADIANUM CLAASSEN

Illustrations. Tab.31, figs.11-13 (Claassen 1961).

Samples. RSA: 276.

Note. *Affinis St. pseudogemma* Claassen, sed brachiis quam prioris varietatis longioribus tenuioribusque differt, quae a vertice visa 4 granula singulis in seriebus ad interiorem circumulum habent.

Arms longer and narrower than in *St. pseudogemma* Claassen; cell wall with the inner series of granules consisting of four granules per group. Length 28.5-32.0 μm ; breadth 16.0-17.0 μm (with arms 34.0-37.0 μm); breadth of isthmus 7.5-9.0 μm (Claassen 1961).

554. STAUSTRUM PSEUDONEGLECTUM A.M. SCOTT ET GRÖNBLAD

Illustrations. Fig.37 (Coesel, van Geest 2009).

Samples. BOT: 400 (incidentally), **402** (incidentally).

Note. As its name already indicates, *Staurostrum pseudoneglectum* described by Scott, Grönblad (1957) as a biradiate species from the southeastern United States much resembles *S. neglectum* described by West (1909) as a triradiate species from southern Australia. We think the presence (in *S. pseudoneglectum*) or absence (in *S. neglectum*) of cell wall sculpturing on the semicell body a more relevant discriminating characteristic than the degree of radiation. Therefore, *S. neglectum* as pictured in Scott, Grönblad (1957: pl. 27/13) probably is a mere triradiate form of their newly described *S. pseudoneglectum*.

Obviously, *S. pseudoneglectum* (like *S. neglectum*) is a rare species, being only known from southern North America (Scott, Grönblad 1957, Förster 1972), Argentina (Tell 1980) and Madagascar (Bourrelly, Couté 1991) (Coesel, van Geest 2009).

555. STAURASTRUM PSEUDOTETRACERUM (NORDST.) W. ET G.S. WEST

Illustrations. Figs.123, 124 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long. without processes, 17.0-19.0 μm ; lat. without processes, 16.0-17.0 μm ; with processes, 23.0-28.0 μm ; isthm., 8.0 μm (Grönblad, Croasdale 1971).

556. STAURASTRUM PTEROSPORUM LUND.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 203.

Note. Long. cell., 11.0-12.0 μm ; lat. sine spin., 12.0-16.0 μm ; isthm., 5.0 μm ; spin., circa 5.0 μm (Fritsch, Rich 1938).

557. STAURASTRUM PUNCTULATUM BRÉB.

- VAR. PUNCTULATUM

- F. PUNCTULATUM

Illustrations. Fig.47 (Cholnoky 1954b).

Samples. RSA: 24 (rather common), **125, 126, 211, 212, 327, 329.**

Note. Long., 33.0 μm ; lat., 26.0 μm ; lat. isthm., 12.0 μm . All individuals triangular in end-view (Fritsch 1918).

Long. cell., 25.6-33.0 μm ; lat., 22.0-27.0 μm ; lat. isthm., 11.2-12.0 μm (Hodgetts 1926).

Long., 26.0 μm ; lat., 23.4 μm (Huber-Pestalozzi 1930).

Observed specimen were slightly different from the typical form (Cholnoky 1954b).

- F. MINUS W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 237.

- VAR. KJELLMANI WILLE

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 385.

- VAR. PYGMAEUM (BRÉB. IN RALFS) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 384.

558. STAURASTRUM PYGMAEUM BRÉB.

- VAR. BOTESHII CLAASSEN

Illustrations. Tab.31, figs.28, 29 (Claassen 1961).

Samples. RSA: 258.

Note. *Affinis* var. *apiculato* W. et G.S. West, *sed angulis apicalibus spinalis munitis, ceteroquin omnino glabra differt.*

This differs from var. *apiculatum* W. et G.S. West (West, West 1985, Pl.8, fig.26) in the cell wall being smooth except for the apical angles, which contains a few spines. Cells small, about as long as broad, deeply constricted, sinus open; semicells with three spines on the apical angles and a circle of spines near the angles. Vertical view triangular. Length 26.0-28.0 μm ; breadth 25.5-26.0 μm ; breadth of isthmus 8.5-10.0 μm . Named after Mr. P.W. Botes of Moddernek, Nylstroom (Claassen 1961).

559. STAUSTRUM QUADRANGULARE BRÉB.

- VAR. **CONTECTUM** (TURN.) GRÖNBLAD 1945, P.29, 12: 255)

Illustrations. Fig.120 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 22.0 μm ; lat. without spines, 22.0 μm ; with spines, 30.0 μm ; isthm., 8.0 μm . Our plant seems closest to *S. quadrangulare* var. *armatum* W. et G.S. West (1896b, p.257, 16: 18) which Thomasson (1963, p.118) fittingly suggests should be included in this variety (Grönblad, Croasdale 1971).

- VAR. **SUBARMATUM** CLAASSEN

Illustrations. Tab.29, fig.18 (Claassen 1961).

Samples. RSA: 292, 295.

Note. *Affinis* *St. quadrangulari* var. *armato* W. et G.S. West, *sed sinu latiore, spinulis ;ongioribus, et cellulis multo maioribus differt; semicellulae e vertice visae triangulatae.*

This differs from var. *armatum* W. et G.S. West (W. and G.S. West, North American Desmidiaceae, Trans Linn Soc. London, Ser2, Bot., Vol.V, 18951901, Pl.16, fig.18) in having a broader sinus, longer spines and considerably larger cells; semicells triangular in vertical view. Fig.18 shows the cell in front view; it was impossible to keep the cell in vertical position in order to illustrate it. Length 32.0 μm ; breadth 41.0-43.0 μm (with spines 48.0-50.0 μm); breadth of isthmus 14.0-14.5 μm (Claassen 1961).

560. STAUSTRUM QUADRICORNUTUM ROY ET BISS.

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 301, 306, 307.

561. STAUSTRUM RECTANGULARE BORGE

Illustrations. Fig.24, *H, I* (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 201.

Note. *Forma minor.* Long. cell. sine proc., 17.0-18.0 μm ; lat. cum proc., 20.0-24.0 μm ; isthm., 4.0-5.0 μm .

The differs from Borge's form essentially in its smaller dimensions, particularly in the narrower isthmus. The apex of the semicell is slightly convex. The short stout processes bear 4 series of denticulations and have a truncate apex bearing minute spines. The end-view is triangular with concave sides. Borge's species does not appear to have been recorded since its discovery in Australia. It seems probable that this species was present also in the samples from Old N'gamo (S. Rhodesia), though recorded under the rather similar *S. pseudotetracerum* (Nordst.) W. et G.S. West (Fritsch, Rich 1938).

562. STAUSTRUM RENARDII REINSCH

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 306.

563. STAUSTRUM ROTULA NORDST.

Illustrations. Fig.24, *F, G* (Fritsch, Rich 1938).

Samples. RSA: 202, 203, 204, 205.

Note. *Forma paullo minor, granulis apicalibus majoribus.* Long. cell., 33.0 μm ; lat. cum proc., 57.0-73.0 μm ; isthm., 8.0 μm .

The rather small individuals were from seven- to nine- (usually eight-) radiate in end-view, the processes being generally provided with 3 (sometimes 4) series of teeth, the terminating in 3 series. The apical granules were larger than in the type and obtusely conical in shape (*cf.* Taylor 1935a, Pl.XXXVII, fig.8).

S. rotula bears a close resemblance to *S. sagittarium* Nordst. (recorded from New Zealand), but differs from it in having fewer denticulations on the arms, and in the presence of the ring of conical papillae near the apex of the semicell. The form here recorded also resembles *S. acanthastrum* W. et G.S. West, recorded from Ceylon, in which, however, the body of the semicell is proportionately smaller. It may be doubted whether *S. acanthastrum* should be regarded as more than variety of a *S. rotula* (Fritsch, Rich 1938).

564. STAUSTRUM RUGULOSUM BRÉB.

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 306.

565. STAUSTRUM RZOSKAE GRÖNBLAD ET A.M. SCOTT

Illustrations. Fig.34 (Coesel, van Geest 2009).

Samples. See end of the note to this species.

Note. *Staurastrum rzoscae* is a characteristic, appealing desmid species. In the original species diagnosis (Grönblad and al. 1958) there is mention of six processes per semicell. Our Okavango material showed consistently eight processes per semicell, but otherwise it agreed very well with the original description.

Thus far, typical *S. rzoscae* was only known from Sudan (Grönblad and al. 1958) and Zambia (Thomasson 1960). The record by Lind (1971) from Uganda rather refers to the closely allied *S. spiculiferum* var. *africanum* than to *S. rzoscae*. In the Okavango Delta, *S. rzoscae* was only found on the sites of Moremi (**BOT: 412-418**) and Mohango (**NAM: 419, 420**), particularly in sample **415** where it was of occasional occurrence (Coesel, van Geest 2009).

566. STAUSTRUM SCHUURMANI RICH

Illustrations. Fig.14, *H, I* (Rich 1932).

Samples. RSA: 188 (November, April, May), **207.**

Note. *Cellulis parvis, profunde constrictis, sinu obtusangulo aperto, isthmo angusto; semicellulis observe triangularibus, apice leviter convexo, seriebus duabus verrucarum emarginatum intra apicem praeditis, processibus elongatis divergentibus gracilibus granulis transverse dispositis et spinis 2 vel 3 modice elongatis in apicem munitis; corpore semicellulae in ambitu delicatae crenulato. A vertice visis anguste ellipticis. Long. sine proc., 17.0-21.0 μm ; lat. cum proc., 50.0-60.0 μm (plerum, 50.0 μm); ist., 3.0-5.0 μm ; crass., 9.0 μm .*

This species somewhat resembles *St. caledonense* G. Huber, but the latter has parallel sides when seen in end-view. It differs from *St. multinodulosum* Grönblad for the same reason and appears to have relatively longer arms. It also resembles certain forms of *St. brachioprominens* Boergesen, which, however, has proportionately broader semicells and is not so deeply constricted. It is something like *St. stephensii*, which is present in the same sample, but its semicells are more elongated (Rich 1932).

None noticed during July and August. During other months the species was recorded to be very rare, excepting for a small maximum registered in December 1927.

2007: September 10 (200 cells per 1 c.c., temp. 15.5°C, pH=6.8), September 17 (400 cells per 1 c.c., temp. 16.5°C, pH=7), September 24 (200 cells per c.c., temp. 16.2°C, pH=6.2), September 30 (400 cells per c.c., temp. 18.8°C, pH=6.5), October 8 (400 cells per 1 c.c., temp. 17°C, pH=6.4), October 15 (200 cells per 1 c.c., temp. 16°C, pH=6.5), October 22 (temp. 15°C, pH=6.6), October 29 (temp. 16.8°C, pH=6.4), November 5 (temp. 21.5°C, pH=6.3), November 12 (temp. 21°C, pH=6.5), November 19 (200 cells per 1 c.c., temp. 18.5°C, pH=6.4), November 26 (500 cells per 1 c.c., temp. 20.5°C, pH=6.3), December 2 (1200 cells per 1 c.c., temp. 22°C, pH=6.3), December 10 (200 cells per 1 c.c., temp. 21°C, pH=6.3), December 17 (200 cells per 1 c.c., temp. 22°C, pH=6.4), December 24 (100 cells per 1 c.c., temp. 21°C, pH=6.4), December 31 (200 cells per 1 c.c., temp. 22°C, pH=6.5); **1928:** January 7 (100 cells per 1 c.c., temp. 21°C, pH=6.5), January 14 (temp. 20°C, pH=6.2), January 21 (temp. 22°C, pH=6.3), January 28 (temp. 22.5°C, pH=6.4), February 4 (temp. 20°C, pH=6.2), February 11 (temp. 20°C, pH=6.), February 18 (temp. 21.5°C, pH=6.62), February 24 (temp. 21°C, pH=6.7, chloride normality=0.0003, diss. O₂ mgrms./litre=7.5, SO₄ mgrms./litre=60), March 3 (temp. 22.5°C, pH=6.79, chloride normality=0.00025, diss. O₂ mgrms./litre=5.2, SO₄ mgrms./litre=30), March 10 (temp. 21°C, pH=6.79, diss. O₂ mgrms./litre=6.3), March 17 (temp. 20°C, pH=6.86, diss. O₂ mgrms./litre=3.98), March 24 (temp. 20°C, pH=7, diss. O₂ mgrms./litre=5.47), March 31 (temp. 19°C, pH=7, diss. O₂ mgrms./litre=5.01), April 6 (temp. 19.5°C, pH=6.8), April 14 (temp. 19°C, pH=6.86), April 21 (temp. 17°C, pH=6.86), April 28 (temp. 16°C, pH=6.89), May 4 (temp. 16°C, pH=6.89), May 12 (temp. 15°C, pH=6.89), May 20 (temp. 15°C, pH=6.79), November 3 (200 cells per 1 c.c., temp. 19°C, pH=7), December 19 (200 cells per 1 c.c., temp. 22°C, pH=6.89); **1929:** February 2 (new net – 400 cells per 1 c.c., temp. 21°C, pH=6.89), April 6 (300 cells per 1 c.c., temp. 18.5°C, pH=7), May 18 (400 cells per 1 c.c., temp. 14°C, pH=6.89), June (200 cells per 1 c.c., temp. 10°C, pH=6.7) (Schuurman 1932).

567. STAUASTRUM SEBALDI REINSCH

- VAR. *ALTUM* (BOLDT) W. ET G.S. WEST (SYN.: *STAUASTRUM PROBOSCIDEUM* ARCH. VAR. *ALTUM* BOLDT)

Illustrations. Fig.19 (Fritsch, Rich 1924).

Samples. RSA: 91 (rather common).

Note. *Forma minor*, semicellulae a vertice visae spinis bicuspidatis intra margines frequentioribus et plus regulariter dispositis, marginibus subconcavis. *Lat. sine spin.*, 44.0-55.0 µm; *lat. c. spin.*, 49.0-60.0 µm; *long.*, 49.0-59.0 µm; *lat. isthm.*, 11.0-12.0 µm.

Our form agreed more closely with that described and figured by Nordstedt (K. Sv. Vet.-Akad. Handl., xxii, No.8, 1888, p.36, Tab.IV, fig.5) than the form of Boldt (Oefvers. Sv. Vet.-Akad. Foerhandl., 1885, No.2, p.117, Tab.VI, fig.34). The

corners of the semicells were little protruded, a fact which was especially evident in the end-view (Fig.19, B), the edges of which were very slightly concave. The markings on the face of the semicell nearest to the isthmus agreed very well with those shown in Nordstedt's fig.5, d, but the distal face bore more numerous and more regularly arranged bicuspid teeth than in the fig.5, b; moreover, they formed in their entirety a more markedly concave group.

There can be no doubt that this and Nordstedt's form diverge somewhat from Boldt's variety and approach nearer to *S. sebaldi* Reinsch. It may be that a further study of these forms will show that they would best be removed from Boldt's var. *altum* and that the letter should remain under *S. proboscideum* Arch., with which is certainly shows some resemblances differentiating it from *S. sebaldi* Reinsch. Unfortunately, Boldt's figure of the front-view is not altogether clear and not quite in agreement with the end-view. This fact, and the rather scanty material we had for investigation, have led us for the present to adopt the current synonymy. The characters of *S. sebaldi* itself are not at all clearly established; cf. for instance the figures given by Migula (Kryptogamenfl., vi, 1907, Pl.XXXVII, E, fig.3), Ducellier (Bull. Soc. Bot. Genève, 1916, p.73, fig.61), and Messrs. West (Trans. Linn. Soc., Bot., v, 1896, p.267, Pl.XVIII, figs.2, 3) (Fritsch, Rich 1924).

- VAR. **ORNATUM** NORDST.

Illustrations. Fig.15 (Rich 1932); Figs.11, 12 (Williamson 1996).

Samples. RSA: 192 (May and July), **381**.

Note. Forma. The present form exhibits the tri-spinate verrucae which are recorded for this variety and some of its forms. Groups of granules (from 5 to 8) above the isthmus recall f. *orientalis* W et G.S. West, but the latter has much shorter arms. The cells were more deeply constricted than is usual, thus making the isthmus smaller. There was a great constancy in the dimensions. Long., 58.0-64.0 μm ; lat., 84.0-100.0 μm ; ist., 11.0-14.0 μm . Var. *ornatum*, as pointed out by West and al. 1923 (p.168), is very similar to *St. manfeldtii*. It is certainly difficult to distinguish the two, but the individuals in Weltevreden West Pan formed two distinct groups which I have separated as above (Rich 1932).

Two specimens were seen. Length 42.0-46.0 μm (between the apices), breadth with processes 80.0-85.0 μm , isthmus 10.0-11.0 μm . The zygospore which has not been previously observed is globular, bearing long processes broad at the base but forked three or four times at the tip (*diameter cum processibus circa 100.0 μm , sine processibus 37.0-40.0 μm*). (Williamson 1996).

568. STAURASTRUM SETIGERUM CLEVE

-VAR. **SETIGERUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 430, 431, 434. - NAM: 307.

- VAR. **PECTINATUM** W. ET G.S. WEST

- F. **AUSTRALE** CLAASSEN

Illustrations. Tab.29, figs. 13, 14 (Claassen 1961).

Sample. RSA: 289.

Note. A var. *pectinato* W. et G.S. West *isthmo multo latiore differt*.

This form differs from var. *pectinatum* (W. and G.S. West, North American Desmidiaceae, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.16, fig.28) in that the isthmus is about 2.2 times broader. Length 33.0 μm (with spines 46.0 μm); breadth 32.0 μm (with spines 48.0 μm); breadth of isthmus 14.0 μm (Claassen 1961).

569. STAURASTRUM SEXCOSTATUM BRÉB. EX RALFS

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 384.

570. STAURASTRUM SPICULIFERUM BORGE

- VAR. AFRICANUM BOURRELLY

Illustrations. Fig.35 (Coesel, van Geest 2009).

Sample. BOT: 409, 410, 415.

Note. *Staurastrum spiculiferum* var. *africanum* differs from the nominate variety as described by Borge (1918) from Brazil by a number of minor features. Main difference is, in var. *africanum*, the lack of any apical ornamentation on the semicell body. Whereas the nominate variety is only known from South America (e.g., Borge 1918, Grönblad 1945, Förster 1964, Scott and al. 1965, Tell 1980, Coesel and al. 1988) var. *africanum* has only been recorded from a number of African countries (Bourrelly 1957, Thomasson 1960, Compère 1977, Bourrelly, Couté 1991). In the Okavango Delta we encountered it in low cell numbers (Coesel, van Geest 2009).

571. STAURASTRUM SPONGIOSUM BRÉB.

Illustrations. Pl.25, Fig.4 (Williamson 1994).

Samples. RSA: 299, 329, 332, 382.

Note. *Forma.* Long. and lat., 33.8 μm ; isthmus, 16.7 μm (Huber-Pestalozzi 1930).

Var. Long. cell. (sine proc.), 34.0 μm ; lat., 34.0 μm ; isthm., circa 16.0 μm . Not nearly so deeply constricted as the type, and probably approaching var. *cumbricum* Bennet, a variety insufficiently described. The numerous verrucae are large enough almost to constitute short processes with emarginate apices. Only a few individuals were seen, and it was not found possible to make a satisfactory drawing. The determination must remain vague (Rich 1940).

Length 39.2 μm (+processes); 35.7 μm (-processes); breadth 34.5 μm ; isthmus 18.8 μm (Williamson 1994). In (Williamson 1994) indicated as *Staurastrum spongiosum* Bréb. ex Ralfs.

572. STAURASTRUM STELLIFERUM BORGE

- VAR. AFRICANUM FRITSCH ET RICH

Illustrations. Fig.25 (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 201.

Note. *Differt a typo brachiis 4 longioribus apice tridenticulato, marginibus lateralibus corporis semicellulae in aspectu frontali undulatis, granulis in parte apicali semicellulae a vertice visae dispositis. Zygosporae globosae, spinis eongatis in apicem cum dentibus recurvatis 2 vel 3 praeditis.* Long. sine proc., 27.0-37.0 μm ; cum proc., 108.0-150.0 μm ; lat. sine proc., 16.0-19.0 μm ; cum proc., 94.0-108.0 μm ; isthm., 13.0-14.0 μm ; diam. zygosp. sine proc., circa 35.0 μm .

The four arms on each semicell appear in the front-view as a pair arising from the apical angles of the semicell, while one arm arises within the apex from each face of the semicell. The smooth arms are longer than in the type, and terminate in 3 slightly curved teeth. In end-view the quadrate body of the semicell shows 3 granules at the base of each arm, and 2, more widely spaced, in the part in between each pair of arms; the angles are flattened and form enlarged bases to

the arms. A characteristic feature is the undulation of the lateral margins of the semicells above the isthmus.

S. stelliferum has hitherto been recorded only from S. America and the zygosporangium has not previously been described. That of the variety here recorded is spherical, and bears symmetrically disposed spines, about half as long as the diameter of the spore, with 2 or 3 recurved teeth at the apex.

A form resembling forma *tetragona* Borge ("Die von Dr. F.C. Hoehne während der Expedition Roosevelt-Rondon gesammelten Süßwasser-algen", Arkiv för Bot., 19, No.17, 1925, p.42, Pl.VI, fig.4), in which 2 or 3 pointed teeth are present at the bases of the arms, was observed in sample **204**. Here too the arms were longer than in the specimens described by Borge (Fritsch, Rich 1938).

573. STAUSTRUM STEPHENSII RICH

Illustrations. Fig.14, E-G (Rich 1932).

Samples. RSA: 188, 207.

Note. *Cellulis parvis, biradiatus, profunde constrictis, sinu aperto; semicellulis obverse triangularibus, cum 4-5 verrucis emarginatis in apicem praeditis; processibus sublongis divergentibus, spinis 2 vel 3 in apicem et seriebus 5-6 denticulorum munitis; supra isthmum cum seriebus transversis granularum 2. Long. sine proc., 16.0-18.0 µm; lat. cum proc., 37.0-41.0 µm; ist., 4.0-5.0 µm.*

This species is very like *St. vestitum* Ralf var. *subanatinum* W. et G.S. West, but it is much smaller, has more divergent processes, and is biradiate. In general form it somewhat resembles *St. volans*, which is present in the same Lake, but it is more ornate than latter. The semicells are more compressed than in *St. schuurmani*, another allied species (Rich 1932).

Present only in December and beginning of January (very rare) (Schuurman 1932).

574. STAUSTRUM STRIOLATUM (NÄG.) ARCH.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 19 (rather rare), **69** (very rare).

Note. *Long., 28.0-30.0 µm; lat., 24.0-25.0 µm; lat. isthm., 9.0 µm.* In some specimens the apex of the semicell, in front-view, appeared very faintly convex. The vertical view was always absolutely typical (Fritsch 1918).

575. STAUSTRUM SUBAVICULA W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

576. STAUSTRUM SUBBREISSONII SCHMIDLE

Illustrations. Fig.3, G, H (Rich 1940).

Sample. RSA: 299, 300.

Note. Approaching var. *hexagonum* Gutwinski. Long. cell., ad 52.0 µm; lat., 40.0-46.0 µm. Covered with longish spines. Vertical view triangular. Very few individuals seen (Rich 1940).

577. STAUSTRUM SUBDILATATUM W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 8.

Note. *Forma granulis paucioribus validioribusque: long. 23.0-26.0 µm; lat. 21.0-25.0 µm; lat isthm. 8.5-9.0 µm* (West 1912).

578. STAURASTRUM SUBGEMMULATUM W. ET G.S. WEST

- VAR. **MATTIEI CLAASSEN**

Illustrations. Tab.31, figs.1, 2 (Claassen 1961).

Sample. RSA: 284.

Note. *Affinis var. gracili W. et G.S. West, sed cellulae brachiis longioribus tenuioribusque praeditae eam distinguunt.*

These specimens are near var. *gracilius* W. et G.S. West (West, West 1895, Pl.8, fig.35); but differ in possessing longer and narrower arms. Length 32.0-32.5 µm; breadth 15.0-17.0 µm (with arms 43.5-46.0 µm); breadth of isthmus 10.0-11.0 µm (Claassen 1961).

579. STAURASTRUM SUBJOHNSONII RICH

- VAR. **SUBJOHNSONII**

Illustrations. Fig.16, A, B (Rich 1932).

Samples. RSA: 192 (not common).

Note. *S. submagnum, fere duplo lat. (proc. incl.) quam long., modice constrictum, sinu aperto acuto vel fere rectangulari, isthmo lato; semicellulis biradiatis, subcuneatus, superne dilatatis, apice levissime convexo serie verrucarum praedito et intra marginem utrobique cum serie granularum vel verrucarum, partibus basalibus semicellularum inflatis cum seriebus granularum duabus transversalibus, processibus elongatis leviter convergentibus, spinis 3 vel 2 in apicem praeditis, cum seriebus denticulorum pluribus. A vertice visis semicellulis ellipticis, in media parte leviter deplanatis, processibus denticulatis. Long., 60.0-65.0 µm; lat. cum proc. 120.0-130.0 µm; ist., 15.0 µm; crass., 20.0-21.0 µm.*

This differs from *St. johnsonii* W. et G.S. West in its greater size, slightly different shape, and in the lateral processes being convergent rather than divergent. It recalls the form of *St. sebaldi* var. *ornatum* present in the same sample, but has longer arms. There are about 15-16 denticulations on the arms which are gracefully curved first downwards, and then slightly upwards at the tips. There is a series of granules just below the apical verrucae (Rich 1932).

- VAR. **MINOR RICH**

Illustrations. Fig.16, C (Rich 1932).

Samples. RSA: 192.

Note. This variety differs from the type in its smaller size, in the cells being usually tri-radiate, and in the number of denticulations in the arms being less (only about 8). The ornamentation is similar to that of the type. Long., 40.0-43.0 µm; lat. cum proc., 60.0-70.0 µm; ist., 9.0 µm (Rich 1932).

580. STAURASTRUM SUBTRIFURCATUM W. ET G.S. WEST

- VAR. **MAJOR W. ET G.S. WEST (SYN.: STAURASTRUM SUBTRIFURCATUM SCHMIDLE)**

Illustrations. Fig.26, A, B (Fritsch, Rich 1938); Tab.30, figs16-18 (Claassen 1961).

Samples. RSA: 198, 204, 205.

Note. *Forma granulis majoribus in parte centrali in aspectu verticali. Long., sine spin., 80.0 µm; lat. sine spin., 60.0-70.0 µm; isthm., 20.0-30.0 µm; long. spin., circa 40.0 µm.*

Krieger ("Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiologie, Suppl. Bd.xi, 1932, p.208, Pl.XIX, fig.1) has already recorded a punctate membrane in this variety, but the Transvaal form is distinguished by the series of larger granules in the middle of the apex in end-view.

S. wildemaniai Gutwinski ("De algis in insula Java collectis", Bull. Int. Acad. Sci. Cracovie, No.9, 1902, p.605, Pl.XL, fig.61) is closely allied to *S. subtrifurcatum*, differing chiefly from it in the fact that the angles of the semicells bear, in the former, only two spines. Schmidle (1902, p.73, Tab.II, fig.9) has recorded from Lake Nyasa a forma *bidens* of *S. wildemaniai* given by Krieger ("Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition", Archiv für Hydrobiologie, Suppl. Bd.xi, 1932, Pl.XIX, fig.2), except that in the latter slightly larger granules are indicated in the middle of the apex in end-view (cf. also Krieger's figure of *S. subtrifurcatum* var. *major*). It may be doubted whether the number of spines in a suitable criterion for distinguishing species, since this character is known to be variable in *Staurastrum*. *S. wildemaniai* should probably be regarded as synonymous with *S. subtrifurcatum* f. *bidens* Schmidle. The form with two spines was recorded from Old N'gamo under *S. wildemaniai* (Fritsch, Rich 1938).

These specimens are larger than in the typical form (W. Schmidle, Engler Bot. Jahrb., XXXII Bd., 1903, p.73, Taf.II, fig.8). Length 72.0-76.0 μm ; breadth 58.0-62.0 μm ; breadth of isthmus 24.0-26.5 μm ; length of spines 20.0-36.0 μm (Claassen 1961).

581. STAURASTRUM SUBUNGUIFERUM FRITSCH ET RICH

Illustrations. Fig.27, F-J (Fritsch, Rich 1938).

Samples. RSA: 202, 203, 204, 205.

Note. *S. ca. duplo longior quam latum, modice constrictum, sinu obtuso aperto; semicellulis a fronte visis subcircularibus, marginibus lateralibus et apicibus convexis, brachiis adsidentibus 3 cum spina brevi acuta terminali, membrana cum serie transversali granulorum 2 in medi parte semicellulae; semicellulis a vertice visis circularibus, processibus 3 symmetrice dispositis. Cum granulo centrali et circulo granulorum 9-10 et aliis granulis in series radiantis 2 inter processus.* Long. cell. (sine proc.), 40.0-44.0 μm ; lat., 24.0-28.0 μm ; isthm., 13.0-17.0 μm ; long. proc. max., 18.0 μm .

The disposition of the granules in end-view is striking, but the exact relation between their arrangement in front- and end-views has not been deciphered. The chloroplasts appear to be axile.

In front-view this species shows a very marked resemblance to *S. unguiferum* Turner ("The Freshwater Algae of East India", Kgl. Svensk. Vetensk.-Ak. Handl., 25, No.5, 1892, p.130). though the apical processes are rather different. In the circular end-view the species differs very markedly from any other known *Staurastrum*, and in this respect approaches the genus *Ichthyocercus* (W. and G.S. West, "Welwitsch's African Freshwater Algae", Journ. Bot., 35, 1897, p.21) (Fritsch, Rich 1938).

582. STAURASTRUM SUBWESTITUM RICH

Illustrations. Fig.13, D, E (Rich 1932).

Samples. RSA: 188 (November, January, April), 207.

Note. *Staurastrum mediocre, ca. 1/3 plo lat. quam long., profunde constrictum, sinu aperto; semicellulis cyathiformibus, in parte inferiore inflatis,*

apice paullo convexo cum verrucis emarginatis vel spinis bifurcatis paucis, angulis superioribus gradatim productis, processibus sublongis plerumque fere horizontalibus vel paullo convergentibus, spinis 3 in apicem praeditis, cum seriebus ca. 5 denticulorum. A vertice visis triangularibus, angulis productis, processibus denticulatis, lateribus fere rectis cum spinis 2 bifurcatis munitis. Long., 26.0-31.0 μm ; lat. cum proc., 36.0-50.0 μm ; ist., 5.0-7.0 μm .

This shows certain resemblances to *St. vestitum* Ralfs, which is a very variable species, but its general shape is different; *St. vestitum* has a more flattened or compressed body, the characteristic bifurcate spines are nearer together and the isthmus is wider. There is also a resemblance to some of the smaller forms of *St. anatinum* Cooke et Wills, but from these it is distinguished by its end-views, which possesses two bifurcate spines on each lateral margin (Rich 1932).

None recorded for period March to August; very rare during the other months excepting for a small maximum in December 1927.

1927: October 29 (temp. 16.8°C, pH=6.4), November 5 (temp. 21.5°C, pH=6.3), November 12 (temp. 21°C, pH=6.5), November 19 (400 cells per 1 c.c., temp. 18.5°C, pH=6.4), November 26 (500 cells per 1 c.c., temp. 20.5°C, pH=6.3), December 2 (800 cells per 1 c.c., temp. 22°C, pH=6.3), December 10 (200 cells per 1 c.c., temp. 21°C, pH=6.3), December 17 (200 cells per 1 c.c., temp. 22°C, pH=6.4), December 24 (100 cells per 1 c.c., temp. 21°C, pH=6.4), December 31 (temp. 22°C, pH=6.5); **1928:** January 7 (temp. 21°C, pH=6.5), January 14 (temp. 20°C, pH=6.2), January 21 (temp. 22°C, pH=6.3), January 28 (temp. 22.5°C, pH=6.4), September 15 (100 cells per 1 c.c., temp. 14°C, pH=6.89), October 6 (200 cells per 1 c.c., temp. 16°C, pH=6.89), November 3 (200 cells per 1 c.c., temp. 19°C, pH=7), December 19 (200 cells per 1 c.c., temp. 22°C, pH=6.89); **1929:** February 2 (new net – 100 cells per 1 c.c., temp. 21°C, pH=6.89) (Schuurman 1932).

583. STAURASTRUM TELIFERUM RALFS

- VAR. **TRANSVAALENSE** CLAASSEN

Illustrations. Tab.31, figs.19, 20 (Claassen 1961).

Samples. RSA: 253.

Note. *A typo speciei spinulis hebetatis differt.*

This is near *St. teliferum* Ralfs (E. Messikommer, Beiträge zur geobotanischen Landesaufnahme der Schweiz, Heft 24, 1942, Taf. XIV, fig.8); but differs in the spines being blunt. Length 30.5-31.0 μm ; breadth 28.0 μm ; breadth of isthmus 11.0-13.0 μm ; length of spines 2.5-4.0 μm . This may also be compared with *St. breviaculeatum* G.M. Smith (Taylor 1935b, p.772, Pl.2, fig.5) (Claassen 1961).

584. STAURASTRUM TETRACERUM RALFS

- VAR. **TETRACERUM**

- F. **TETRACERUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 328. - NAM: 305, 325. - LES: 426.

- F. **TRIGONA** LUND.

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192.

Note. Long. sine proc., 10.0-12.0 μm ; lat. cum proc., 22.0-25.0 μm ; ist., 4.0-5.0 μm (Rich 1932).

585. STAURASTRUM THERONII CHOLNOKY

Illustrations. Figs.48-50 (Cholnoky 1954b).

Samples. RSA: 213.

Note. This species belongs to the *S. striolatum* Arch. group of species, from which it differs both in its form and structure of the cells, as well as in dimensions. The cells are triangular in end-view, their corners broadly rounded, inflected the sidelines. The semicell are rotated at about 45° one to another. The cell wall near the corners in concentric rings, making these sections appear notched. The length of the cell is 17.0 μm, their width in the widest point 20.0 μm, isthmus is 7.5 μm. The type named after collector of these samples Dr. J.J. Theron from Pretoria (Cholnoky 1954b).

586. STAURASTRUM TOHOPEKALIGENSE WOLLE (SYN.: *STAURASTRUM NONANUM* W.B. TURNER)

- VAR. **TOHOPEKALIGENSE**

- FACIES **TRIFURCATUM** (W. ET G.S. WEST) BROOK 1958, p.91-95

Illustrations. Pl.26, Fig.4 (Williamson 1994).

Samples. RSA: 344, 366.

Note. Length 53.0-63.0 μm (+processes); 35.0-37.0 μm (-processes); breadth 49.0-70.0 μm (+processes); 26.0-29.0 μm (-processes); isthmus 12.0-18.0 μm (Williamson 1994).

- VAR. **TRIFURCATUM** W. ET G.S. WEST

Illustrations. Fig.13, A, B (Rich 1932), Fig.26, C, D (Fritsch, Rich 1938).

Samples. RSA: 192 (July), 198. – NAM: 307.

Note. *Forma.* Var. *trifurcatum* is characterized by possessing shorter processes than the type, with bifurcate or trifurcate apices. The form here present shows small spines, similar to those figured by G.M. Smith for his var. *brevispinum*. Long., sine proc., 28.0-36.0 μm; cum proc., 40.0-49.0 μm; lat. sine spin., 24.0-27.0 μm; cum proc., 39.0-48.0 μm; ist., 14.0-16.0 μm. On the whole a little smaller than var. *trifurcatum* but with a slightly larger isthmus (Rich 1932).

Forma minor. Long. sine proc., 13.0-18.0 μm; cum. proc., 24.0-37.0 μm; lat. sine proc., 13.0-18.0 μm; cum proc., 24.0-30.0 μm; isthm., 8.0-9.0 μm.

The end-view shows 6 processes arranged in pairs at the angles, and three further processes arising at a lower level and inserted between those of each pair. In front-view the paired apical processes are likewise recognizable, while the lateral margins, a little way above the isthmus, bear an additional process, often directed towards the isthmus. The processes vary in the number of apical teeth, most usually there are 2, while the lateral processes occasionally have 3 teeth. Carter (West and al. 1923, p.179) has already commented on the variability of this feature. The specimens found in the Belfast Pan are appreciably smaller than those recorded from other regions (Fritsch, Rich 1938).

587. STAURASTRUM TRANSVAALENSIS CHOLNOKY

Illustrations. Figs. 51, 52 (Cholnoky 1954b).

Samples. RSA: ?(210-218) (Cholnoky 1954b).

Note. This species belongs to the *S. gracile* Ralfs group of species, from which it is different.

The cells are triangular, with moderate, often ± irregularly inflected sidelines. The each corners of the triangle carry a long spine. In side-view semicells are trapeziforme, with a fairly deep but open isthmus. The spines are

directed outward. The cell wall is smooth. Length about 35.0 μm , largest width 40.0 μm , isthmus 10.0 μm , length of spine 5.0-6.0 μm (Cholnoky 1954b).

588. STAURASTRUM TRIHEDRALE WOLLE

- VAR. TRIHEDRALE

Illustrations. Pl.27, Fig.2 (Williamson 1994).

Sample. RSA: 91 (rare), **356**.

Note. *Long. cell.*, 46.0 μm ; *lat. cell.*, 31.0 μm ; *lat. isthm.*, 10.0 μm (Fritsch, Rich 1924).

Length 46.0 μm ; breadth 34.0 μm ; isthmus 12.0-13.0 μm ; ratio of length to breadth 1.35. Cell wall with prominent large scrobiculations (Williamson 1994).

- VAR. AUSTRALE CLAASSEN

Illustrations. Tab.31, figs.17, 18 (Claassen 1961).

Samples. RSA: 261.

Note. *A typo speiei ishmo multo latiore differt.* This differt from the typical form (W. and G.S. West, North American Desmidiaceae, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.16, fig.29) in that the isthmus is 1.5 times broader. Length 44.0 μm ; breadth 30.0 μm ; breadth of isthmus 14.0-15.5 μm (Claassen 1961).

589. STAURASTRUM TUMIDUM BRÉB.

- VAR. TUMIDUM

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 295.

- VAR. BIBAPILLATUM CROASD.

Illustrations. Fig.117 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Differing from the type in being much smaller and in having paired (not single) papillae at each angle. *Long.*, 70.0 μm ; *lat.* without spines, 60.0 μm ; with spines, 64.0 μm ; *isthm.*, 39.0 μm . R. Grönblad suggested "S. *prainii* W. et G.S. West" (1907, p.212, 16: 10), and the size is closer, but its shape is quite different, with its narrow isthmus and linear sinus (Grönblad, Croasdale 1971).

590. STAURASTRUM UNGUIFERUM TURNER

- VAR. CORNICULAUTM TURNER

Illustrations. Fig.27, A, B (Fritsch, Rich 1938).

Samples. RSA: 201.

Note. *Differt a typo processibus longioribus gracilioribus.* *Long. cell.*, 30-34 μm ; *lat.*, 19 μm ; *isthm.*, 13-27 μm .

The general appearance of the front-view is quite as in the type, but the upwardly directed processes are appreciably longer, and, in proportion to their length, more slender; the terminal spines are not so distinctly set off from the rest of the process as in the type (Fritsch, Rich 1938).

591. STAURASTRUM VESTITUM RALFS

Illustrations. Fig.27, E (Fritsch, Rich 1938).

Samples. RSA: 192, 198, 199, 200.

Note. *Forma minor.* *Long. cell.*, 26.0-28.0 μm ; *lat. cum proc.*, 30.0-52.0 μm ; *isthm.*, 4.0-7.0 μm .

Since no good specimens showing the individuals in front-view were obtained, this reference is based mainly on the end-view. The latter shows the two

emarginate warts projecting from the middle part of each margin which is characteristic of *S. vestitum*; a smaller wart was evident on either side of each pair (Fritsch, Rich 1938).

592. STAURASTRUM VOLANS W. ET G.S. WEST

Illustrations. Fig. nostr.14, A-D (Rich 1932).

Samples. RSA: 188 (July, December, January, May), **207**.

Note. The Wests (West, West 1895, Pl.IX, figs.10-11) give 18.0-19.0 μm as the length; the individuals in Florida Lake were barely as long (14.0-17.0 μm), but they showed the convex apex to the semicells characteristic of the species and the slender two-spined processes. This *Staurastrum* is very like *St. gallatorium* Nordst. var. *americanum* W. et G.S. West, which, however, has arms more horizontally directed, with more crenulations on them. In describing this variety (North American Desmidiaceae, Trans. Linn. Soc. London, 1896, Bot.V, p.265) the Wests do not draw attention to the resemblance to *St. volans*. G.M. Smith (Ecology of the Plankton Algae in the Palisades Interstate Park, 1924, p.100) makes this variety of *St. gallatorium* a separate species, *St. americanum*. Long., 14.0-17.0 μm ; lat. cum proc., 32.0-44.0 μm ; ist., 4.0-6.0 μm ; crass., 8.0-9.0 μm . Occasional tri-radiate forms were observed (see fig.14, D) (Rich 1932).

Recorded only in November and January (Schuurman 1932).

593. STAURASTRUM WILDEMANII GUTW.

- VAR. **MAJUS** (W. ET G.S. WEST) SCOTT ET PRESCOTT 1956, P.353, FIGS.8-12

Illustrations. Pl.26, Fig.3 (Williamson 1994).

Samples. RSA: 356, 375.

Note. Length 81.0-133.0 μm (+processes); 76.0-87.0 μm (-processes); breadth 104.0-160.0 μm (+processes); 65.0-80.0 μm (-processes); isthmus 30.0-33.0 μm ; length of processes 39.0-44.0 μm (Williamson 1994).

594. STAURASTRUM XIPHIDIOPHORUM WOLLE

- VAR. **WESTIORUM** CLAASSEN

Illustrations. Tab.30, figs.12, 13 (Claassen 1961).

Samples. RSA: 241.

Note. *E vertice visae cellulae cum var. brachyacantho* W. et G.S. West *valde congruunt, sed differt spinis in angulis apicalibus multo breviorum.*

This closely resembles var. *brachyacanthum* W. et G.S. West (W. and G.S. West, North American Desmidiaceae, Trans. Linn. Soc. London, Ser.2, Bot., Vol.V, 1895-1901, Pl.18, fig.7) in vertical view; but the spines on the apical angles are much shorter and the cells are smaller. Cells small, about 1.3 times as long as broad, fairly deeply constricted, sinus open; basal and apical angles of semicells truncate and furnished with a few spines. Semicells more or less triangular in vertical view; each angle with three spines (it seems to be 9-angular). Length 24.0 μm ; breadth 18.5-19.0 μm ; breadth of isthmus 10.0-10.5 μm . Named after Messrs. W. and G.S. West (Claassen 1961).

595. STAURASTRUM ZAHLBRUCKNERI LÜTKEMÜLLER

- VAR **AFRICANUM** FRITSCH ET RICH

Illustrations. Fig.27, C, D (Fritsch, Rich 1938).

Samples. RSA: 198, 199, 200, 201.

Note. *Differt a typo magnitudine multe minore, semicellulis plus minus depressis ellipticis, marginibus lateralibus semicellulae in aspectu frontali basin*

versus crenulatis; semicellulis a vertice visis lateralibus leviter concavis, angulis 2-3 crenatis; membrana glabra vel punctata. Long. cell., 42.0-48.0 μm ; lat., 39.0-45.0 μm ; isthm., 12.0-15.0 μm .

This variety is distinguished by its much smaller dimensions which are less than half those of the type, by the often depressed semicells which have slightly concave margins in end-view, and by the crenation of the lateral margins in the basal parts of the semicells in front-view. The basal angles of the semicells show a stronger thickening of the membrane, which is also evident in the end-view. The angles in the end-view are crenulate, and the edges of the down-curved processes of the semicells are seen, in the front-view, practically to interlock by means of these crenations. Some individuals are slightly longer than broad, others are about as long as broad. The membrane may be smooth or punctate (Fritsch, Rich 1938).

Also see note about *Staurastrum bidentulum* Grönblad.

596. STAUSTRUM ZONATUM BÖRG.

- VAR. HORIZONTALIS BÖRG

Illustrations. Fig.17, G (Rich 1932).

Samples. RSA: 192 (very rare).

Note. *Forma.* A little smaller than Borge's variety, and very few individuals observed had only four arms whereas those observed by him had six. Long., 28.0-30.0 μm ; lat. cum proc., 34.0-36.0 μm ; ist., 9.0-10.0 μm (Rich 1932).

- VAR. PRODUCTUM W. ET G.S. WEST

Illustrations. Fig.17, D, E, F (Rich 1932).

Samples. RSA: 192.

Note. *Forma.* In this form the arms are not quite so long as in var. *productum*. There are regularly seven denticulations along each arm. Three, four, five, and six-rayed individuals were found; at least two were observed in which one semicell was three-rayed, the other four-rayed (see Fig.17, E). Long., 28.0-32.0 μm ; lat. cum proc., 45.0-55.0 μm ; ist., 9.0-12.0 μm (Rich 1932).

Note to the genus *Staurastrum* Meyen ex Ralfs

597. STAUSTRUM SP.

Illustrations. Fig.126 (Grönblad, Croasdale 1971).

Samples. NAM: 307.

Note. Long., 26.0 μm ; lat. with processes, 30.0-34.0 μm ; isthm., 8.0 μm . Our plant is probably the same as *S. disputatum* W. et G.S. West var. *annulatum* Rich (1940, p.12, 3: A, B), which, however, H. Croasdale feels is not a *S. disputatum* because the processes are too distinct, and are truncate with small apical spines, and also there are apical verrucae. Perhaps a separate species could be made out of these, but Rich does not give dimensions and R. Grönblad's figure is not clear in all its details (Grönblad, Croasdale 1971).

Species of this genus which were not identified were occurred in following samples: RSA: 427, 428, 430, 431, 434.

SPHAEROZOSMA CORDA EX RALFS

598. SPHAEROZOSMA AUBERTIANUM WEST

- VAR. AUBERTIANUM

Illustrations. Tab.32, fig.9 (Claassen 1961).

Samples. RSA: 298.

Note. Cells somewhat smaller than in the type (W. West, Journ. Bot., Vol. XXVII, 1889, Tab. 291, fig. 17). Length 10.0-12.0 μm ; breadth 13.0-16.0 μm ; breadth of isthmus 5.0-6.0 μm (Claassen 1961).

- VAR. **COMPRESSUM** RICH

Illustrations. Fig. 17, A (Rich 1932). (Williamson 1994).

Samples. RSA: 192 (rather common).

Note. *Cellulis evidenter latis quam longis, profunde constrictis, sinu lineari; semicellulis elliptico-oblongis cum seriebus horizontalibus duabus, granularum in media parte semicellulae interruptis, et granulis supernumerariis paucis in marginem lateralem.* Long., 13.0-16.0 μm ; lat., 24.0-27.0 μm ; ist., 8.0-10.0 μm ; crass., 10.0-12.0 μm .

In front-view this variety closely resembles *Sph. vertebratum* (Bréb.) Ralfs var. *depressum* Grönblad, but as the semicells are subspherical in side-view it cannot be placed under *vertebratum*, a species that has an oblong, slightly constricted, lateral view. There is a great resemblance between *Sph. vertebratum* var. *depressum* and *Sph. aubertianum* West var. *archerii* West (Rich 1932).

- VAR. **HIMEVILLII** WILLIAMSON

Illustrations. Pl. 24, Fig. 7 (Williamson 1994).

Samples. RSA: 356.

Note. Cells very small, 1.1-1.38 times broader than long. Sinus open at a very acute angle (ca. 20°). Semicells oblong-elliptic with round lateral margins. The apices are broad with two knob-like processes only one of which shows in the front view, connecting with or very proximal to the adjacent cell wall. On each side of the process is a flat elevated protrusion which also connects, or proximates, to a similar protrusion on the next cell. The cell wall has two indistinct transverse rows of pores more clearly visible near the lateral margins than at the median part of the semicells. In lateral view the semicells are globose. The flat apical protrusions are unique in *Sphaerozosma* and sufficiently distinct to enable these specimens to be described as a new variety. Length 14.0-15.7 μm ; breadth 16.0-21.5 μm ; crass. 6.0-7.0 μm (Williamson 1994).

599. **SPHAEROZOSMA EXCAVATUM** RALFS

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 199, 200, 211, 212.

Note. Long. cell., 9.0-11.0 μm ; lat., 8.0-11.0 μm ; isthm., 4.5 μm ; crass., 5.0 μm ; lat. zygosp., 12.0-15.0 μm .

The zygospore is more or less spherical, with a smooth wall (Fritsch, Rich 1938).

600. **SPHAEROZOSMA GRANULATUM** ROY ET BISS.

- VAR. **GRANULATUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 188 (December), **207, 328.** - **NAM: 307.**

Note. Long., 7.8 μm ; lat., 7.8 μm ; in thick gelatinous sheaths (Huber-Pestalozzi 1930).

Very rare during September and December 1927 and also in December 1928; otherwise the species was not observed (Schuurman 1932).

- VAR. **PERGRANULATUM** W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 192 (May, July).

Note. Long., 10.0-15.0 μm ; lat., 10.0-11.0 μm ; ist., 4.0-5.0 μm (Rich 1932).

Drakensberg (orig.)

601. SPHAEROZOSMA VERTEBRATUM (BRÉB.) RALFS 1848

- VAR. **PUNCTULATUM** W. ET G.S. WEST

Illustrations. Pl.24, Fig.9 (Williamson 1994).

Samples. RSA: 344.

Note. Length 16.0-17.0 μm ; breadth 29.0-32.0 μm ; isthmus 10.7-11.5 μm ; ratio of length to breadth – ca. 1.8 broader than long (Williamson 1994).

ONYCHONEMA WALL.

602. ONYCHONEMA FILIFORME (EHR.) ROY ET BISS.

Illustrations. Fig.134 (Grönblad, Croasdale 1971); Pl.24, Fig.2 (Williamson 1994).

Samples. RSA: 192 (May), 198, 201, 328, 343. – NAM: 307.

Note. Long., 10.0 μm ; lat., 10.4 μm ; or long., 10.4 μm ; lat., 11.7 μm . Very often in single cells, short and very long filaments (Huber-Pestalozzi 1930).

Long. cell., 11.0-12.0 μm ; lat., 10.0-13.0 μm ; isthm., 3.5 μm (Fritsch, Rich, 1938).

Length 11.2 μm ; breadth 12.0-12.6 μm ; isthmus 2.5 μm ; ratio of length to breadth – 1.07-1.12 broader than long; thickness 6.3 μm (Williamson 1994).

603. ONYCHONEMA LAEVE NORDST.

- VAR. **LAEVE**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198 (rare). – NAM: 305.

Note. *Forma.* Long. cell., 16.0 μm ; lat. sine spin., 18.0 μm ; isthm., 5.0 μm .

The form present differs from the type as described and figured by Nordstedt (“Desmidiaceae”, in E. Warming, *Symbolae ad floram Brasiliae centralis cognoscendam*, Copenhagen, 1887, p.206, fig.34) in the lesser width and in the shorted spines which are not markedly convergent. The spines are slightly shorter than the apical processes (Fritsch, Rich 1938).

- VAR. **LATUM** W. ET G.S. WEST

Illustrations. Pl.24, Fig.10 (Williamson 1994).

Samples. RSA: 338.

Note. Length 15.5 μm ; breadth 31.0 μm (+ spines); 24.0 μm (- spines); isthmus 4.5 μm ; thickness 7.7 μm . Cell wall irregularly punctate. Apices slightly elevated and truncate (Williamson 1994).

- VAR. **MICRACANTHUM** NORDST.

Illustrations. Tab.32, fig.10 (Claassen 1961).

Samples. RSA: 192, 298. – NAM: 307.

Note. *Onychonema species ad O. laeve* Nordst. var. *micracanthum* Nordst. The cells correspond with those in Nordstedt’s variety except for the somewhat undulated apical margin in some specimens; this may be due to the fixative as other specimens from the fresh material have smooth apical margins. Unfortunately the measurements of Nordstedt’s variety are not available. Length 16.0-18.0 μm ; breadth 20.0-24.0 μm (with spines 24.0-30.0 μm); breadth of isthmus 4.0-4.5 μm (Claassen 1961).

SPONDYLOSIUM BRÉBISSON EX RALFS

604. SPONDILOSIUM PLANUM (WOLLE) W. ET G.S. WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 305.

605. SPONDYLOSIUM PYGMAEUM (COOKE) WEST (= *SPHAEROZOSMA PYGMAEUM* COOKE NON RABENH.)

- VAR. *CAPENSIS* FRITSCH

Illustrations. Fig.33, A-G (Fritsch 1918).

Samples. RSA: 24 and **26** (in clusters on surface of *Tribonema bombycinum*), **54, 124** (rare).

Note. The cells are rather larger than those recorded by Cooke (*long.*, 11.0-12.0 μm ; *lat.*, 10.0-12.0 μm ; *lat. isthm.*, 4.0-5.0 μm ; *crass.*, 6.0 μm) and were rarely connected in chains of more than three or four, often merely forming irregular groups attached to the surface of the substratum. Numerous isolated cells were encountered. In some of the longer chains a tightly-fitting mucilage envelope could be distinguished. As regards shape of cell, the apices were, on the whole, rather flatter than appears in Cooke's figures. Whilst in many cases the end-view was a broad ellipse, numerous individuals were encountered in which it was triangular. In view of these differences, the form in the present material should perhaps be distinguished as a var. *capensis*, nov. var., with following diagnosis:

Differt a typo cellulis majoribus, apicibus plus minus complanatis, isthmo latiore; a vertice visis ellipticis vel triangularibus, angulis rotundatis. Cellulis aut singulis aut in filis brevibus dispositis, saepe algis filamentosis adhaerentibus.

Attention may be drawn to the similarity between these specimens and *Cosmarium minimum* W. et G.S. West, as well as *C. inconspicuum* W. et G.S. West. Both of these show certain differences, but in view of the capacity of *S. pygmaeum* to exist in the non-filamentous condition, the possibility of some of these minute *Cosmaria* being forms or varieties of this species should be kept in sight. Another form that bears some resemblance to the specimens of *S. pygmaeum* with triangular end-views in *Staurastrum coarctatum* Bréb. var. *curtum* Nordstedt (Fritsch 1918).

Long. cell., 12.0 μm ; *lat.*, 8.0-10.6 μm ; *lat. isthm.*, 5.5-6.0 μm . This agreed fairly well with the form described by Fritsch. The flattening of the apices of the cells was sometimes very slightly retuse. The cells were either united to form very short filaments, or were isolated (Hodgetts 1926).

606. SPONDILOSIUM TETRAGONUM WEST

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 199, 201.

Note. *Long. cell.*, 9.0-11.0 μm ; *lat.*, 6.0-7.5 μm ; *isthm.*, 4.0-4.5 μm (Fritsch, Rich 1938).

HYALOTHECA EHRENBERG EX RALFS

607. HYALOTHECA DISSILIENS (SMITH) BRÉB.

- VAR. *DISSILIENS*

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 91 (common, with zygospores), **238, 299, 329, 430.** - **NAM: 307.**

Note. *Lat. cell.*, 24.0-30.0 μm (Fritsch, Rich 1924).

Long. cell., 18.0 μm ; lat., 17.0 μm (Rich 1940).

"*Forma minor*" (R. Grönblad). Lat., 19.0 μm (Grönblad, Croasdale, 1971).

Drakensberg (orig.).

- VAR. **HIANS WOLLE**

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

- VAR. **TATRICA RACIB.**

Illustrations. Absent in literature on Southern African desmids.

Sample. NAM: 307.

Note. "Lat., 18.0 μm " (R. Grönblad) (Grönblad, Croasdale, 1971).

608. HYALOTHECA MUCOSA (MERT.) EHR.

- VAR. **MUCOSA**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 186, 192 (July). – **NAM: 305.**

Note. The examples found in Lake Chrissie are slightly narrower than the type – they are only 14.0 μm wide (Rich 1932).

"*Minor*" (R. Grönblad) (Grönblad, Croasdale, 1971). In (Grönblad, Croasdale, 1971) indicated as *Hyalotheca mycosa* (Mert.) Ehrb.

- VAR. **MINOR ROY ET BISS.**

Illustrations. Absent in literature on Southern African desmids.

Samples. RSA: 198, 199.

Note. Long. cell., 14.0 μm ; lat., 10.0 μm . Zygospores were observed in one sample (Fritsch, Rich 1938).

DESMIDIUM C.A. AG. EX RALFS

609. DESMIDIUM BAILEY (RALFS) DE BARY

- VAR. **COELATUM (KIRCHN.) NORDST.**

Illustrations. Fig. nostr.17, *B, C* (Rich 1932); Pl.24, Fig.3 (Williamson 1994).

Samples. RSA: 185, 188, 192, 207, 350 (trigonal), **375** (trigonal). – **NAM: 307.** – **SWA: 378** (tetragonal).

Note. The type is described as being destitute of a gelatinous sheath; here, in the specimens from Weltevreden West and Florida Lake, the sheath was distinctly seen. Long., 17.0-18.0 μm ; lat., 24.0-25.0 μm (Rich 1932).

Observed only in May 1928, when it occurred very rare (Schuurman 1932).

In (Grönblad, Croasdale, 1971) indicated as *Desmidium baileyi* (Ralfs) Nordstedt (1880, p.4).

Length 17.7-20.0 μm ; breadth 19.6-25.8 μm ; ratio of length to breadth - 1.0-1.4 broader than long (Williamson 1994).

In (Williamson 1994) indicated as *Desmidium baileyi* (Ralfs) Nordstedt.

Drakensberg (orig.).

610. DESMIDIUM COARCTATUM NORDST.

- VAR. **COARCTATUM**

Illustrations. Absent in literature on Southern African desmids.

Samples. NAM: 307.

- VAR. **CAMBRICUM WEST**

Illustrations. Fig. nostr.29, *C* (Fritsch, Rich 1938).

Samples. RSA: 201, 202.

Note. Long. cell., 24.0-25.0 μm ; lat., 35.0-37.0 μm . The apex of the semicell is equal to about half the diameter of the widest portion of the cell (Fritsch, Rich 1938).

611. DESMIDIUM GRACILICEPS (NORDST.) LAGERH.

Illustrations. Fig.29, *D* (Fritsch, Rich 1938); Pl.24, Fig.6 (Williamson 1994).

Samples. RSA: 199, 356.

Note. *Forma.* Long. cell., 29.0-30.0 μm ; lat., 21.0 μm ; isthm., 16.0 μm ; lat. apic., 9.0-10.0 μm . The cells are rather longer and narrower than in the type (Fritsch, Rich 1938).

Length 25.5 μm ; breadth 25.5 μm ; isthmus 21.0 μm ; ratio of length to breadth 1.0; thickness 20.0 μm (Williamson 1994).

612. DESMIDIUM OCCIDENTALE W. ET G.S. WEST

Illustrations. Fig. nostr.29, *A, B* (Fritsch, Rich 1938); Pl.24, Fig.4 (Williamson 1994).

Samples. RSA: 202, 204, 206, 355.

Note. Long. cell., 24.0-26.0 μm ; lat., 30.0-35.0 μm . Rather common amongst *Utricularia* and *Cyperaceae* (Fritsch, Rich 1938).

Length 20.7 μm ; breadth 29.3 μm ; isthmus 19.5 μm ; ratio of length to breadth – 1.41 broader than long (Williamson 1994).

613. DESMIDIUM QUADRANGULATUM RALFS

Illustrations. Pl.24, Fig.5 (Williamson 1994).

Samples. RSA: 343, 358.

Note. Length 18.8-18.2 μm ; breadth 30.0-39.0 μm ; ratio of length to breadth – 1.8-2.1 broader than long (Williamson 1994).

614. DESMIDIUM QUADRATUM NORDST.

- *F. PUNCTATA* FRITSCH ET RICH

Illustrations. Fig.29, *E-G* (Fritsch, Rich 1938).

Samples. RSA: 198, 201, 202, 204.

Note. *Semicellulis cum seriebus punctorum circa 4 horizontalibus munitis.* Long. cell., 21.0-24.0 μm ; lat., 33.0-36.0 μm ; crass., 21.0-22.0 μm ; diam. zygosp., 30.0 μm .

Each semicell is furnished with about 4 horizontal rows of puncta. Such puncta are not mentioned by Carter and West in their description of the species, although a single row of puncta is indicated in the original figure of Nordstedt. The successive cells are connected by thick intercellular pads. The zygospore has a smooth thick membrane (Fritsch, Rich 1938).

615. DESMIDIUM SWARTZII AG.

Illustrations. Absent in literature on Southern African desmids.

Sample. RSA: 221, 223, 224, 228, 229, 299, 430.

Note. Long. cell., 20.0 μm ; lat., 35.0 μm (Rich 1940).

Die Zellen sind wohl in ihren Abmessungen manchmal von dem Typus abweichend (die Breite schwankt zwischen 30.0 and 45.0 μm), ich halte aber doch alle die gesehenen vielen Exemplare für dem Typus angehörig. In einer Kultur in saurem, aber ziemlich warmem (21-25°C) Medium - pH 5,7 - ist die Vermehrung der Art ausserordentlich lebhaft, so dass sie sicher als eine

mesotherme, aber stenotypisch azidobiontische Spezies gelten muss (Cholnoky 1955).

PHYMATODOCIS NORDST.

616. PHYMATODOCIS IRREGULARE SCHMIDLE

Illustrations. Fig. nosrt. 28, A, B (Fritsch, Rich 1938); Pl.24, Fig.8 (Williamson 1994).

Samples. RSA: 198, 199, 201, 205. – SWA: 378.

Note. Long. cell., 26.0-29.0 μm ; lat., 48.0-50.0 μm . The dimensions agree with those of individuals found by Messrs. West ("A Contribution of the Freshwater Algae of Ceylon", Trans. Linn. Soc. (Bot.), vi, 2 ser., 1902, p.175) in Ceylon (Fritsch, Rich 1938).

Length 26.6 μm ; breadth 40.0-51.0 μm (Williamson 1994).

GYMNOZYGA EHRENB.

617. GYMNOZYGA BREISSONII (KÜTZ.) NORDST.

Illustrations. Figs.149-152 (Cholnoky 1955).

Samples. RSA: 227, 231, 238, 430.

Note. In den beiden Rayton-Materialien ist die Art sehr häufig. Es ist allerdings bemerkenswert, dass sie nur in den Standorten vorkommt, in welchen auch *Anomoeoneis serians* reichlich vertreten ist. – Das reichliche Material hat es mir ermöglicht, die Zellteilung dieser bisher wenig untersuchten Form eingehend zu studieren. Am Anfange des Vorgangs wandert der Kern nach einer Seite (Fig.149, right cell), wo die Kernteilung stattfindet and erscheint – zentripetal - die Anlage der Scheidewand. Der Chloroplast bleibt an seinem ursprünglichen Platz, wird aber durchgeschnürt and durch die sich entwickelnde Wand durchgeschnitten (Fig.150). Die Verdickung der neuen Zellwand ist nicht gleichmässig, auf der am Anfange dünnen Wandung entstehen sehr kürzlich – wahrscheinlich durch lokales interkalares Wachstum - zwei Falten, die am Anfange noch dünn and nicht besonders lang sind (Fig.149, left). In diesem Zustand sind die Tochterzellen nur durch eine schwache Geradestreckung der zwei grossen Ausbuchtungen etwas verlängert, eine weitere Verlängerung erfolgt vorläufig noch nicht . In dieser Zeit entwickeln sich die am Anfang noch kleinen and diinnen Leisten (Falten), ziehen sich die Chromatophorenhälften zusammen and teilt sich auch das Pyrenoid (Fig.151). Der Kern verlässt seine anfängliche Position and wandert nach der Mitte. Die Teilung der Pyrenoide erfolgt immer transversal (Fig.151), die Tochterpyrenoide begeben sich nach einer Drehung von 90° nach den Polen (Fig.152), wobei auch die mittlere Einschnürung des Chloroplasts ausgebildet wird and der Zellkern seine Ruheposition zentral in der Einschnürung des Chromatophors einnimmt. In den inzwischen vollentwickelten Leisten (Falten) löst sich die Mittellamelle wahrscheinlich auf, wonach die aufeinandergefalteten Wandabschnitte sich frei strecken können and durch diese Streckung wird die normale Länge einer Ruhezelle verhältnismässig schnell erreicht (Fig.152, wo die Streckung deutlich sichtbar ist). Die Ausbildung des Isthmus and das Erreichen der Ruhelage der Chromatophoren erfolgt erst nach der Streckung. Aus der Beobachtung dieser Erscheinungen ist auch deutlich, dass in der Ruhezelle nur ein Chromatophor mit zwei Pyrenoiden vorhanden ist, dass der Kern in einer mittleren Einschnürung des Chromatophors zu finden ist and dass das Chromatophor nur während der Zellteilung geteilt wird (Cholnoky 1955).

Draakensberg, Mpumalanga (orig.).

618. GYMNOZYGA MONILIFORMIS EHRENB.

- VAR. **GRACILESCENS** NORDST.

Illustrations. Fig. nosrt. 28, *C, D* (Fritsch, Rich 1938).

Samples. RSA: 198 (rather common), **199**.

Note. Long. cell., 30.0-36.0 μm ; lat., 14.0-15.0 μm ; zygosp., 22.0 x 15.0 μm (Fritsch, Rich 1938).

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APPENDIX. DESMIDS DESCRIBED FROM SOUTHERN AFRICA

In total according to the published literature data **618** species (**960** intraspecific taxa including type taxa) recorded in Southern Africa, from them **307** taxa were described as new for science i.e. **110** new species, **1** new subspecies, **165** new varieties, **29** new forms, **1** new name, **1** new combination.

Cylindrocystis barbarica Claassen, sp. nov. (Claassen 1961).

Cylindrocystis caffra Claassen, sp. nov. (Claassen 1961).

Cylindrocystis crassa De Bary f. *tenuis* Hodgetts, f. nov. (Hodgetts 1926).

Cylindricystis ornata Fritsch, sp. nov. (Fritsch 1918).

Netrium oblongum (De Bary) Lütkemüller var. *cylindricum* W. et G.S. West f. *curvata* Fritsch, f. nov. (Fritsch 1918).

Penium barbaricum Claassen, sp. nov. (Claassen 1961).

Penium conspersum Wittrock var. *capense* Fritsch, var. nov. (Fritsch 1918).

Penium costatum Hodgetts, sp. nov. (Hodgetts 1926).

Penium cucurbitinum Biss. f. *botesii* Claassen, f. nov. (Claassen 1961).

Penium curtum Bréb. var. *waterbergense* Claassen, var. nov. (Claassen 1961).

Penium gonatozygiforme Claassen, sp. nov. (Claassen 1976).

Penium libellula (Focke) Nordst. var. *schweickerdtii* Claassen, var. nov. (Claassen 1961).

Penium margaritaceum (Ehrenb.) Bréb. var. *brevior* Claassen, var. nov. (Claassen 1961).

Penium margaritaceum (Ehrenb.) Bréb. *incognitum* Claassen, var. nov. (Claassen 1961).

Penium mesianum Claassen, sp. nov. (Claassen 1961).

Penium minutum (Ralfs) Cleve var. *productum* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).

Penium navicula Bréb. f. *major* Huber-Pestalozzi, f. nov. (Huber-Pestalozzi 1930).

Penium plymatosporum Nordst. var. *crassulum* Cholnoky, var. nov. (Cholnoky 1955).

Penium pseudofurescens Claassen, sp. nov. (Claassen 1961).

Penium subcucurbitinum Claassen, sp. nov. (Claassen 1961).

Closterium abruptum West var. *westiorum* Claassen, var. nov. (Claassen 1961).

Cosmarium acerosum (Schrank) Ehrenb. var. *waterbergense* Claassen, var. nov. (Claassen 1961).

Closterium acutum (Lyngb.) Bréb. var. *linea* (Perty) W. et G.S. West. f. *minor* Claassen, f. nov. (Claassen 1961).

Closterium atomicum Claassen, sp. nov. (Claassen 1961).

Closterium barbaricum Claassen, sp. nov. (Claassen 1961).

Closterium boyanum Claassen, sp. nov. (Claassen 1961).

Closterium caffrorum Claassen, sp. nov. (Claassen 1961).

Closterium calosporum Wittr. var. *minor* Claassen, var. nov. (Claassen 1961).

Closterium capense Rabenh., sp. nov. (Rabenhorst 1855).

Closterium ceratium Perty var. *angustum* Claassen, var. nov. (Claassen 1961).

Closterium cornu Ehrenb. var. *angustum* Claassen, var. nov. (Claassen 1961).

Closterium cornu Ehrenb. var. *minor* Claassen, var. nov. (Claassen 1961).

Closterium cymbellaeformis Claassen, sp. nov. (Claassen 1961).
Closterium cyntia De Not var. *waterbergense* Claassen, var. nov. (Claassen 1961).
Closterium decorum Bréb. var. *minor* Claassen, var. nov. (Claassen 1961).
Closterium ehrenbergii Menegh. var. *minutissimum* Claassen, var. nov. (Claassen 1961).
Closterium gracile Bréb. var. *brevius* Claassen, var. nov. (Claassen 1961).
Closterium hutchinsonii Rich, sp. nov. (Rich 1932).
Closterium incurvum Bréb. var. *elaboratum* Claassen, var. nov. (Claassen 1961).
Closterium insolitum Claassen, sp. nov. (Claassen 1961).
Closterium intermedium Ralfs var. *mesianum* Claassen, var. nov. (Claassen 1961).
Closterium jenneri Ralfs var. *dubitalibus* Claassen, var. nov. (Claassen 1961).
Closterium knysnanum Huber-Pestalozzi, sp. nov. (Huber-Pestalozzi 1930).
Closterium kranskopense Claassen, sp. nov. (Claassen 1961).
Closterium kuetzingii Bréb. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Closterium lineatum Ehrenb. var. *major* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
Closterium lunula (Müll.) Nitzsch var. *maximum* f. *crassissimum* Croasdale, f. nov. (Grönblad, Croasdale 1971).
Closterium moniliferum (Bory) Ehrenb. var. *epithemioides* Claassen, var. nov. (Claassen 1961).
Closterium moniliferum (Bory) Ehrenb. var. *nasutum* Rich, var. nov. (Rich 1932).
Closterium okavangicum Coesel et Van Geest, sp. nov. (Coesel, van Geest 2008).
Closterium parvulum Näg. var. *minor* Claassen, var. nov. (Claassen 1961).
Closterium pegleri F.E. Fritsch, sp. nov. (Fritsch, Stephens 1921).
Closterium peracerosum Gay var. *arcuatus* Fritsch et Rich, var. nov. (Fritsch, Rich 1930).
Closterium polystictum Nygaard, sp. nov. (Nygaard 1932).
Closterium pritchardianum Arch. f. *minor* Fritsch, f. nov. (Fritsch 1918).
Closterium prolongum Rich, sp. nov. (Rich 1932).
Closterium pseudokuetsingii Williamson, sp. nov. (Williamson 1996).
Closterium pseudoleibleinii Claassen, sp. nov. (Claassen 1961).
Closterium pseudolibellula F.E. Fritsch, sp. nov. (Fritsch, Stephens 1921).
Closterium pseudolunula Claassen, sp. nov. (Claassen 1961).
Closterium ralfsii Bréb. var. *glentigianum* Claassen, var. nov. (Claassen 1961).
Closterium ralfsii Bréb. var. *minor* Claassen, var. nov. (Claassen 1961).
Closterium ralfsii Bréb. var. *nodosum* Claassen, var. nov. (Claassen 1961).
Closterium ralfsii Bréb. var. *subralfsii* Claassen, var. nov. (Claassen 1961).
Closterium schweickerdtii Claassen, sp. nov. (Claassen 1961).
Closterium sinuosum Williamson, sp. nov. (Williamson 1994).
Closterium spetsbergense Borge var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1930).
Closterium spetsbergense Borge var. *laticeps* Grönblad f. *majus* Croasdale, f. nov. (Grönblad, Croasdale 1971).
Closterium spetsbergense Borge var. *subafricanum* Claassen, var. nov. (Claassen 1961).
Closterium spinosporum Hodgetts, sp. nov. (Hodgetts 1926).
Closterium spinosporum Hodgetts var. *minus* Hodgetts, var. nov. (Hodgetts 1926).
Closterium stellenboschense Hodgetts, sp. nov. (Hodgetts 1926).

Closterium striolatum Ehrenb. var. *nylstromicum* Claassen, var. nov. (Claassen 1961).
Closterium striolatum Ehrenb. var. *subnylstromicum* Claassen, var. nov. (Claassen 1961).
Cosmarium subdecorum Claassen, sp. nov. (Claassen 1961).
Closterium sublagoense Claassen, sp. nov. (Claassen 1961).
Cosmarium subsiliqua Claassen, sp. nov. (Claassen 1961).
Closterium truncatum Claassen, sp. nov. (Claassen 1961).
Closterium tumidum Johnson var. *angustum* Claassen, var. nov. (Claassen 1961).
Closterium venus Kützing var. *debegenica* Cholnoky, var. nov. (Cholnoky 1954a).
Closterium venus Kützing var. *inflatum* Claassen, var. nov. (Claassen 1961).
Closterium warmbadianum Claassen, sp. nov. (Claassen 1961).
Closterium warmbadianum Claassen var. *porulosum* Claassen, var. nov. (Claassen 1961).

Pleurotaenium caffrorum Claassen, sp. nov. (Claassen 1961).
Pleurotaenium ehrenbergii (Bréb.) var. *waterbergense* Claassen, var. nov. (Claassen 1961).
Pleurotaenium multitaeniatum Rino var. *coronatum* Williamson, var. nov. (Williamson 1994).
Pleurotaenium pseudoehrenbergii Claassen, sp. nov. (Claassen 1961).
Pleurotaenium trabecula (Ehrenb.) Näg. var. *angustum* Claassen, var. nov. (Claassen 1961).
Pleurotaenium trabecula (Ehrenb.) Näg. var. *barbaricum* Claassen, var. nov. (Claassen 1961).
Pleurotaenium trabecula (Ehrenb.) Näg. var. *brevis* Claassen, var. nov. (Claassen 1961).
Pleurotaenium trochiscum W. et G.S. West var. *galpinii* Claassen, var. nov. (Claassen 1961).
Pleurotaenium truncatum (Bréb.) Näg. var. *mattiei* Claassen, var. nov. (Claassen 1961).
Pleurotaenium westiorum Claassen, sp. nov. (Claassen 1961).

Tetmemorus euastroides A.M. Scott et Prescott var. *africanus* Coesel et Van Geest, var. nov. (Coesel, van Geest 2008).

Euastrum africanum (Bourrelly) Coesel et Van Geest, stat. nov. (Coesel, van Geest 2008).
Euastrum ansatum Ralfs var. *robustum* Ducell. f. *gracilior* Huber-Pestalozzi, f. nov. (Huber-Pestalozzi 1930).
Euastrum attenuatum Wolle var. *groenbladii* Coesel et Van Geest, var. nov. (Coesel, van Geest 2008).
Euastrum bainsii Williamson, sp. nov. (Williamson 1994).
Euastrum biceps Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum binale (Turp.) Ehrenb. var. *juvae* Croasdale, var. nov. (Grönblad, Croasdale 1971).
Euastrum brasiliense Borge var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Euastrum brasiliense Borge var. *theronii* Claassen, var. nov. (Claassen 1961).
Euastrum capense Fritsch, sp. nov. (Fritsch 1918).

Euastrum capense Fritsch var. *knysnanum* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
Euastrum capitatum Huber-Pestalozzi, sp. nov. (Huber-Pestalozzi 1930).
Euastrum compereanum Coesel et Van Geest, nom. et stat. nov. (Coesel, van Geest 2008).
Euastrum cuneatum Jenner var. *minor* Claassen, var. nov. (Claassen 1961).
Euastrum degii Williamson, sp. nov. (Williamson 1994).
Eustrum divaricatum Lund. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Euastrum divergens Lund. var. *galpinii* Claassen, var. nov. (Claassen 1961).
Euastrum divergens Joshua var. *subbifidum* Claassen, var. nov. (Claassen 1961).
Eustrum dubitalibilis Claassen, sp. nov. (Claassen 1961).
Euastrum dubium Näg. var. *transvaalense* Cholnoky, var. nov. (Cholnoky 1955).
Euastrum elegans (Bréb.) Kütz. var. *compactum* (Wolle) Krieg. f. *miriforme* Croasdale, f. nov. (Grönblad, Croasdale 1971).
Euastrum elegans (Bréb.) Kütz. var. *symmetricum* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Euastrum elegans (Bréb.) Kütz. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Euastrum fritschii Coesel et Van Geest, nom. et stat. nov. (Coesel, van Geest 2008).
Euastrum galpinii Claassen, sp. nov. (Claassen 1961).
Euastrum incertum Fritsch et Rich, sp. nov. (Fritsch, Rich 1924).
Euastrum inerme (Ralfs) Lund. f. *africana* Cholnoky, f. nov. (Cholnoky 1955).
Euastrum knysnanum Huber-Pestalozzi, sp. nov. (Huber-Pestalozzi 1930).
Euastrum monocyllum (Nordst.) Racib. var. *abbreviata* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Euastrum okavangicum Coesel et Van Geest, sp. nov. (Coesel, van Geest 2008).
Euastrum platycerum Reinsch var. *obtusius* Grönblad et Croasdale, var. nov. (Grönblad, Croasdale 1971).
Euastrum praemorsum (Nordst.) Schmidle var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Euastrum pseudocoralloides Fritsch, sp. nov. (Fritsch 1918).
Euastrum pseudovalidum Claassen, sp. nov. (Claassen 1961).
Euastrum pulcherrimum W. et G.S. West var. *ornatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Euastrum quadriceps Nordst. var. *minor* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Eustrum rectangulare Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum rostratum Ralfs subsp. *umbonatum* W. et G.S. West var. *kranskopense* Claassen, var. nov. (Claassen 1961).
Euastrum rostratum Ralfs var. *transvaalensis* Cholnoky, var. nov. (Cholnoky 1954b).
Euastrum schweickerdtii Claassen, sp. nov. (Claassen 1961).
Euastrum scottii Coesel et Van Geest, nom. et stat. nov. (Coesel, van Geest 2008).
Euastrum sibiricum Boldt. var. *capense* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
Euastrum simpliciforme F.E. Fritsch, sp. nov. (Fritsch, Stephens 1921).
Euastrum spinulosum Delp. var. *borgei* Williamson, var. nov. (Williamson 1994).
Euastrum spinulosum Delp. subsp. *africanum* Nordst. var. *transvaalense* Claassen, var. nov. (Claassen 1961).

Euastrum splendens Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum subcrassum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum subinoisum (?) Reinsch, sp. nov. (Reinsch 1878).
Euastrum subhypochondrum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum submontanum F.E. Fritsch, sp. nov. (Fritsch, Stephens 1921).
Euastrum subpraemorsum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Euastrum sudanense Coesel et Van Geest, sp. nov. (Coesel, van Geest 2008).
Euastrum theronii Cholnoky, sp. nov. (Cholnoky 1954b).

Micrasterias americana (Ehrenb.) Ralfs var. *transvaalensis* Claassen, var. nov. (Claassen 1961).
Micrasterias apiculata (Ehrenb.) Menegh. var. *lacerata* Turn. f. *ornata* Williamson, f. nov. (Williamson 1994).
Micrasterias bewsii Fritsch et Rich, sp. nov. (Fritsch, Rich 1924).
Micrasterias crux-melitensis (Ehrenb.) Hass. var. *aequalis* Rich, var. nov. (Rich 1932).
Micrasterias crux-melitensis (Ehrenb.) Hass. var. *transvaalensis* Claassen, var. nov. (Claassen, 1961).
Micrasterias decemdentata (Näg.) Arch. var. *galpinii* Claassen, var. nov. (Claassen 1961).
Micrasterias denticulata Bréb. var. *africana* Claassen, var. nov. (Claassen 1961).
Micrasterias denticulata Bréb. var. *subnotata* West f. *cornuta* Claassen, f. nov. (Claassen 1961).
Micrasterias groenewaldii Claassen, sp. nov. (Claassen 1961).
Micrasterias mahabuleshwarensis Hobson var. *transvaalensis* Claassen, var. nov. (Claassen 1961).
Micrasterias nylstromica Claassen, sp. nov. (Claassen 1961).
Micrasterias pinnatifida (Kütz.) Ralfs var. *transvaalensis* Claassen, var. nov. (Claassen 1961).
Micrasterias schmidleana Coesel et Van Geest, nom. et stat. nov. (Coesel, van Geest 2008).
Micrasterias tropica Nordst. var. *elongatissima* Claassen, var. nov. (Claassen 1961).
Micrasterias tropica Nordst. var. *tenuior* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Micrasterias truncata (Corda) Bréb. var. *africana* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Micrasterias truncata (Corda) Bréb. var. *minor* Claassen, var. nov. (Claassen 1961).

Cosmarium abnorme Nordstedt var. *triocetrum* Reinsch, var. nov. (Reinsch 1878).
Cosmarium adoxum W. et G.S. West f. *minor* Huber-Pestalozzi, f. nov. (Huber-Pestalozzi 1930).
Cosmarium asperulum Reinsch, sp. nov. (Reinsch 1978).
Cosmarium barbaricum Claassen, sp. nov. (Claassen 1961).
Cosmarium bewsii Fritsch et Rich, sp. nov. (Fritsch, Rich 1924).
Cosmarium bituberculatum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Cosmarium botesii Claassen, sp. nov. (Claassen 1961).
Cosmarium botrytis Menegh. var. *pegleri* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).

Cosmarium caffrorum Claassen, sp. nov. (Claassen 1961).
Cosmarium capense De Toni var. *minor* Fritsch, var. nov. (Fritsch 1918).
Cosmarium ciskeium Williamson, sp. nov. (Williamson 1994).
Cosmarium connatum Bréb. var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium connatum Bréb. var. *subellipticum* Claassen, var. nov. (Claassen 1961).
Cosmarium conspersum Ralfs var. *capense* Hodgetts, var. nov. (Hodgetts 1926).
Cosmarium contractum Kirchn. var. *pseudogartanense* Claassen, var. nov. (Claassen 1961).
Cosmarium debaryi Arch. var. *minor* Claassen, var. nov. (Claassen 1961).
Cosmarium decoratum W. et G.S. West var. *galpinii* Claassen, var. nov. (Claassen 1961).
Cosmarium decoratum W. et G.S. West var. *waterbergense* Claassen, var. nov. (Claassen 1961).
Cosmarium doidgei Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Cosmarium doidgei Fritsch et Rich var. *depressum* Coesel et Van Geest, var. nov. (Coesel, van Geest 2009).
Cosmarium favum W. et G.S. West var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium fritschii Hodgetts, sp. nov. (Hodgetts 1926).
Cosmarium fuelleborniforme Coesel et Van Geest, sp. nov. (Coesel, van Geest 2009).
Cosmarium galpinii Claassen, sp. nov. (Claassen 1961).
Cosmarium gayanum De Toni var. *rotundata* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).
Cosmarium geometricum W. et G.S. West var. *adoxoides* G.S. West, var. nov. (West 1912).
Cosmarium granatum Bréb. var. *africanum* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).
Cosmarium granatum Bréb. var. *latum* Rich, var. nov. (Rich 1940).
Cosmarium hammeri Reinsch var. *africanum* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).
Cosmarium hammeri Reinsch var. *minor* Claassen, var. nov. (Claassen 1961).
Cosmarium haynaldii Schaarschm. var. *africanum* Coesel et Van Geest, var. nov. (Coesel, van Geest 2009).
Cosmarium haynaldii Schaarschm. var. *ambadiense* (Grönblad et A.M. Scott) Coesel et Van Geest, comb. nov. (Coesel, van Geest 2009).
Cosmarium hellbergii Grönblad et Croasdale, sp. nov. (Grönblad, Croasdale 1971).
Cosmarium javanicum Nordst. var. *profundo-constrictum* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Cosmarium karibanum Coesel et Van Geest, nom. et stat. nov. (Coesel, van Geest 2009).
Cosmarium laeve Nordst. var. *distentum* G.S. West, var. nov. (West 1912).
Cosmarium laeve Nordst. var. *majus* Claassen, var. nov. (Claassen 1961).
Cosmarium laeve Rabenh. var. *pseudo-octangularis* Frich et Rich, var. nov. (Fritsch, Rich 1930).
Cosmarium lobatum Boergensen var. *elliptica* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).

Cosmarium logiense Bisset f. *subcirculare* Williamson, f. nov. (Williamson 2000).
Cosmarium mansangense W. et G.S. West var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Cosmarium margaritifерum Menegh. var. *exsertum* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).
Cosmarium mbabanicum Williamson, sp. nov. (Williamson 1994).
Cosmarium meneghini Bréb. f. *africana* F.E. Fritsch, f. nov. (Fritsch, Stephens 1921).
Cosmarium moremiense Coesel et Van Geest, sp. nov. (Coesel, van Geest 2009).
Cosmarium multituberculatum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Cosmarium nanum Claassen, sp. nov. (Claassen 1961).
Cosmarium nylstromica Claassen, sp. nov. (Claassen 1961).
Cosmarium obsoletum (Hantzsch) Reinsch var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Cosmarium obtusatum Schmidle var. *undulatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium ocellatum Eichl. et Gutw. var. *rotundatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium okavangicum Coesel et Van Geest, sp. nov. (Coesel, van Geest 2009).
Cosmarium orthostichum Lund. var. *pseudopumilum* Claassen, var. nov. (Claassen 1961).
Cosmarium orthostichum Lund. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Cosmarium pachydermum Lund. var. *tuberculatum* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).
Cosmarium pachydermum Lund. var. *waterbergense* Claassen, var. nov. (Claassen 1961).
Cosmarium pappekuilense G.S. West, sp. nov. (West 1912).
Cosmarium pearsoni G.S. West, sp. nov. (West 1912).
Cosmarium pericymatium Nordst. var. *latior* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium permaculatum Grönblad et A.M. Scott var *bituberculatum* Coesel et Van Geest, var. nov. (Coesel, van Geest 2009).
Cosmarium pseudobiremum Boldt. var. *punctatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium pseudopachydermum Nordst. var. *incrassata* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium pseudopraemorsum Hodgetts, sp. nov. (Hodgetts 1926).
Cosmarium pseudoprotractum Claassen, sp. nov. (Claassen 1961).
Cosmarium pseudoprotuberans Kirchn. var. *retusifforme* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmarium pseudoquadrifarium Cholnoky, sp. nov. (Cholnoky 1954b).
Cosmarium pseudosexangulare Hodgetts, sp. nov. (Hodgetts 1926).
Cosmarium pseudotaxichondrum Nordst. var. *atomicum* Claassen, var. nov. (Claassen 1961).
Cosmarium pseudotus Coesel et Van Geest, sp. nov. (Coesel, van Geest 2009).
Cosmarium pseudoxanthidium Coesel et Van Geest, nom. nov. (Coesel, van Geest 2009).
Cosmarium pyramidatum Bréb. var. *elongatum* Claassen, var. nov. (Claassen 1961).

Cosmarium pyramidatum Bréb. var. *majus* Claassen, var. nov. (Claassen 1961).
Cosmarium quadratum Ralfs var. *africanum* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921)
Cosmarium quadratum Ralfs var. *willei* Schmidle f. *punctata* Hodgetts, f. nov. (Hodgetts 1926).
Cosmarium quadratum Lund. var. *distentum* Fritsch et Rich, var. nov. (Fritsch, Rich 1930).
Cosmarium rarissimum Williamson, sp. nov. (Williamson 1996).
Cosmarium salisburii Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Cosmarium schweickerdtii Claassen, sp. nov. (Claassen 1961).
Cosmarium scrobiculatum Fritsch et Rich, sp. nov. (Fritsch, Rich 1930).
Cosmarium sexangulare Lund. f. *minutissima* Fritsch et Rich, f. nov. (Fritsch, Rich 1924).
Cosmarium sexangulare Lund. var. *subangulare* Fritsch, var. nov. (Fritsch 1918).
Cosmarium sexnotatum Gutw. var. *simplex* Claassen, var. nov. (Claassen 1961).
Cosmarium smolandicum Lund var. *maius* Cholnoky, var. nov. (Cholnoky 1955).
Cosmarium speciosum Lund. var. *reductum* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
Cosmarium speciosum Lund. var. *simplex* Nordst. f. *africanum* Claassen, f. nov. (Claassen 1961).
Cosmarium sportella Bréb. var. *simplex* F.E. Fritsch, var. nov. (Fritsch, Stephens 1921).
Cosmarium sp. nov. (Reinsch 1878).
Cosmarium stephensii Rich, sp. nov. (Rich 1932).
Cosmarium subbromei Schmidle var. *pseudopearsoni* Fritsch, nov. nov. (Fritsch 1918).
Cosmarium subconnatum Claassen, sp. nov. (Claassen 1961).
Cosmarium subcostatum Nordst. var. *warmbadianum* Claassen, var. nov. (Claassen 1961).
Cosmarium subhumile Rich. var. *reductum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Cosmatium submonomazum Rich, sp. nov. (Rich 1932).
Cosmarium subprotumidum Nordst. subsp. *simplex* F.E. Fritsch, subsp. nov. (Fritsch, Stephens 1921).
Cosmarium subtumidum Nordst. var. *theronii* Claassen, var. nov. (Claassen 1961).
Cosmarium subundulatum Wille var. *minor* Fritsch et Rich, var. nov. (Fritsch, Rich 1930).
Cosmarium sulcatum Nordst. var. *compressum* Rich, var. nov. (Rich 1940).
Cosmarium synthlibomenum West var. *africanum* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
Cosmarium taxichondrum P. Lundell var. *pentachondrum* (Bourr.) Coesel et Van Geest, comb. nov. (Coesel, van Geest 2009).
Cosmarium tetragonum (Näg.) Archer. var. *tetragonum* f. *punctata* Hodgetts, f. nov. (Hodgetts 1926).
Cosmarium tetragonum (Näg.) Archer. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
Cosmarium tinctum Ralfs var. *intermedium* Nordst. f. *minor* Huber-Pestalozzi, f. nov. (Huber-Pestalozzi 1930).
Cosmarium trachyleurum Lund. var. *natalensis* Fritsch et Rich, var. nov. (Fritsch, Rich 1924).

- Cosmarium trachypleurum* Lund. var. *pseudonatalensis* Claassen, var. nov. (Claassen 1961).
- Cosmarium trachypleurum* Lund. var. *pseudonatalensis* Claassen f. *irregularare* Claassen, f. nov. (Claassen 1961).
- Cosmarium trachypleurum* Lund. var. *subspinosum* Claassen, var. nov. (Claassen 1961).
- Cosmarium transvaalense* Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
- Cosmarium transvaalense* Claassen, sp. nov. (Claassen 1961).
- Cosmarium trilobulatum* Reinsch. f. *major* Huber-Pestalozzi, f. *major* (Huber-Pestalozzi 1930).
- Cosmarium ungerianum* (Näg.) De Bary var. *bohemicum* Lütkem. f. *minus* Williamson, f. nov. (Williamson 1994).
- Cosmarium waterbergense* Claassen, sp. nov. (Claassen 1961).
- Holacanthum mogolense* Cholnoky, sp. nov. (Cholnoky 1954b).
- Xanthidium brevispinum* Fritsch, sp. nov. (Fritsch 1918).
- Xanthidium cristatum* Bréb. var. *delpontei* Roy et Biss. f. *laevis* Claassen, f. nov. (Claassen 1961).
- Xanthidium cristatum* Bréb. var. *transvaalense* Claassen, var. nov. (Claassen 1961).
- Xanthidium decoratum* Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
- Xanthidium helenae* Huber-Pestalozzi, sp. nov. (Huber-Pestalozzi 1930).
- Xanthidium micracanthum* Grönblad et A.M. Scott var. *angustatum* Coesel et Van Geest, var. nov. (Coesel, van Geest 2009).
- Arthrodesmus bifidus* Bréb. var. *iniquispinosus* Huber-Pestalozzi, var. nov. (Huber-Pestalozzi 1930).
- Arthrodesmus quiriferus* W. et G.S. West var. *evolutus* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
- Arthrodesmus subulatus* Kütz. var. *validus* (W. et G.S. West) Fritsch et Rich, comb. nov. (Fritsch, Rich 1938).
- Arthrodesmus theronii* Cholnoky, sp. nov. (Cholnoky 1954b).
- Staurastrum americanum* (W. et G.S. West) Smith var. *elaboratum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
- Staurastrum barbaricum* Claassen, sp. nov. (Claassen 1961).
- Staurastrum bohlinianum* Schmidle var. *capense* Hodgetts, var. nov. (Hodgetts 1926).
- Staurastrum brevispinum* Bréb. var. *masoganum* Claassen, var. nov. (Claassen 1961).
- Staurastrum caffrorum* Claassen, sp. nov. (Claassen 1961).
- Staurastrum caledonense* G. Huber, sp. nov. (Huber-Pestalozzi 1929).
- Staurastrum capense* Hodgetts, sp. nov. (Hodgetts 1926).
- Staurastrum connatum* Roy et Biss. var. *warmbadianum* Claassen, var. nov. (Claassen 1961).
- Staurastrum crenatum* Claassen, sp. nov. (Claassen 1961).
- Staurastrum cyclacanthum* W. et G.S. West var. *africanum* Croasdale, var. nov. (Grönblad, Croasdale 1971).
- Staurastrum dickiei* Ralfs f. *longispina* Fritsch et Rich, f. nov. (Fritsch, Rich 1938).

Staurastrum disputatum Ehrenb. var. *annulatum* Rich, var. nov. (Rich 1940).
Staurastrum doidgei Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Staurastrum exiguum Reinsch, sp. nov. (Reinsch 1878).
Staurastrum furcatum (Ehrenb.) Bréb. f. *richae* Croasdale, f. nov. (Grönblad, Croasdale 1971).
Staurastrum galpinii Claassen, sp. nov. (Claassen 1961).
Staurastrum gemelliparum Nordst. var. *africanum* Claassen, var. nov. (Claassen 1961).
Staurastrum hexacerum Wittr. var. *reductum* Hodgetts, var. nov. (Hodgetts 1926).
Staurastrum hexagonale Fritsch, sp. nov. (Fritsch 1918).
Staurastrum johnsonii W. et G.S. West var. *altior* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Staurastrum laevispinum Biss. var. *abbreviata* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Staurastrum leptocladum Nordst. var. *simplex* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Staurastrum leptodermum Lund. var. *subcorniculatum* Rich, var. nov. (Rich 1932).
Staurastrum longiradiatum W. et G.S. West var. *elevatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Staurastrum lunatum Ralfs facies *biradiatum* Williamson, nom. nov. (Williamson 1994).
Staurastrum mandfeldtii Delp. var. *africanum* Hodgetts, var. nov. (Hodgetts 1926).
Staurastrum mattiei Claassen, sp. nov. (Claassen 1961).
Staurastrum mesianum Claassen, sp. nov. (Claassen 1961).
Staurastrum mogolense Cholnoky, sp. nov. (Cholnoky 1954b).
Staurastrum okavangicum Coesel et Van Geest, sp. nov. (Coesel, van Geest 2009).
Staurastrum orbiculare Ralfs var. *waterbergense* Claassen, var. nov. (Claassen 1961).
Staurastrum pseudogemmulum Claassen, sp. nov. (Claassen 1961).
Staurastrum pseudogemmulum Claassen var. *warmbadianum* Claassen, var. nov. (Claassen 1961).
Staurastrum pygmaeum Bréb. var. *botesii* Claassen, var. nov. (Claassen 1961).
Staurastrum quadrangulare Bréb. var. *subarmatum* Claassen, var. nov. (Claassen 1961).
Staurastrum schuurmani Rich, sp. nov. (Rich 1932).
Staurastrum setigerum Cleve var. *pectinatum* W. et G.S. West f. *australe* Claassen, f. nov. (Claassen 1961).
Staurastrum stelliferum Borge var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).
Staurastrum stephensii Rich, sp. nov. (Rich 1932).
Staurastrum subgemmaulatum W. et G.S. West var. *mattiei* Claassen, var. nov. (Claassen 1961).
Staurastrum subjohnsonii Rich, sp. nov. (Rich 1932).
Staurastrum subjohnsonii Rich var. *minor* Rich, var. nov. (Rich 1932).
Staurastrum subunguiferum Fritsch et Rich, sp. nov. (Fritsch, Rich 1938).
Staurastrum subwestitum Rich, sp. nov. (Rich 1932).

Staurastrum teliferum Ralfs var. *transvaalense* Claassen, var. nov. (Claassen 1961).

Staurastrum theronii Cholnoky, sp. nov. (Cholnoky 1954b).

Staurastrum transvaalensis Cholnoky, sp. nov. (Cholnoky 1954b).

Staurastrum trihedrale Wolle var. *australe* Claassen, var. nov. (Claassen 1961).

Staurastrum tumidum Bréb. var. *bipapillatum* Croasdale, var. nov. (Grönblad, Croasdale 1971).

Staurastrum unguiferum Turner. var. *corniculatum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).

Staurastrum xiphidiophorum Wolle var. *westiorum* Claassen, var. nov. (Claassen 1961).

Staurastrum zahlbruckneri Lütkemüller var. *africanum* Fritsch et Rich, var. nov. (Fritsch, Rich 1938).

Sphaerosma aubertianum West var. *compressum* Rich, var. nov. (Rich 1932).

Sphaerosma aubertianum West var. *himevillii* Williamson, var. nov. (Williamson 1994).

Desmidiium quadratum Nordst. f. *punctata* Fritsch et Rich, f. nov. (Fritsch, Rich 1938).

New taxonomical combinations

Closterium claassenii Levanets, nom. nov. (Basionym: *Closterium pseudolunula* Claassen 1961, *Bothalia* 7, p.575, Tab.4, fig.1; non *Closterium pseudolunula* Borge 1909, p.3).

Cosmarium claassenii Levanets, nom. nov. (Basionym: *Cosmarium transvaalense* Claassen 1961, *Bothalia* 7, p.597, Tab.25, fig.11; non *Cosmarium transvaalense* Fritsch et Rich 1938, pp.198-199, Fig.13, *F-H*).

Xanthidium mogolense (Cholnoky) Levanets, comb. nov. (Basionym: *Holocanthum mogolense* Cholnoky 1954, *Österreichischen Botanischen Zeitschrift*, Band 101, Heft 1/2, p.135, Fig.44).