The Theory of Type and the Natural System

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(Table 1—3)

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I

In divers realms of Science one comes continually across the idea of a type and its derivatives, but in the science of biology especially the notion of a definite type is of special importance. In nearly every systematical monograph "typical" and "deviating" forms are mentioned. In the domain of morphology we also have to do with typical organs and typical structures. The idea of a typical reaction is continually used in experimental biology.

And yet the notion of type, though worthy through importance of being carefully analysed, is not even exactly defined. When using the expression "type" and "typical form" authors evidently suppose that any further explanation is superfluous. But if we were to ask for a more exact definition, we would only be told that "it is in typical forms that the peculiarities of the given systematical group are most evident", or that this form "serves as a specimen of the group".

Such definitions are clearly insufficient. All these questions pertain essentially to scientific classification and therefore it is for the systematician that their elucidation is of the greatest value. In no other branch of biology is the need of an analysed notion of type so evident as in systematic. The fundamental principle of this science—the principle of a natural system—is indissolubly fixed to the notion of type.

The author of this article, being a systematician himself, has felt for a long time already the necessity of solving the problem so as to: *firstly*, simplify and correct the methods used in systematics and, *secondly*, to promote a more complete systematical research.

The problem of type is a too complicated and extensive one to be worked out fully in a small article. The author considers his present work only as a tentative essay in this direction. To solve completely this problem necessitates a long and systematical study.

The most distinguished morphologists and comparative-anatomists of the past understood clearly the necessity of working out the problem of type: one can gather as much from the works of GOETHE, G. DE SAINT-HILAIRE and later OKEN, OWEN and others.

The researches of GOETHE, the first in this direction, are of especial interest, as he has most correctly stated the fundamental question and indicated several ways of answering it.

Let us see how GOETHE approaches the problem of type and what reasons he gives for its existence. In an article of the year 1795 (¹), he circulates the following opinion.

The progress of Natural Science is founded on the comparative study of facts. The resemblance between man and animals (of the highest classes) is evident, but yet no fixed point of comparison exists.

Animals have been compared with each other and with man. But all had to be compared with every one, and each one with all. It is evident that thus one cannot arrive at a general idea. Therefore GOETHE proposes to create a certain "anatomical type", like "a collective presentment containing the peculiarities of all animals and which could be used for describing different animal forms in a definite order".

From the general notion of what is type, one concludes already that no one animal can be used as a norm of comparison, because no separate unit making part of a whole can serve as a specimen of this whole.

A type having been elaborated, it can be used for comparisons in a twofold manner: either different species of animals are compared with the type (and in this case there is no necessity to compare

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(¹) Erster Entwurf einer allgemeinen Einleitung in die vergleichende Anatomie, ausgehend von der Osteologie.

Zur Morphologie, I. Band, 2. Heft. Jena 1795.

animals to each other, the comparison of their descriptions sufficing), or same special organ is studied in various representatives.

In another article, of the year 1796(²), GOETHE again insists on the necessity of paying attention to the *whole* when comparing animal forms.

"If Creative Power produces perfect organic forms according to one general scheme, we cannot visualise this plan, if only mentally, and then use it as a norm of comparison, working out our descriptions according to it and comparing with it the most varied forms."

We cannot take as a unit of comparison a separate genus, because classes, genera, species are to the whole as special cases are to the law — they are contained in it, but not vice versa.

From what precedes one can understand clearly the importance GOETHE attributes to the elaboration of type: type must serve for comparison, be a norm conformed to in describing the different forms of animals.

The peculiarity of type according to GOETHE is a synthetic-type and though unique contains in itself an enormous variety of forms.

In the first of the articles mentioned GOETHE says that not only the permanent, but also the mutable must be studied to enable one to follow the type in all its variations. Insisting on the unity of type, he gives the name of metamorphoses to its variations. A good example of such variations are different parts of a plant, such as petals, sepals etc. GOETHE has consecrated a well known treatise to the metamorphosis of plants (³).

According to GOETHE, another example of metamorphosis may be seen in the vertebrae—as a whole they are similar, but if one compares the first vertebra with the caudal one, it is difficult to find at first sight even the smallest resemblance between them. Yet at the same time there can be no doubt that all vertebrae belong to the same type.

In spite of the manifold diversity of variations GOETHE thinks quite possible the elaboration of a type, because metamorphosis is a limited and fixed process. Nature, says GOETHE, does not deviate from the principal characteristics of each separate part, and this allows us

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(²) Vorträge über drey ersten Capitel des Entwurfs einer allgemeinen Einleitung in die vergleichende Anatomie, ausgehend von der Osteologie, 1796. (Zur Morphologie, I. Bd., 3. Heft.)

(³) Die Metamorphose der Pflanzen. Zur Morphologie, I. Bd., 1807.

to find the type from which proceed the numerous genera and species of perfect (4) animals.

We thus clearly see what GOETHE means when he talks about type and its variations. The principal aim of the type theory is to find such a unit which will contain all multiplicity of form.

Let us see further how GOETHE tries to solve this problem. In the first treatise (1) he shows us an "osteological type" elaborated for mammals. This „type" consists, to begin with, in a list of every bone to be found in each and every mammal. In this catalogue the bones are listed in a certain order, beginning with the cranium and ending with the extremities. Furthermore GOETHE examines the manner in which bones vary in different specimens of Mammalia.

The variations consist in peculiarities of bone concretions, their continuously changing surfaces, peculiarities of quantity, size and form. All these properties of different bones are subject to metamorphosis and different combinations are to be found in different representatives. Sometimes whole elements, parts of the common type, are missing. "Experience shows us which parts are common to different animals and also in what consists the difference between them."

Such is the context of GOETHE's idea of type.

II.

The theory of type must solve two problems. The first is to find a certain norm of comparison, or unit of measurement, by means of which all the variations (metamorphoses) of type might be noted in a uniform manner.

The second, more complex, problem is to elaborate such a synthetical construction, which would be characteristic of the whole group of manifestations belonging to the same given type.

The necessity of a norm of comparison is particularly insisted upon by GOETHE in his works, but this problem is of course far from having been solved by him.

He has only faintly outlined the second problem, although in many parts of his work he mentions the *synthetical* character of type and says that a type must express the different features of all its variations.

Both problems may finally by reduced to one only. It is evident that to do this we must find such a unit of comparison, which should

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(4) that is Vertebrate animals.

be at same time characteristic of a given group of manifestations. This ideal notion is what we shall call a *type.*

Type cannot be produced abstractly(⁵) as we can see from what follows. Let us designate a row of features by the letters a, b, c . . . . . n. The combinations of these letters, we suppose to be characteristic of the genera belonging to one family.

abdfkl . . . + bedkmn . . . + abcdmo . . .
+ bdefln . . . + abcdef . . . . + abdikl.

By abstraction, proceeding from particularization to generalities, we can see which manifestations are common to all the genera of this family:

bd . . . (afkl . . . + ekmn . . . + acmo . . . + efln . . . + acef . . . + aikl).
It is clear that the common features *bd* are unsufficient to characterise the family, because they give a most incomplete representation of it; the quantity of features common to all genera in a family is very small, as compared with the particularities specific to each genus. And thus all the variations of its construction will have no influence whatever on the common characteristics. In other words, type cannot be evolved by abstraction, it must be synthetical. Every organic peculiarity, however insignificant it may be, of each member of a group must be reflected in the type.

We shall now examine the methods of creating a synthetical type.

Let us take quite the simplest case—the diversity of some features in individuals belonging to one species, the diversity of size, for example, and particularly the length of the body. According to the law of QUETELET, all observed variations in length will form a binomial curve of distribution and the arithmetical mean will be the type of the given feature.

This mean is effectively the ideal norm of comparison because we can note each variation as a certain deviation (positive or negative, but still measurable) from the normal. On the other hand, the mean contains all existing variations of feature, because every separate variation, however small, has an influence on the magnitude of the mean.

Thus in the given simplest case the mean solves the above mentioned problem of type, because it fulfills the conditions which we required of it.

(⁵) RAUTHER, M., Über den Begriff der Verwandtschaft. — Zool. Jhrb., Suppl. 15, Bd. 3, 1912.

Let us now examine a more complex case, namely, let us try to find a type not for a feature, but for a group of individuals forming part of same species.

Every individual of this species we can consider as the sum total of a certain number of features. If the mean of all possible variations of a feature is considered by us as its type, it is evident that the type for all the individuals of the species will be the sum total of the means of all features. This "medium individual" will satisfy all conditions imposed by us on a type. A very good illustration of the typical individual is the "medium man" of anthropologists, a real medium creature in every way.

We find a brillant analysis of the notion "medium individual" in the book of F. HEINCKE (6).

HEINCKE was able to establish for the herring a whole series of local forms, every one of which was characterised by a fixed geographical habitat on one side and by specific morphological differences on the other; the races being distinguished from each other by differences in the arithmetical means of their features. Each of these races, according to HEINCKE, partakes of a special "ideal type", which is the sum total of the means of different features. HEINCKE analogises separate individuals of the race with the errors common to those who observe a series of objects; these errors are controlled by the law of the greatest numbers.

"In the same way that all separated observations of an object give us as basis its essential dimensions, so at the root of each special feature of all individuals of the race lies the essential (medium, typical) dimension, which is the expression of the local conditions of life. Nature is continually striving to produce these essential dimensions of feature, but she cannot attain this completely: on the contrary, at every attempt she makes a more or less considerable mistake."

"The individuals of whom a race consists are not only in each separate feature, but in the combination of all features—casual variations of an ideal type, which represents the sum total of the means of all features of all individuals, each feature being capable of a certain defined variability."

Though the individuals of a race may be extremely different, still they constitute one whole. This is formulated by HEINCKE as a law:

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(6) F. HEINCKE, Die Naturgeschichte des Herings. — Abh. d. Deutsch. Seefischereivereins. 1897—98.

the sum of quadratic deviations of features from the ideal type of a race is a constant.

"All the individuals (of one race) have the same average deviation from the ideal type, but each of them is characterised by its own transposition of the same series of deviations (in all his features). For all of them the sum of their quadratic deviations from the type of the race is the same and, after all, minimal."

HEINCKE's greatest service to biology is to have applied this method of the least quadratics in creating the ideal type which characterises a race. This method allows us to find the point (or quantity), which is the nearest to the sum total of points (or quantities).

We can thus elaborate a type: the form of all possible ones, which approaches most closely to the sum total of all forms, because a type represents such a quantity, in which the sum of quadratic deviations from all forms is of minimal value. This enables us to consider HEINCKE's ideal type as the quantity the most markedly characterising a race.

HEINCKE quotes the following words of QUETELET elucidating the notion of "ideal type".

"Make a hundred sculptors of the same ability do of the same material as exact a copy as possible of an antique statue. You will obtain a hundred different copies, comparable by analogy to a hundred individuals, animals or plants".

From all that precedes, we can see that HEINCKE not only understood the importance of the theory of type, but also worked to solve the problem of type. What is most important of all, is his being able to find a law closely adhered to in the variations of type, in its "metamorphoses" and in expressing this law mathematically. Unfortunately HEINCKE did not apply these same methods to the systematical categories of a higher order than race. It is to the elucidation of this question especially that the present work is devoted.

In a first article on the theory of system(7), we have already touched on type in connection with the higher systematical units, through without any precise definition of type. We have shown that systematical categories are "congregations", that is conglomerations of similar members of a same order; we gave to the term "congregation" a definite

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(7) Über den Bau der systematischen Kategorien. — Revue Zoologique Russe, 1923 (russian, with germ résumé).

context. We indicated that certain laws preside at the formation of a congregation and remarked on the existence, first, of "typical" or central congregational members, then of peripheric members adjoining them and, lastly, of intermediate ones. A congregation is the realisation of a certain type with all its different variations. Members of the congregation approach more or less closely the type. The nearest it are the central members, which are because of that called *typical.* In the peripherical members type is less clearly defined, while in the intermediate ones, which combine the features of different congregations, we find an interesting example of the combination of two or more different types.

In what way might it be possible to create a type for the higher systematical categories?

We consider that in this case also the method of the mean previously chosen by us is quite applicable(8). As an example we will take a family we have studied—that of the *Syrphidae* (Diptera) and particularly one of its subfamilies, the *Syrphinae.*

To simplify the problem, let us examine only a small group of features—namely, the internal male sexual system—and elaborate its type.

The fig. 2—12 and 14—26 (tab. I—III) represent the male genital system of 24 genera of the subfamily mentioned. We will indicate in a few words its construction.

There are always 2 testicles, seminal ducts, a deferent duct, prostate glands, a seminal ampulla and an ejaculatory canal.

The testicles *(t.)* are either spherical or oval, elongated, sometimes curved. From them proceed the seminal ducts, two in number *(v. s.).* In some genera they blend together, sometimes partly, sometimes in all their length, a single seminal duct being then the result. The vasa seminalia lead into the deferent duct *(v. d.).*, which is a single conduit very variable in length and often more or less strongly curved.

We will designate as the seminal vesicle *(ves. s.)* that part of vas deferens, which is situated opposite the entrance of the seminal ducts. But one must add that this part is not always sufficiently distinguishable from the rest of vas deferens.—The prostate glands *(pr.)* also have an orifice in the deferent duct, immediately below that of the vasa seminalia. They are always two in number.—The seminal ampulla

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(8) Treating the type as a congregate of means, I cannot agree with the way of deduction of type that is recommanded by NAEF in his very important work "Idealistische Morphologie und Phylogenetik," Jena, 1919.

(a.) is situated between the deferent duct and the ejaculatory canal, which is the continuation of the preceding parts *(d. ej.)*. Both these divisions are of no interest in the construction of the typical genital system of the *Syrphinae* and we only mention them casually.

We will use the following notations of dimensions:

V—length of the seminal duct (if the double ducts have blended, the length of the conjoined part is added to the rest of the length).

D—length of deferent duct.

T—length of testicle.

B—width of testicle.

Pr—length of prostate gland.

Ves—length of seminal vesicle.

V_1—length of blended part of seminal ducts.

$B:T$—relation between the width and length of testicle.

$V_1:V$—relation between the length of the blended part and the entire length of the deferent duct.

$P=(V+D+T)$—entire length.

$V:P$—relative length of seminal duct.

$D:P$—relative length of deferent duct.

$T:P$—relative length of testicle.

$Pr:P$—relative length of prostate glands.

As the size of the divisions of the genital system depends largely on the size of the entire body, we have to examine the length of the testicle, seminal and deferent ducts in relation to that quantity which we have called "entire length" *(P)* of the genital system. For the same reason, instead of the absolute length of the blended part of the seminal ducts, we shall examine its relation to the actual length of the ducts. So also the length of the seminal vesicle will be determined by its relation to the length of the entire seminal duct.— We have defined the quantities V, D and T by the equation $V+D+T=P$, thus it is evident that if two of the quantities forming part of P are known to us, the third will be determined automatically by the given equation. Therefore we will in future consider only the terms $V:P$ and $D:P$ and allude to the term $T:P$ only in particular cases.

The sum total of these quantities does not define accurately enough the aspect of the genital system. Thus for example, we have qualified the shape of the testicle by the terms $V:D$ and $B:T$. Of course they do not exhaust all the various aspects of the testicle in the genera of our subfamily. For example we can say that the axis of the testicle takes different inclinations, the testicle can be more or less curved, also it has not always the same width in its entire length, may narrow or widen, and take a shape differing from that of an ellipsoid and so on.

But for characterising the general and most important traits of the genital system, these formulae are sufficient.

Let us further examine the variations of different parts of the genital apparatus in the subfamily we are dealing with. The following table gives us the 24 genera arranged to the increase of *(V : P)*.

1. *Syrphus*	0·66	13. *Heringia*	0·38
2. *Chrysotoxum*	0·63	14. *Chilosia*	0·27
3. *Xanthogramma*	0·61	15. *Sphegina*	0·23
4. *Leucozona*	0·61	16. *Chrysogaster*	0·18
5. *Ischyrosyrphus*	0·60	17. *Paragus*	0·17
6. *Pyrophaena*	0·57	18. *Rhingia*	0·13
7. *Lasiopticus*	0·56	19. *Hammerschmidtia*	0·12
8. *Sphaerophoria*	0.53	20. *Liogaster*	0·11
9. *Platychirus*	0·46	21. *Ferdinandea*	0.10
10. *Didea*	0·44	22. *Orthoneura*	0·09
11. *Bacha*	0·44	23. *Brachyopa*	0·08
12. *Pipiza*	0·44	24. *Neoasaia*	0·07

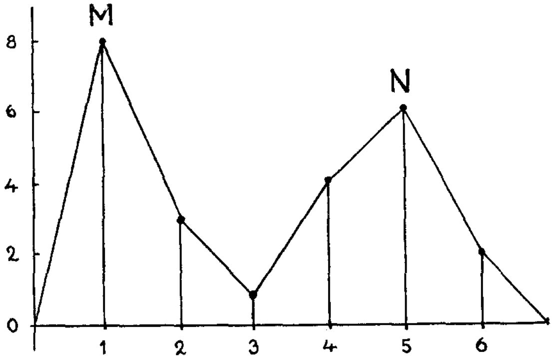
We see that the relation *(V : P)* is very variable and fluctuates from 0·07 to 0·66. In other words, the greatest length is 9·4 times more than the smallest.

Looking over this table, we also notice that the genera classified according to this feature seem to divide into two groups—the first distinguished by a comparatively very long seminal duct, the second by a comparatively short one. This is especially noticeable if we trace a curve of the distribution of the said feature. Let us divide the numbers given for the variation of length into 6 classes and count up how many genera enter into each class. We will fixe at 0·10 the interval of variation for each class. We thus obtain a table:

class	frequency	class	frequency
0·07—0·17	8	0·40—0·50	4
0·18—0·28	3	0·51—0·61	6
0·29—0·39	1	0·62—0·72	2

This division can be indicated by the following curve.

The curve has two evident maxima. The maximum M belongs to the class (0·07—0·17) and the maximum N to the class (0·51—0·61). Between these maxima is a large cavity due to class 3.



Basing ourselves on the given feature, we may divide our genera into two groups, each of which would belong to a different type. We shall show later that such a division is quite reasonable.

Seminal ducts vary not only according to their length, but also according to the length of their blended parts, which we have already noted as $V_1 : V$.

If we place the genera according to the increase of this quantity, we obtain the following table:

1.	*Pipiza*	0·00	13.	*Lasiopticus*	0·62
2.	*Sphegina*	0·00	14.	*Bacha*	0·62
3.	*Chrysogaster*	0·00	15.	*Liogaster*	0·67
4.	*Neoascia*	0·00	16.	*Platychirus*	0·67
5.	*Ferdinandea*	0·31	17.	*Chrysotoxum*	0·68
6.	*Heringia*	0·41	18.	*Ischyrosyrphus*	0·77
7.	*Hammerschmidtia*	0·46	19.	*Rhingia*	0·80
8.	*Xanthogramma*	0·46	20.	*Didea*	0·85
9.	*Orthoneura*	0·54	21.	*Pyrophaena*	0·88
10.	*Chilosia*	0·54	22.	*Brachyopa*	0·89
11.	*Syrphus*	0·55	23.	*Sphaerophoria*	1·00
12.	*Leucozona*	0·60	24.	*Paragus*	1·00

The amplitude of fluctuation is 1. The number 0 shows that the seminal ducts are completely separate from each other, while the number 1 marks on the contrary the complete blending of the ducts. Except these extreme terms of the series, we find several intermediate ones, most of the genera having the relation $V_1 : V$ approaching to $\frac{1}{2}$ or more..

Let us now examine the relation *(T : P)*. According to the increase in dimension of this feature, our 24 genera assume the following disposition:

1.	*Liogaster*	0·16
2.	*Chrysotoxum*	0·19
3.	*Sphegina*	0·22
4.	*Heringia*	0·23
5.	*Pipiza*	0·24
6.	*Chilosia*	0·24
7.	*Rhingia*	0·26
8.	*Syrphus*	0·26
9.	*Sphaerophoria*	0·27
10.	*Ischyrosyrphus*	0·28
11.	*Ferdinandea*	0·29
12.	*Platychirus*	0·29
13.	*Lasiopticus*	0·29
14.	*Pyrophaena*	0·30
15.	*Leucozona*	0·33
16.	*Brachyopa*	0·33
17.	*Xanthogramma*	0·35
18.	*Orthoneura*	0·40
19.	*Chrysogaster*	0·42
20.	*Paragus*	0·42
21.	*Neoascia*	0·43
22.	*Bacha*	0·44
23.	*Didea*	0·50
24.	*Hammerschmidtia*	0·62

One sees from this table that the relative lengths of the testicle vary from 0·16 to 0·62, so that the greatest length is 3·87 times more than the smallest.

The variations in shape of the testicle are characterised first of all by the relation *(B : T)*. This relation gives the following disposition of the genera according to the degree of increase.

1.	*Hammerschmidtia*	0·13
2.	*Orthoneura*	0·21
3.	*Sphaerophoria*	0·27
4.	*Brachyopa*	0·32
5.	*Ferdinandea*	0·42
6.	*Chilosia*	0·50
7.	*Didea*	0·51
8.	*Bacha*	0·55
9.	*Leucozona*	0·58
10.	*Lasiopticus*	0·58
11.	*Neoascia*	0·62
12.	*Pipiza*	0·65
13.	*Heringia*	0·66
14.	*Liogaster*	0·67
15.	*Chrysogaster*	0·69
16.	*Rhingia*	0·69
17.	*Paragus*	0·70
18.	*Sphegina*	0·70
19.	*Ischyrosyrphus*	0·70
20.	*Syrphus*	0.75
21.	*Xanthogramma*	0·81
22.	*Pyrophaena*	0.82
23.	*Platychirus*	0·87
24.	*Chrysotoxum*	0·94

According to this table, we see some very elongated testicles (as in the genus *Hammerschmidtia, Orthoneura, Sphaerophoria*), but in the greatest number of genera the relation approaches to 1, that is that the testicles are nearly spherical in shape. The greatest width is 7·23 times more than the smallest.

Another particularity of shape in the testicle is the curvature of its axis. *Brachyopa* and *Orthoneura* can serve as examples of this curved testicles; both genera are remarkable at the same time for the extreme length of the testicle. In the *Sphaerophoria*, on the other hand, the axis remains straight in spite of the length of the testicle. We find the beginning of a spiral twist of the testicle only in one case—that of the *Hammerschmidtia.* The *Didea* have an aberration in the shape of the testicle—which is bent, not curved, the proximal part being remarkably bulky.

The deferent duct *(D : P)* gives us the following disposition of genera according to the increase in the relative length:

1.	*Xanthogramma*	0·04	13.	*Pipiza*	0·32
2.	*Leucozona*	0·04	14.	*Heringia*	0·38
3.	*Didea*	0·05	15.	*Chrysogaster*	0·40
4.	*Syrphus*	0·07	16.	*Paragus*	0·41
5.	*Ischyrosorphus*	0·11	17.	*Chilosia*	0·49
6.	*Pyrophaena*	0·12	18.	*Neoascia*	0·50
7.	*Bacha*	0·12	19.	*Orthoneura*	0·51
8.	*Lasiopticus*	0·15	20.	*Brachyopa*	0·54
9.	*Chrysotoxum*	0·19	21.	*Sphegina*	0·55
10.	*Sphaerophoria*	0·19	22.	*Rhingia*	0·60
11.	*Platychirus*	0·25	23.	*Ferdinandea*	0·61
12.	*Hammerschmidtia*	0·25	24.	*Liogaster*	0·73

The amplitude is very large—from 0·04 to 0·73. This latter is 18·2 times more than the first. The deferent duct varies greatly, not only in length, but also in shape. Its distal end as a rule broadens and often forms seminal vesicle (of which further). This broadening is either gradual (in the *Liogaster* for example) or sudden, forming, so to say, a special distal part of the duct (as in *Brachyopa, Ferdinandea* and less apparently in *Chilosia*). The axis of the duct is either straight *(Pyrophaena, Chrysogaster)* or more often curved *(Paragus, Sphegina)* or even twisted. This twist is more or less accentuated: in the *Chilosia* we find the beginning of its formation, in the *Brachyopa* it is more developed, and still more so in the *Ferdinandea.*

The seminal vesicle is more or less apparent. Its variations are expressed by the following series:

1. *Syrphus*	0·00	13. *Neoascia*	0·03
2. *Xanthogramma*	0·00	14. *Liogaster*	0·06
3. *Leucozona*	0·00	15. *Chrysotoxum*	0·11
4. *Ischyrosyrphus*	0·00	16. *Ferdinandea*	0·13
5. *Pyrophaena*	0·00	17. *Platychirus*	0·16
6. *Lasiopticus*	0·00	18. *Sphaerophoria*	0.18
7. *Didea*	0·00	19. *Chilosia*	0·24
8. *Bacha*	0·00	20. *Brachyopa*	0·29
9. *Chrysogaster*	0·00	21. *Paragus*	0·38
10. *Hammerschmidtia*	0·00	22. *Pipiza*	0·49
11. *Orthoneura*	0·01	23. *Rhingia*	0·53
12. *Sphegina*	0·02	24. *Heringia*	0·67

Ten genera out of the 24, as we see, miss this seminal vesicle completely, while in the *Heringia*, on the contrary, it takes up most of the length of the deferent duct. In some genera the seminal vesicle is clearly distinct from the rest of the deferent duct, as for instance in the *Ferdinandea*, as we have said already. In the majority of cases it forms a natural continuation of the deferent duct—being situated opposite the orifice of the seminal ducts. In shape the seminal vesicle is elongated (*Heringia*, *Paragus*) or oval shaped (*Ferdinandea*).

We now pass on to the next division of the genital system—the prostate glands. Let us examine the comparative length of this increase in length:

1. *Neoascia*	0·15	13. *Bacha*	0·42
2. *Rhingia*	0·20	14. *Heringia*	0·42
3. *Didea*	0·21	15. *Xanthogramma*	0·47
4. *Sphegina*	0·24	16. *Syrphus*	0.47
5. *Hammerschmidtia*	0·26	17. *Chrysotoxum*	0·48
6. *Ferdinandea*	0·27	18. *Paragus*	0·48
7. *Brachyopa*	0·28	19. *Platychirus*	0·51
8. *Chilosia*	0·28	20. *Ischyrosyrphus*	0·51
9. *Chrysogaster*	0·34	21. *Pyrophaena*	0·52
10. *Pipiza*	0·38	22. *Lasiopticus*	0·53
11. *Liogaster*	0·39	23. *Orthoneura*	0·62
12. *Leucozona*	0·40	24. *Sphaerophoria*	0·94

The relation of the greatest length to the smallest is 6·26. The shape of the prostata glands varies comparatively little. When the glands are very long, they are generally curved (*Sphaerophoria*, *Ortho-*

neura). Habitually the glands are elongated, but in some cases their shape approaches the spherical (in the *Rhingia* especially). The *Paragus* have a broadened proximal part.

Having now a sufficient number of facts, we can begin to construct a type.

In describing the variations of the seminal duct we have shown that this feature allows a division of the genera into two natural groups; we will give later the reason of this.

The groups of the genera are as follows:

I

1. *Syrphus*
2. *Chrysotoxum*
3. *Xanthogramma*
4. *Leucozona*
5. *Ischyrosyrphus*
6. *Pyrophaena*
7. *Lasiopticus*
8. *Sphaerophoria*
9. *Platychirus*
10. *Didea*
11. *Bacha*

(The genera are not placed according to their relations to each other.)

II.

1. *Pipiza*
2. *Heringia*
3. *Chilosia*
4. *Sphegina*
5. *Chrysogaster*
6. *Paragus*
7. *Rhingia*
8. *Hammerschmidtia*
9. *Liogaster*
10. *Ferdinandea*
11. *Orthoneura*
12. *Brachyopa*
13. *Neoascia*

These 2 groups represent two different congregations, the realisation of two different types. Therefore we will elaborate the type separately for each group.

Using the same method of the mean in the higher systematical categories, here also we can define type as being the sum total of the means of every feature.

Let us find the medium size of different features in the Ist group by adding the sizes of the feature in all genera and dividing the sum obtained by the number of genera.

	Ist group	IId group	Difference I—II
1. $M\ (V:P)$	= 0·55	0·18	+ 0·37
2. $M\ (D:P)$	= 0·12	0·48	— 0.36
3. $M\ (Pr:P)$	= 0·50	0·32	+ 0·18
4. $M\ (Ves:D)$	= 0·04	0·22	— 0·18
5. $M\ (B:T)$	= 0·67	0·53	+ 0·14
6. $M\ (V_1:V)$	= 0·70	0·43	+ 0·27

The sum total of the numbers obtained is the type of the genital system of groups I and II.

Let us make a graphical construction of the type of group I.

We assume $P = 100$. The first equation will read:

$$V : 100 = 0{\cdot}55, \text{ hence } V = 55.$$

Correspondingly equations: $D : P = 0{\cdot}12$ and $Pr : P = 0{\cdot}50$ give us $D = 12$ and $Pr = 50$.

Replacing D by its value in equation $Ves : D = 0{\cdot}04$, we obtain $Ves = 0{\cdot}48$. Further:

$$T = P-(D + V) = 100-67 = 33.$$

Replacing T by its value in equation: $B : T = 0{\cdot}67$, we obtain: $B : 33 = 0{\cdot}67$, hence $B = 22{\cdot}11$.

Replacing V by its value in equation $V_1 : V = 0{\cdot}70$, we obtain: $V : 55 = 0{\cdot}70$, hence $V_1 = 38{\cdot}5$.

We now have all the necessary data for constructing the type of the Ist group:

$$P = 100;\ V = 55;\ D = 12;\ Pr = 50;\ T = 33;$$
$$Ves = 0{\cdot}48:\ B = 22{\cdot}11;\ V_1 = 38{\cdot}5.$$

Fig. 1 (tbl. I) represents the ideal type constructed according to all these data.

The type thus elaborated is incomplete, because though the most characteristic features of the male genital system were taken into consideration, yet a whole series of features were not included in the type. Thus for example we characterised the shape of the testicle by the relation of width to length. But in some genera (*Hammerschmidtia*), the testicle is twisted in a spiral, and this aspect has had no influence on the elaborated type.

The same can be said of the unevenness in width of the testicle, as often it is wider in the distal part than in the proximal; likewise about the space of the prostate glands, the deferent duct etc.

Except such like deficiencies, the type thus constructed by us can be considered as the most characteristic representation of the given group of genera, as regards its male genital system, because the sum of quadratic deviations from different representatives is here of minimal value.

On the other hand, the type can serve as an ideal unity of comparison between the different genera and can thus allow of an exact measurement of their similarity. In comparing each separate case with the type, it will be sufficient to find its deviation in different features from the mean forming the type.

As an example we shall examine the genus *Syrphus*. The table which appears further shows the deviation of the *Syrphus* from the type, according to different features. The deviations are here expressed by the differences $(a-M)$, where M is the arithmetic mean (the size of the feature of this type) and a is the size of the feature in the given genus.

Still this method of comparison with the type is not sufficient. Different features do not always vary in the same measure; so, for instance, the quantity $(V:P)$ fluctuates from 0·66 to 0·07, while the feature $(V_1:V)$ varies from 0 to 1. It is evident that a deviation of 0·05 for the first feature removes it further from the type than the same deviation for the second, which has wider margins for its variation. It is clear that the 2d deviation must be diminished by a certain quantity proportionately to the degree of variability of the given feature. That is why Galton expresses deviation from a mean as the multiple of the probable error in a defined binomial curve. In our case we will express the deviation as the multiple of the arithmetical mean of the given feature, that is $(a:M)$.

Having expressed a by means of M, we will further find the deviations of $(a:M)$ from 1, as 1 is nothing but $M:M$. The deviations less than 1 will be negative, those larger positive. The following table shows us the deviations of the genus *Syrphus* from the type in different features of the male genital system.

		Type M	*Syrphus* a	Difference $a-M$	$a:M$	Deviation from 1
1	$V:P$	0·55	0·66	+ 0·11	1·20	+ 0·20
2	$D:P$	0·12	0·07	— 0·05	0·58	— 0·42
3	$Pr:P$	0·50	0·47	— 0·03	0·94	— 0·06
4	$Ves:D$	0·04	0·00	— 0·04	0·00	— 1·00
5	$B:T$	0·67	0·75	+ 0·08	1·12	+ 0·12
6	$V_1:V$	0·70	0·55	— 0·15	0·78	— 0·22

The greatest deviation, and negative as well, is given by the feature $(Ves:D)$—the relative length of the seminal vesicle. In the genus *Syrphus* this vesicle is completely missing, while in the type it attains 0·05. The length of the deferent duct $(D:P)$ also deviate very much from the norm, being by 0·42 shorter than the normal one. The length of the seminal duct on the contrary is more than the norm, though not in too great a measure (+ 0·20). The degree of blending of the seminal ducts deviates considerably from the normal (— 0·22). The relative width of the testicle is a little larger than the typical one (+ 0·12). Lastly the prostate glands are slightly shorter than those of the type (— 0·06).

The table on page 47 contains all numerical data, not only the deviations ($a : M$—1), but also the absolute values of a. The genera are arranged here according to the increase of the feature ($V : P$). Every horizontal row contains the absolute values of each of the 6 features mentioned above and likewise the measures of the deviations from the mean. The combination of 6 such deviations can serve to characterise the construction of the genital system of the given genus.

We have now to answer the following question: how to express the degree of remoteness of the given genus from the type?

We consider that a good indication of this would be the sum total of the deviations in different features expressed by M, the total being made out of the absolute values of the numbers given, the quality of the deviation being of no interest to us in the given case. Such summed up deviations (we willl call them S) are given in the above mentioned table for each of the genera (see two last columns), S_1 being the deviation from the Ist type, S_2—from the IId.

The genera of the Ist type, if placed according to the increase of S_1, give us the following row:

1. *Ischyrosyrphus*	1·33
2. *Pyrophaena*	1·56
3. *Lasiopticus*	1·59
4. *Bacha*	1·66
5. *Syrphus*	2·02
6. *Leucozona*	2·17
7. *Xanthogramma*	2·39
8. *Didea*	2·81
9. *Chrysotoxum*	2·94
10. *Platychirus*	4·60
11. *Sphaerophoria*	6·03

We notice that the genus *Ischyrosyrphus* shows the nearest approach to the type. The size of S for *Sphaerophoria* is nearly 5 times larger than S in the *Ischyrosyrphus*. The other genera are placed between these extreme cases. The three first genera are very like the *Ischyrosyrphus*, but with the *Syrphus* the deviation from the type grows rapidly.

The genus *Ischyrosyrphus* Big. (tbl. I, fig. 2), as the most typical, presents no more or less appreciable deviations. The seminal duct is a little longer than in the type, while the deferent is slightly shorter. The seminal vesicle is absent. A slight surpassig of the norm (+ 0·10) is to be found in the blended seminal duct. The length of the prostate glands and the width of the testicle are nearly the same as in the type.

Pyrophaena Sch. (tbl. I, fig. 3). The characteristic trait of the construction of the genital system of this genus is a strong deviation in the feature $(V_1 : V)$. The blending of the seminal ducts is very considerable (+ 0·26) and is only surpassed in the genus *Sphaerophoria*. The testicles are nearly spherical (+ 0·22), only in the genus *Platychirus* (+ 0·30) and *Chrysotoxum* (+ 0·40) are they still wider. The seminal vesicle is absent. The length of the deferent duct does not deviate from the type. It is interesting to note such a rare case where $\left(\frac{a}{M}-1\right) = 0$. In the 2d (right hand part) of our table zero is to be found only twice (the other case is the deviation of the same feature in the genus *Bacha*). The deviations in the length of the seminal duct and the prostate glands are inconsiderable (+ 0·04).

Lasiopticus Rnd. (tbl. I, fig. 4). No particularly characteristic feature to be noted. The deferent duct is a little longer than the norm (+ 0·25). The testicle is slightly narrower than the type (— 0·14). The blending of the seminal ducts is less than the norm (— 0·12). The seminal vesicle is absent. The other features deviate only slightly from the norm.

Bacha Fab. (tbl. I, fig. 5) is marked by a very much shortened seminal duct (— 0·20). It is in this and in the *Didea* genus that we find the greatest shortening of this part to be observed in the genera of the Ist group. The prostate glands are also shortened. The seminal vesicle is absent. The degree of blending of the seminal ducts is not very distant (negatively) from the typical. The length of the deferent duct, as has been already stated, does not deviate from the type.

The particularities of the genus *Syrphus* Fab. (tbl. I, fig. 6) have been described already.

The *Leucozona* Schin. (tbl. I, fig. 7) present as peculiarity the smallest length (after the *Didea* genus) of the prostate glands. The deferent duct is also considerably shortened (— 0·58). The width of the testicle and degree of blending of the seminal ducts is slightly less than the norm (— 0·14). The seminal vesicle is absent. The length of the seminal duct is greater than in the type (+ 0·11).

	V : P	D : P	Pr : P	Ves : D	B : T	$V_1 : V$	Deviations $\left(\frac{a}{M}-1\right)$						S_1	S_2
							V : P	D : P	Pr : P	Ves : D	B : T	$V_1 : V$		
1. *Syrphus* . . .	0·66	0·07	0·47	0·00	0·75	0·55	+0·20	−0·42	−0·06	−1·00	+0·12	−0·22	2·02	
2. *Chrysotoxum* . .	0·63	0·19	0·48	0·11	0·94	0·68	+0·14	+0·58	−0·04	+1·75	+0·40	−0·03	2·94	
3. *Xanthogramma* .	0·61	0·04	0·47	0·00	0·81	0·46	+0·11	−0·67	−0·06	−1·00	+0·21	−0·34	2·39	
4. *Leucozona* . . .	0·61	0·05	0·40	0·00	0·58	0·60	+0·11	−0·58	−0·20	−1·00	−0·14	−0·14	2·17	
5. *Ischyrosyrphus* .	0·60	0·11	0·51	0·00	0·70	0·77	+0·09	−0·08	+0·02	−1·00	+0·04	+0·10	1·33	
6. *Pyrophaena* . .	0·57	0·12	0·52	0·00	0·82	0 88	+0·04	0·00	+0·04	−1·00	+0·22	+0·26	1·56	
7. *Lasiopticus* . .	0·56	0·15	0·53	0·00	0·58	0·62	−0·02	+0·25	+0·06	−1·00	−0·14	−0·12	1·59	
8. *Sphaerophoria* .	0·53	0·19	0·94	0·18	0·27	1·00	−0·04	+0·58	+0·88	+3·50	−0·60	+0·43	6·03	6·49
9. *Platychirus* . .	0·46	0·25	0·51	0·16	0·87	0·67	−0·16	+1·08	+0·02	+3·00	+0·30	−0·04	4·60	
10. *Didea*	0·44	0·05	0·21	0·00	0·51	0·85	−0·20	−0·58	−0·58	−1·00	−0·24	+0·21	2·81	
11. *Bacha*	0·44	0·12	0.42	0·00	0·55	0,62	−0·20	0·00	−0·16	−1·00	−0·18	−0·12	1·66	
M	0·55	0·12	0·50	0·04	0·67	0·70								
1. *Pipiza*	0·44	0·32	0·38	0·49	0·65	0·00	+1·44	−0·33	+0·19	+1·23	+0·23	−1·00	14·39	4·42
2. *Heringia* . . .	0·38	0·38	0 42	0·67	0·66	0 41	+1·11	−0·21	+0·31	+2·04	+0·24	−0·05	18·83	3·96
3. *Chilosia* . . .	0·27	0·49	0·28	0·24	0·50	0 54	+0·50	+0·02	−0·13	+0·09	−0·06	+0·25	9·51	1·05
4. *Sphegina* . . .	0·23	0·55	0·24	0·02	0·70	0·00	+0·28	+0·14	−0·25	−0·91	+0·32	−1·00	6·22	2·90
5. *Chrysogaster* . .	0·18	0·40	0·34	0·00	0·69	0·00	0·00	−0·17	+0·06	−1·00	+0·30	−1·00	5·35	2·53
6. *Paragus* . . .	0·17	0·41	0·48	0·38	0·70	1·00	−0·06	−0·15	+0·50	+0·73	+0·32	+1·32	12·12	3·08
7. *Rhingia* . . .	0·13	0·60	0·20	0·53	0·69	0·80	−0·28	+0·25	−0·38	+1·41	+0·30	+0·86	17·78	3·48
8. *Hammerschmidtia*	0·12	0·25	0·26	0·00	0·13	0·46	−0·33	−0·48	−0·19	−1·00	−0.76	+0·07	4·49	2·83
9. *Liogaster* . . .	0·11	0·73	0·39	0·06	0 67	0·67	−0·39	+0·52	+0·22	−0·73	+0·26	+0·56	6·64	2·68
10. *Ferdinandea* . .	0·10	0·61	0·13	0·13	0·42	0 31	−0·45	+0·27	−0·59	−0·41	−0·21	−0·28	8·83	2·21
11. *Orthoneura* . .	0·09	0·51	0·62	0·01	0·21	0·54	−0·50	+0·06	+0·94	−0·96	−0·60	+0·25	6·10	3·31
12. *Brachyopa* . . .	0·08	0·54	0·28	0·29	0·32	0·89	−0·56	+0·12	−0·13	+0·32	−0·40	+1·07	11·84	2·60
13. *Neoascia* . . .	0·07	0·50	0·15	0·03	0·62	0·00	−0·61	+0·04	−0·53	−0·86	+0·17	−1·00	6·37	3·21
M	0·18	0·48	0·32	0·22	0·53	0·43								

The genus *Chrysotoxum* MG. (tbl. I, fig. 8) is characterised by the elongation of its seminal (+ 0·14) and deferent ducts (+ 0·58). The testicle is considerably wider than the norm (+ 0·40). The seminal vesicle exists, though hardly developed (+ 1·75). The deviations of the other features are inconsiderable.

Xanthogramma SCH. (tbl. I, fig. 9) has the shortest deferent duct (— 0·67) and the smallest blending of the seminal duct (— 0·34). The testicle is considerably wider than the norm (+ 0·21). The deferent duct is slightly longer than the type. The seminal vesicle is absent. The prostate glands deviate very slightly from the norm (— 0·06).

The great deviation from the type is to be found in the genus *Didea* MCQ. (tbl. I, fig. 10). The testicle is of a very particular shape: a bulky appendix grows out of the principal part of the testicle and gives it the shape of a bent knee. Moreover, the length of the testicle as related to *P* is the greatest of all the genera in the Ist group. This produces another particularity—the very small (the smallest!) length of the seminal ducts (— 0·20). The length of the deferent duct is also distinctly smaller than the norm (— 0·58). The shorteness of the prostate glands (— 0·58) deserves especial notice: they are nearly three times shorter than in *Leucozona* (— 0·20) and thus are the shortest in the whole group. The seminal vesicle is absent. The width of the testicle is considerably less than the norm (— 0·24). The degree of blending of the seminal ducts is considerable (+ 0·21).

In the genus *Platychirus* ST. FRG. (tbl. I, fig. 11) we find as characteristic a great length of the deferent duct (+ 1·08). It surpasses all the other genera in this respect. As peculiar is the presence of the seminal vesicle—small but well defined. The testicle is very wide, nearly spherical (+ 0·30), wider than in other genera. The seminal duct is short (— 0·16). The other features approach the normal.

Sphaerophoria ST. FARG. (tbl. I, fig. 12). This genus is the most deviated from the type and the most peculiar in the construction of its genital system. In four features it presents a maximum of deviation, negative and positive. The whole of the genital system is extremely elongated, occupying the greatest part of the length of the abdomen. The testicle, instead of the usual oval or rounded shape, is extremly elongated. The relation of its width and length, marking the degree of elongation is negatively the most conspicuously deviated (— 0·60). The prostate glands are also greatly elongated (+ 0·88), attaining nearly the size of *P*; except that they are considerably curved. The seminal vesicle is relatively strongly developed (+ 3·50), more than in any other representative of the first group of genera. A very marked deviation from the type is in the degree of blending of the seminal ducts—both ducts make one the whole length through (+ 0·43). The deferent duct is very elongated (+ 0·58). The length of the seminal duct hardly differs from the type.

We will now examine the II^d^ group of genera and first of all construct graphically its type. Just as for the I^st^ group let us assume that $P = 100$. Then the first equation (see the table on p. 44) will appear as

$$V : 100 = 0{\cdot}18, \text{ hence } V = 18.$$

Correspondingly we find, that

$$D = 48 \text{ and } Pr = 32.$$

Replacing D by its value in equation $Ves : \mathrm{D} = 0{\cdot}22$, we obtain: $Ves = 10.56$. Further

$$T = P - (D + V) = 100 - 66 = 34.$$

Replacing T by its value in equation $B : T = 0{\cdot}53$, we obtain:

$$B : 34 = 0{\cdot}53, \text{ hence } B = 18{\cdot}02.$$

Replacing V by its value in equation $V_1 : V = 0{\cdot}43$, we obtain

$$V_1 : 18 = 0{\cdot}43, \text{ hence } V_1 = 7{\cdot}74.$$

Thus we obtain all the necessary values for the construction of a type for the II^{d} group:

$$P = 100;\ V = 18;\ D = 48;\ Pr = 32;$$
$$T = 34;\ Ves = 10{\cdot}56;\ B = 18{\cdot}02;\ V_1 = 7{\cdot}74.$$

Fig. 13 (tbl. II) represents the type of the II^{d} group of genera, constructed according to the data obtained. Comparing it with the type of the Ist group, we find a series of clearly marked differences, which we shall mention after having examined separately the genera of the II^{d} group.

According to the increase of the quantity S, the genera place themselves thus:

1. *Chilosia*	1·05	8. *Paragus*	3·08
2. *Ferdinandea*	2·21	9. *Neoascia*	3·21
3. *Chrysogaster*	2.53	10. *Orthoneura*	3·31
4. *Brachyopa*	2·60	11. *Rhingia*	3·48
5. *Liogaster*	2.68	12. *Heringia*	3·96
6. *Hammerschmidtia*	2·83	13. *Pipiza*	4·42
7. *Sphegina*	2·90		

Closest to the type is the genus *Chilosia* MG. The deviation from the type of the *Pipiza*, the genus most differing from the type, is 4·21 times more than the deviation of the *Chilosia*.

Chilosia MG. (tbl. II, fig. 14) is characterised by an elongated seminal duct (+ 0·50) and by their blending slightly more than the norm (+ 0·25). The prostate glands are a little shorter than the norm (— 0·13). The length of the deferent duct and seminal vesicle are nearly those of the norm. The deferent duct is rather clearly divided into two parts—the distal half forms a kind of widening, the distal part of which in its turn is the seminal vesicle. The proximal half is a narrow, slightly curved duct, getting narrower still in the proximal direction.

Ferdinandea ROND. (tbl. II, fig. 15). The most striking feature of the genus is the reduction of the prostate glands. They are very short (— 0·59), shorter than in any other genus of the group, and comparatively wide. The deferent duct, on the contrary, is very elongated (+ 0·27), slightly curved. The seminal vesicle is markedly short (— 0·41) and of a rather regular oval shape. The seminal ducts are short (— 0·45), their degree of blending is slightly less than the norm (— 0·28). The testicle is slightly elongated: $(B:T) = -0{\cdot}21$, but widens in the distal direction.

The genus *Chrysogaster* MG. (tbl. II, fig. 16) is distinguished by the small size of the genital system. Among the separate features, one most notice first of all the complete absence of the seminal vesicle (— 1·00), while the mean of this feature in the given group of genera is comparatively large (0·22). The degree of blending of the seminal ducts gives us a second maximal negative deviation (— 1·00), as in this case the ducts enter the deferent duct completely separated from each other. The testicle is considerably wider than the norm (+ 0·30) and comparatively long. The deferent duct is slightly shorter than the norm (— 0·17). It is interesting to note that the length of the seminal duct coincides with that of the type (the deviation equals 0). The length of the prostate glands is nearly that of the norm.

Brachyopa MG. (tbl. II, fig. 17). The testicle is elongated (— 0·40) and curved like a bow. The seminal ducts are very short (— 0·56)— only in the genus *Neoascia* they are shorter,—still blended nearly in all their length (+ 1·07), which is also a sharp deviation in this genus from the norm. The seminal vesicle is strongly developed (+ 0·32) and quite distinct from the rest of the deferent duct, which is narrow and slightly twisted at the proximal end. The prostate glands widen towards the distal end, they are slightly shorter than the norm (— 0·13). The length of the deferent duct is but slightly greater than that of the type (+ 0·12).

The characteristic trait of the genus *Liogaster* RND. (tbl. II, fig. 18) is the extreme elongation of the deferent duct (+ 0·52). In this respect the *Liogaster* leaves far behind it all the other genera, and the length of the duct is nearly twice as long as in the *Ferdinandea* genus, which also possesses a very elongated deferent duct (+ 0·27). The proximal part of the duct is narrow, but in its distal part it widens gradually and at last becomes considerable. The seminal vesicle is very little developed and quite indistinct from the rest of the deferent duct (— 0·73). The seminal ducts are comparatively short (— 0·39); the degree of blending is considerably higher than the normal (+ 0·56). The prostate glands are longer than in the type (+ 0·22), curved. The testicles are wider than the norm (+ 0·26).

In the *Hammerschmidtia* SCHUM. (tbl. II, fig. 19) we meet a whole row of singular peculiarities. The testicle is very long (— 0·76, which is the maximal negative deviation) and begins in its proximal part to twist spirally, forming 1½ twists, the long distal part being straight. This genus seems to start in the testicle alike an orthogenetic spiral-convolutionary process, which goes on still further in other subfamilies of the *Syrphidae* and at last evoluates into forming a long spiral testicle with many twists of the spiral (in the genus *Spilomyia* in the *Milesiinae* subfamily, for example). The seminal ducts are short (— 0·33), not clearly distinct from the testicles, gradually merging into them. Their degree of blending is hardly a deviation from the norm (+ 0·07), the proximal part of the common duct is bent over twice and these bent parts are closely pressed together. This peculiarity characterises the given genus and is not to be found in other genera of this subfamily. The deferent duct is very short (— 0·48), narrow in its proximal and gradually widening towards the distal part, where it attains a considerable breadth. The seminal vesicle is completely absent (— 1·00)— a peculiarity usual in the Ist group of genera, but to be found in the II^{d} group only in the *Hammerschmidtia* and *Chrysogaster*. The prostate glands are only slightly shorter than the normal (— 0·19).

Sphegina MG. (tbl. II, fig. 20) is characterised by a complete separation of the seminal ducts (— 1·00) and a nearly complete absence of the seminal vesicle (— 0·91). The testicle is considerably wider than the type (+ 0·32, which is the maximal positive deviation). The seminal ducts are slightly longer than in the type (+ 0·28), the deferent duct is likewise longer than the norm (+ 0·14); it is narrower in the proximal part and rather wide in the distal one, that is in nearly all its length. The prostate glands are slightly shortened (— 0·25).

The structure of the genital system of the genus *Paragus* Ltr. (tbl. II, fig. 21) is peculiar. The greatest deviation from the norm is that the seminal ducts are blended in all their length (+ 1·32). The testicles are large, considerably wider than in the type (+ 0·32, which is the maximal positive deviation) and widened in the distal part. The deferent duct is slightly shorter than the norm and widens in the distal part; the seminal vesicle is strongly developed (+ 0·73), elongated and rather clearly distinct from the rest of the deferent duct. The prostate glands are very long (+ 0·50), they are still longer only in the *Orthoneura*. The proximal part of the glands is inflated. The length of the seminal ducts is nearly that of the norm.

Neoascia Will. (tbl. III, fig. 22). The testicles are large, slightly wider than in the type (+ 0·17). The seminal ducts are very short (— 0·61), the shortest in the whole *Syrphinae* subfamily. The deferent duct is of nearly normal length (+ 0·04), nearly the same width all through, narrowing only near the proximal end. The prostate glands are very short (— 0·53), only in the genus *Ferdinandea* are they shorter. The sharpest deviation from the type are the complete separation of the seminal ducts (— 1·00) and the feeble development of the seminal vesicle (— 0·86).

In the *Orthoneura* Mcq. (tbl. III, Fig. 23) genus parts of the genital system are greatly elongated. The testicles in length give way only to those of the *Hammerschmidtia* genus (— 0·60) and have a bowlike curve. The seminal ducts are very much elongated (— 0·50), their degree of blending slightly exceeds the norm (+ 0·25). The deferent duct, if considered absolutely, is long, but in relation to *P* hardly deviates from the normal (+ 0·06) and widens at the distal end. The seminal vesicle is feebly marked (— 0·96). The prostate glands are very long (+ 0·94), the longest in the genera of the II^{d} group.

The genus *Rhingia* Scop. (tbl. III, fig. 24) possesses an extremely original construction of the genital system. Contrary to the preceeding genus, all its parts are short and compressed, forming a compact mass. The form of the deferent duct is especially original—its proximal part being a narrow duct, while the distal part rather sharpely separated from the rest, forms an enormous inflation to the central part of which are attached the seminal ducts and prostate glands. On the ventral part of this inflation is a small appendix. The distal part of this inflation (half of it approximatively) forms the seminal vesicle, which attains here a very large development (+ 1·41), greater than in any other genus of the *Syrphinae* subfamily. The testicles are wide, considerably wider than the norm (+ 0·30). The seminal ducts are shorter than the type (— 0·28). Their degree of blending is very great (+ 0·86). The prostate glands are very short (— 0·38) and, what is of especial interest, are only slightly longer than wide, being nearly spherical in shape. The deferent duct is considerable longer than the norm (+ 0·25).

Heringia Rond. (tbl. III, fig. 25) is distinguished by very long seminal ducts (+ 1·11) and an excessively long seminal vesicle (+ 2·04), this last in length exceeds several times the rest of the deferent duct and is so long that at first glance it may be taken for one of the prostate glands, especially as these last in width nearly equal it. As a whole the deferent duct is shorter than the norm (— 0·21). The prostate glands are long, considerably longer than those of the type (+ 0·31). The testicles are wide, the degree of blending of the seminal ducts is nearly normal (— 0·05).

Lastly the genus *Pipiza* Fall. (tbl. III, fig. 26) has the largest deviation from the type. The seminal ducts are extremely elongated (+ 1·44), the longest in the genera of the II^{d} group. They emerge into the deferent duct quite separated from each other, a feature which also sharply marks a deviation of the given genus from the type (— 1·00). The deferent duct has a particular shape: it is very wide, even in its proximal part (contrary to what happens usually), is still wider in the distal part and then passes into the seminal vesicle, which is at a right angle from the rest of the duct. The seminal vesicle is very strongly developed (+ 1·23) and only in the genus *Rhingia* and *Heringia* do we find it more so. The prostate glands are slightly longer than the type (+ 0·19). The testicles are considerably wider than the type (+ 0·23). The deferent duct is short (— 0·33).

Having examined the construction of the genital system in both groups of genera, we will now indicate the peculiarities of each type.

The most sharply defined distinctive feature is the length of the seminal and deferent ducts.

The first type is marked by a very long seminal duct, longer than half the total length of the genital system ($V = 0{\cdot}55\, P$). The second type, on the contrary, is distinguished by the comparatively small length of this part ($V = 0{\cdot}18\, P$). The contrary must be noted about another feature—the length of the deferent duct. In the first type this part is very little developed, whilst in the second type it is very long (0·12 and 0·48 P). Furthermore a sharp difference between both types is to be found in the degree of blending of the seminal ducts. In the first case both ducts are blended for more than $^2/_3$ of their length (0·70), in the 2^d—less than half (0·43). We find another very characteristic difference in the construction of the seminal vesicle. In the genera of the first type the seminal vesicle generally attains a hardly noticeable size (0·04 D) and in some genera is completely absent. The II^d type is marked by a comparatively very well developed long vesicle ($Ves = 0{\cdot}22\, D$). There are considerable differences between the types in the length of the prostate glands. In the first type they attain exactly half the total length ($Pr = 0{\cdot}50\, P$), while in the II^d they are only one third of it ($Pr = 0{\cdot}32\, P$). The testicle shows only slight differences. Its length is nearly the same in both types (0·33 and 0·34) and the width in the first (0·67) slightly more than in the II^d (0·53).

All these distinctions are clearly seen if you compare the types according to figures 1 and 13 (tabte I, II).

Except the differences contained in the means of different features, we must indicate also how the types differ according to the degree of variability of these same features. The following table gives us an idea of amplitude of variability.

	I^{st} type	II^d type
$V:P$	0·44—0·66	0·07—0·44
$D:P$	0·04—0·25	0·25—0·73
$Pr:P$	0·21—0·94	0·15—0·62
$Ves:D$	0·00—0·18	0·00—0·67
$B:T$	0·27—0·94	0·13—0·70
$V_1:V$	0·46—1·00	0·00—1·00
$T:P$	0·19—0·50	0·16—0·62

We divided the genera into two groups according to the length of the seminal duct as a feature. We must notice that in the II^d type the amplitude of variation is larger than in the first; the corresponding numbers being 0·37 and 0·22.

In studying the length of the deferent duct, we obtain the same result, there is no *transgression* of this feature. The amplitude of variation in the II^{d} type is considerably larger than in the first one. The corresponding values are 0·48 and 0·21.—The length of the prostate glands is a feature, which in the II^{d} type shows a great transgression, namely from 0·21 to 0·62, that is equal to 0·41. The amplitude of this variation is 0·47 and 0·73 and is considerably larger in the first group than in the II^{d}.

The degree of blending of the seminal ducts also shows a transgression from 0·46 to 1·00, that is equal to 0·54. Here the variation of this feature in the first type stays within the limits of the variation of this feature in the II^{d}. The amplitude of variation is 1·00 and 0·54, that is nearly double in the II^{d} type.

The relation of the width of the testicle to its length gives a transgression between 0·27 and 0·70, equal to 0·43. The corresponding values of the amplitude of variation are 0·57 (II^{d} type) and 0·67.

The transgression in the length of the seminal vesicle equals 0·18 and is contained between 0 and 0·18. Thus here as in the 4th feature, the variation of the Ist type is within the limits of the variation of the II^{d}. The amplitude is 0·67 and 0·18.

Lastly the length of the testicle varies in both types in approximatively the same manner. The transgression is large (0·41), but again the amplitude of variation of the II^{d} type (0·46) includes the amplitude of the Ist (0·31).

We see that some features allow us to divide completely the two groups. Others do so in a smaller measure (if the transgression exists), but the possibility to define two groups gets less and less, as the transgression increases.

The comparison we made put also in evidence some facts as to how widespread is the degree of parallelism of features. First of all one must note that a complete parallelism of features is improbable(⁹). Parallelism can exist only in such cases when a complete transgression in variation of both types can be observed.

(⁹) And yet N. I. Vavilov in his article "The homologous series in variation" (Journ. Gen., 1922) insists on a complete parallelism of features in different systematical categories.

The two first features—length of seminal and deferent ducts, which helped to determine with facility to which definite type such or such a construction of the genital system belonged, will be called by us "indicators", in opposition to others that differ from each other in both types hardly by their means.

The "indicators" may also be called "typical" features, because it is they that characterise in the best way systematical categories. The research of properties of different features must certainly contribute many interesting facts to theoretical systematics.

Up to now we have examined the construction of the male genital system only in the limits of the *Syrphinae* subfamily. According to our researches, the *Syrphidae* family consists of 7 natural subfamilies. It is of interest to compare the construction of the male genital system of this first subfamily with that of the others.

In *Spilomyia* Mg.—a genus belonging to the subfamily *Milesiinae*—our attention is drawn first at all to the shape of the testicle, perfectly different from what we saw in the *Syrphinae* subfamily. This testicle is extremely elongated and has several turns of spiral convolution, the end of the testicle being bent in the opposite direction.

The seminal ducts are very much elongated and even slightly twisted, what does not happen in any of the *Syrphinae* genera. We also find a great difference with the first subfamily in the shape of the deferent duct, the distal part of which widens extremely and forms an enormous seminal vesicle. The prostate glands are elongated and twisted.

To characterise the genital system of the *Spilomyia*, the criteria we have used for the *Syrphinae* are unsufficient. Thus we must introduce the evaluation of the degree of the testicle's spiral convolution, the degree of elongation of the seminal duct and prostate glands as given by the relation of width to length, etc.

In the subfamily *Zeliminae* (example—genus *Zelima* Mg. whose genital system is shown in fig. 27), we as a rule meet on elongated and bow-curved testicle (only in some species it has a spiral twist). *Zelima* are characterised also by greatly elongated seminal and deferent ducts and prostate glands.

Sphecomyia Latr. is one of deviating genera of the *Zeliminae* subfamily (intermediate to the *Milesiinae*). Here we find as an especially evident feature in the construction of the genital system an extreme elongation of the seminal vesicle, which, in addition, is strongly twisted.

The testicles are also very much elongated and twisted, as likewise the prostate glands.

In the *Cerioidinae* subfamily (example—*Cerioides* ROND.) (¹⁰), we find several peculiarities of the genital system. The testicles are very much elongated and twisted. The seminal ducts are longer than in any other genus of the other subfamilies and widen considerably before blending. The deferent duct in its distal part presents a characteristic glandular dilatation. The prostate glands are comparatively very short, the seminal vesicle quite distinct from the the rest of the deferent duct, bent back and closely pressed against the duct.

In the subfamily *Eumerinae* (example—*Microdon* MG.) we find in the genital system quite a new element—a pair of special prostate glands, situaded at the proximal end of the deferent duct, quite near to the seminal vesicle; they are short, but rather broad. The testicle is elongated, spirally twisted and is terminated by an oval dilatation. The seminal ducts are absent, so that the testicle emerges directly into the deferent duct. This last forms a spherical seminal vesicle, the distal end of which is bent; the deferent duct is comparatively wide, of the same width all through. The prostate glands are very short.

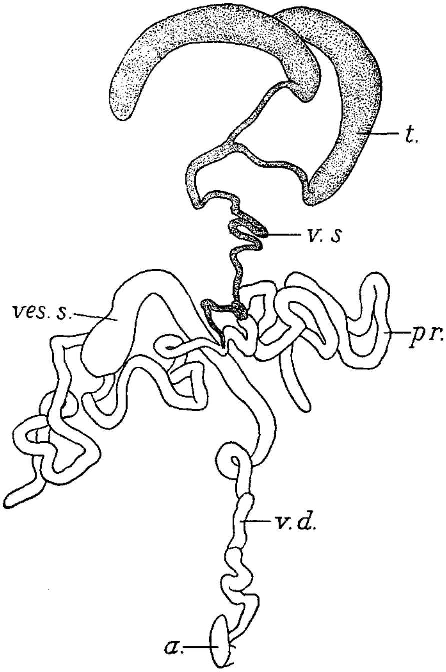


Fig. 27. *Zelima*

In the subfamily *Eristalinae* we meet, as in the *Syrphinae*, two types of construction of the genital system—the type *Helophilus* MG. and the type *Eristalis* MG. In the genus *Helophilus* we find great differences between the species. As we have described them elsewhere (¹¹),

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(¹⁰) E. SMIRNOV. Zur Kenntnis der Gattung *Cerioides* RND. — Zoolog. Anzeiger, Bd. 58, 1924.

(¹¹) E. SMIRNOV. Ein Beitrag zur Kenntnis der Gattung *Helophilus* MG. (= *Tubifera* MG.) — Zoolog. Anzeiger, Bd. 56, 1923.

it will be sufficient to mention, that the construction of the genital system of the *Helophilus* is very peculiar and at the same time quite different from that of the *Syrphinae*.

The genus *Eristalis* MEIG. is quite different from the *Helophilus* and greatly resembles the *Syrphinae* especially the tribus *Chilosiini*. Its characteristic features are: elongated prostate glands, a comparatively long deferent duct and a short seminal one. The seminal vesicle is strongly developed. On the ventral side of the deferent duct, near the orifice of the prostate glands, is a small appendix. The seminal ducts emerge separately.

If we refer the *Eristalis* to the *Chilosia*-type, the sum total of the deviations (S_2) is 3·42, that is smaller than in some deviating genera, which we have referred to this type. Nevertheless, according to all other features (as also by the construction of the female genital system), *Eristalis* is without doubt to be classed in a subfamily other than *Chilosia*.

Lastly the genus *Volucella* is the representative of the subfamily—the *Volucellinae*. The genital system of this genus also nearly approaches to that of the *Syrphidae*, but the sum total of deviations from the type *Chilosia* ($S_2 = 4{\cdot}78$) surpasses the quantity S_2 of every genus of the II^{d} group. The greatest deviation from the type of the *Chilosia* group consists more specially in a greater length of the seminal duct and prostate glands, as likewise that seminal ducts are completely separated and the seminal vesicle is absent. All that has already been said about the parallelism of features between the 2 groups of genera of the *Syrphinae* subfamily, is still more evident when one compares the genital system of different subfamilies. Of course nowhere in the *Syrphinae* subfamily will we find such a typical spiral testicle as in the *Spilomyia*, nor a spherical or oval testicle among the *Milesiinae*. Comparing different features, we find a certain transgression in their variations and thus somewhat of a parallelism, though far from complete.

We examined above the relation of separate genera to the ideal type constructed by us. Having fixed the specific particularities of each genus in its deviation from the type, we found easily enough the "sum total of deviations", which showed us how far distant a separate genus was from our ideal type. Using the same method of appreciating different particularities, we can find the sum total of deviations which correspond to the distance between any two genera. As an example, let us examine the genus *Syrphus* and *Ischyrosyrphus.*

	Syrphus	*Ischyrosyrphus*	Difference
$V : P$	+ 0·20	+ 0·09	0·11
$D : P$	— 0·42	— 0·08	0·34
$Pr : P$	— 0·06	+ 0·02	0.08
$Ves : D$	— 1·00	— 1·00	0·00
$B : T$	+ 0·12	+ 0·04	0·08
$V_1 : V$	— 0·22	+ 0·10	0·32
	$\frac{a}{M} - 1$		0·93

As regards the first feature, they both exceed the norm positively. It is evident that the mutual distance from the type is equal to the difference of both deviations. The deviations from the type according to the third feature are positive and negative; as here both genera diverge from the type in diametrically opposite directions, it is evident that the mutual distance is equal to the sum of these divergencies. Proceeding in the same way with the other features and summing up the numbers obtained, we find the quantity $S_R = 0{\cdot}93$, which gives us the distance between *Syrphus* and *Ischyrosyrphus.* The following table contains the value of S_R for each two genera of the Ist group of genera of *Syrphinae.*

	Syrphus	*Chrysot.*	*Xanthogr.*	*Leucozona*	*Ischyros.*	*Pyroph.*	*Lasiopt.*	*Sphaeroph.*	*Platych.*	*Didea*	*Bacha*
Syrphus	—	4·30	0·55	0·73	0·93	1·26	1·33	8·05	6·30	1·87	1.32
Chrysot.	4·30	—	4·55	4·75	4·01	3·98	3·93	4·31	2·22	5·67	4·46
Xanthogr.	0·55	4·35	—	0·78	1·30	1·45	1·70	8·42	6·49	1·92	1·69
Leucozona	0·73	4·75	0·78	—	1·16	1·65	1·20	7·92	6·69	2·04	0·99
Ischyros.	0·93	4·01	1·30	1·16	—	0·49	0·84	7·12	5·81	1·78	0·99
Pyroph.	1·26	3·98	1·45	1·65	0·49	—	1·03	7·19	5·68	1·95	1·22
Lasiopt.	1·33	3·93	1·70	1·20	0·84	1·03	—	6·72	5·57	2·12	0·73
Sphaeroph.	8·05	4·31	8·42	7·92	7·12	7·19	6·72	—	3·35	7·86	7·25
Platych.	6·30	2·22	6·49	6·69	5·81	5·68	5·57	3·35	—	7·09	5·86
Didea	1·87	5·67	1·92	2·04	1·78	1·95	2·12	7·86	7·09	—	1·39
Bacha	1·32	4·46	1·69	0·99	0·99	1·22	0·73	7·25	5·86	1·39	—

Of course these numbers refer only to the male genital system, and there is no reason to consider them as an expression of the actual resemblance between genera; this must be based on the appreciation of a greater number of features.

The study of the distribution of systematical elements according to their mutual resemblance is one of the most important subjects of research for the systematician. But the material on hand is insufficient for any more or less important generalisations.

In the present chapter we have several times had to do with a quantitative expression of feature and even to use some biometrical methods. In reality in studying the variability of the higher systematical categories, we might have applied those same methods which are at the disposal of biometrics. Most of them, it is true, are used in cases of *normal* distribution, but this would not be of any hindrance to us, as 1: the variability of higher systematical categories is probably often normal or nearly normal and 2: methods of studying a distribution other than the normal one exist. We do not apply them in this work only because they would lead us away from the subject we have set ourselves viz. the theory of type.

The present chapter does not clear up completely also some other questions of methodics. In constructing a type of the genital system, we purposely left aside all other features of internal and external structure. The *Syrphinae* genera have been studied by us in many of their different relations, and we are in a position to conclude from this work that this subfamily is certainly a naturally formed one (a "congregation"), being built on a basis of complete evaluation of different features. One may say the same about the other subfamilies of *Syrphidae* (^{7}). The *Syrphinae* subfamily, as shown by the analysis of a great number of features, is clearly divided into 2 tribes: *Syrphini* and *Chilosiini.* This division nearly corresponds to these two types which we have built according to the features of the male genital system. Thus after having constructed a type of genital system we have found, with a certain degree of accuracy, the general type. The study and careful comparison of the other features of the internal and external construction must be used to verify our construction.

In comparing the genital system of different genera of *Syrphinae,* we tolerated a inaccuracy in accepting a species as representative of a genus. It would have been better to take instead of divers species the type of the genus—that is the mean of all species of a genus—because a particular species can only to a certain degree serve as a sample of its genus. Nevertheless this inaccuracy is in a great measure redeeme by the fact, that the differences between the genital system in species of one genus are habitually small in comparison with the differences between genera.

We will now give the reasons for dividing our 24 genera in two groups, as above mentioned, according to the construction of the sexual system. In the table on page 47 we have given (in the penultimate vertical column) the values of S_1—that is the sum total of deviations of the genera from the corresponding type. In the same column, lower down, we give the sum total of the deviations for the II^d group, also compared to the Ist type. In the following column are given the values of S_2, that is the sum total of deviations of the genera calculated in relation to the second type. In comparing both series, we see that there is no genera in the Ist group in which S_1 is larger than S_2. In the same way in the II^d group S_2 is always smaller than S_1. This gives us the right to conclude that the transfer of any genus from one group to another would be an infringement of the natural system(12). If we classify different values of S_1 and examine how many genera are in each class, we will obtain two clearly marked maxima of frequency—corresponding to the two types.

Classes	Frequency	Classes	Frequency
1·33— 3·52	9	10·09—12·28	2
3·52— 5·71	3	12·28—14·47	1
5·72— 7·90	5	14·47—16·66	0
7·90—10·09	2	16·66—18·85	2

Thus the correctness of our division of genera (according to the genital system) into the two groups mentioned above, is once more corroborated.

III.

What is the importance of the theory of type and what are the limits of its application—such is the subject which we must now examine.

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(12) This refers of course only to the construction of the genital system.

The scientific investigation of facts ends after all in establishing between them fixed relations according to certain laws. In certain cases these relations are simple and may even be formulated mathematically; in other cases they form a whole chain of various elements mutually conjoined and can be with difficulty analysed.

The systematician has to do principally with these complex relations. A natural systematical category represents a union of various features. The study of the laws, qualifying these combinations, is the first and principal problem of systematic.

Let us imagine a large number of different kinds of objects mingled in disorder. If we look closely at this variegated medley, we will find that different objects are near each other and more or less far from each other. After a more detailed inspection it seems possible to locate larger or smaller groups of objects mutually related to each other. To select these groups is the first step towards the study of diversity.

An analogous process is undergone when classifying any group of organisms. Among all the divers forms we notice immediately that some of our objects mutually related by their similarity congregate together (congregations).

This grouping is natural, once it can be objectively determined, and, if only attentively observed, is self evident. Such groupings are the natural systematical categories.

If we turn firstly to those systematical elements, which are further indivisible, these groupings will furnish us with elemental congregations, or congregations of the Ist order. If further we consider these elemental congregations as some sort of a whole, the units thus obtained form again a conglomeration—a congregation of the 2^{d} order. The systematical element in this congregation will be the elemental congregation. Congregations of the 2^{d} order in their turn group into new conglomerations—congregations of the 3^{d} order. This process can of course continue still further.

In the existing system of animals and plants, these congregations correspond to such notions as race, nation, subspecies, species, genus, family &c. And between the units mentioned one can further place others, such as sections, subfamilies and so on.

The process of systematisation can follow also a centrary direction—from large units proceed to small ones. If we consider the animal kingdom as a whole, we immediately note the first, most evident subdivisions viz. phyla. A more detailed survey shows that phyla divide into classes, classes into orders, and so on till we reach the individual.

Both ways mentioned are equally feasible and bring finally to the same results.

Let us now examine, what is the importance of the theory of type in natural system. We have determined type as a certain ideal construction, sum total of the means of different features, the notion of type being equally applicable to all congregations of divers orders.

A congregation as a whole can be considered as the realisation of a type, while its members (the elements of the system) are variations of this type. Because of this, one must study congregations keeping always as basis the type we have realised. In the preceding chapter we have seen that members of a congregation can be qualified as certain deviations from the type. This allows us to characterise them quite simply and at the same time completely by roting their specific particularities and bringing out their typical ones.

The variations of type are, without doubt, subject to certain laws. As regards race, HEINCKE (6) has established the above cited law of the fixity of the sum of quadratic deviations of individuals from the ideal type of the race. Do the higher systematical categories submit to this law? A definite answer to this question can be given only after manifold researches on the construction of systematical categories. For the present we can only establish the following principle: round an ideal type, which is the center of a congregation, are grouped a number of typical members. One can say about them that they deviate from the type in about equal measure—as a rule, but in the most varied directions. This cannot be said about the forms on the periphery, which diverge much more. And, lastly, the intermediate forms do not obey in the slightest the law of HEINCKE.

Thus to units higher than a race, this law can be applied only to a limited degree. At all events we must note, that it successfully characterises a certain ruling in locating typical genera round the ideal type of the congregation.

Can we see in all this an essential difference between races and higher categories? We opine that the peculiarities of race can be thus qualified: undoubtedly race obeys the law of congregations, all more or less considerable deviations of the individual from the ideal type being removed by continual sexual comminglings and by similarity of influence, the same outward conditions generally existing in the area limit of race diffusion. One may say, that the majority of individuals forming a race are very near to the type.

Are intermediate forms between races possible? HEINCKE himself answers the question affirmatively. As the areas of diffusion of races do not seem to be clearly delimitated (though this does happen), but are joined together by zones, whose character by its physico-chemical properties is intermediate, it is thus quite possible for individuals intermediate between two (or even three and more) races to appear. And if we turn to the researches on geographical variability, we shall find many examples of such intermediate crossings in geographical races.

Up to now we have considered the laws ruling the disposition of congregational elements, as represented by individuals, races, species, genera etc. But there is another, perhaps, more important, ruling viz. the laws of feature disposition. In this case we must investigate the combination of features. That the combination of features is subject to a certain ruling, may be seen even in those biometrical researches, which have put in evidence the existence of manifold correlations between different features. In our example, that is in the construction of the genital system of the *Syrphidae*, such ruling was also made evident, though instead of comparing in the usual way the features of individuals, we compared with each other corresponding features of genus, subfamily etc. Some parts of the genital system were found to be in a very close correlation, as for example the length of the seminal and deferent ducts, the correlation being a negative one. Evidently there exists a general law of correlation, which regulates all the mutual relations of features.

Here also the type appears to be a very useful method of research. With it we can appreciate the particularities of features by examining their deviations from the type.

Up to now we have insisted on the importance of type as a norm of comparison. Type is still more important as a characteristic.

One of the principal aims of any scientific research is to characterise succinctly and accurately existing multipicity. Here also type is of great value. Instead of heaping up a mass of features, which can with difficulty be summed up and appreciated, we find in the ideal type a formula, though short, yet containing all the essential traits of multiplicity: because every element, even the smallest, reacts on the character of the type and changes it in this or that direction.

If we are not satisfied with an artificially constructed type, we can use it for finding in nature the most typical forms, those which show the best the characteristic of the group. We have seen already, that such forms may be approached very near to ideal type.

Systematisation according to type is called typisation. Without doubt typisation can be very widely applied in different sciences; but generally it is applied without a clear notion of what type really stands for. The typisation in this case is unconscious, but still the existing systematical categories in Zoology and Botany do represent in a considerable degree natural units.

According to methodics, typisation is the opposite of classification, that is systematisation by classes. We mean by class an artificial group, formed according to the presence or absence of some arbitrarity chosen feature. This kind of systematisation is very imperfect and of course does not express the real resemblances and relations between the elements of a system.

In Zoology and Botany many systematical groups are artificially constructed, being a product of classification. This is mostly explained by an unsufficient study of such groups and sometimes by the fact, that the systematician lacked the sense of discerning natural systems.

As a result of the typisation process, we acquire the possibility of representing the total of the numerous congregations as a system of media types of different orders. The typical individual is subordinated to the typical race, the race to the typical species, the species to the genus, etc.

Are these characteristics sufficient to express all the particularities of a system? When the variability of a feature is characterised, not only the arithmetical mean, but also the coefficient of variability are given; of course the same is necessary also in our case. How can one find the coefficient of variability of a race, species, genus, etc,? We think, that this problem is not very difficult to solve.

Even in the highest systematical categories the systematical elements may be disposed according to the variation of their features in orthogenetical series. Dividing these series into classes, we can characterise each by fixed numbers; furthermore, the coefficient of variation may be calculated by the methods used in biometry and using these numbers as basis. The calculation of the coefficient of variability is simplified, when the variation of a feature can be expressed lineally, as then it is unnecessary to construct orthogenetic series.

Such then is the importance of the theory of type in systematisation. There can be no doubt, that the type must play a most important part in all disciplines having to do with systematisation.

The methodological importance of type must be made clear by special research not only from a natural-history point of view, but also, and in no less degree, by a philosophical investigation(13).

Explanation of figures

Table I

Fig. 1. Type of male genital system of the Ist group of genera *(Syrphini).*
„ 2. *Ischyrosyrphus.*
„ 3. *Pyrophaena.*
„ 4. *Lasiopticus.*
„ 5. *Bacha.*

Fig. 6. *Syrphus.*
„ 7. *Leucozona.*
„ 8. *Chrysotoxum.*
„ 9. *Xanthogramma.*
„ 10. *Didea.*

Table II

Fig. 11. *Platychirus.*
„ 12. *Sphaerophoria.*
„ 13. Type of male genital system of the IInd group of genera *(Chilosiini).*
„ 14. *Chilosia.*
„ 15. *Ferdinandea.*

Fig. 16. *Chrysogaster.*
„ 17. *Brachyopa.*
„ 18. *Liogaster.*
„ 19. *Hammerschmidtia.*
„ 20. *Sphegina.*
„ 21. *Paragus.*

Table III

Fig. 22. *Neoascia.*
„ 23. *Orthoneura.*
„ 24. *Rhingia.*

Fig. 25. *Heringia.*
„ 26. *Pipiza.*

Abbreviations

t.	testis	*v. d.*	vas deferens
v. s.	vas seminale	*a.*	ampulla seminalis
pr.	prostata	*d. ej.*	ductus ejaculatorius.
ves. s.	vesic. seminalis		

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(13) Since then I have published 2 articles on theoretical systematic: 1. "Probleme der exakten Systematik und Wege zu ihrer Lösung". — Zoolog. Anzeiger, Bd. 61, 1924. 2. "Sur l'analyse de la distribution et de la corrélation des caractères dans les unités systématiques". — Comptes Rendus de l'Acad. des Sciences de Russie. 1924.

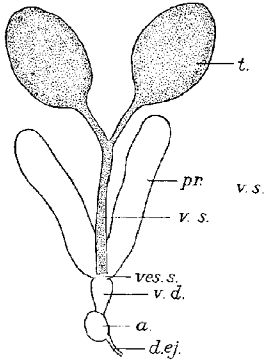
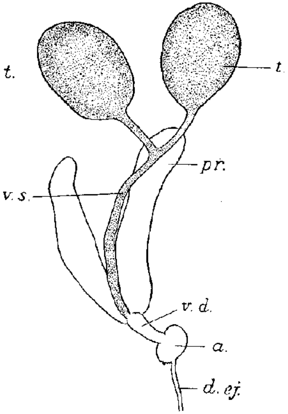


Fig. 1



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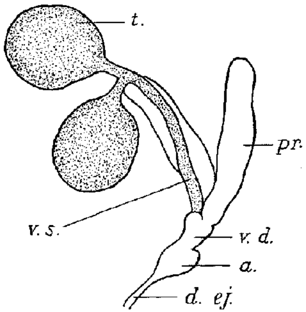

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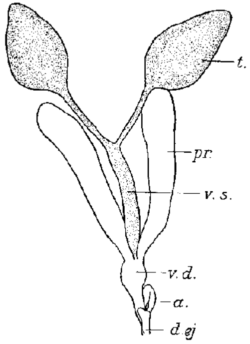

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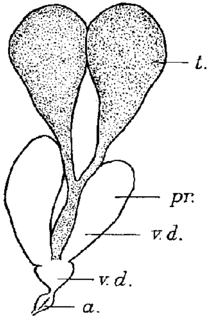

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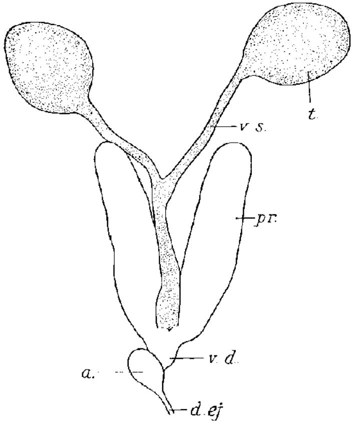

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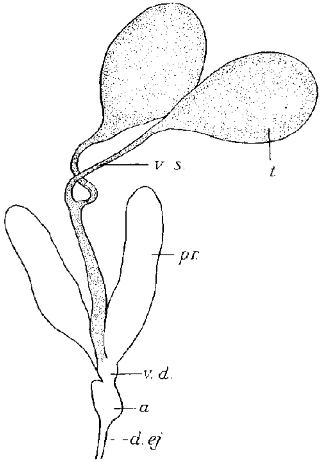

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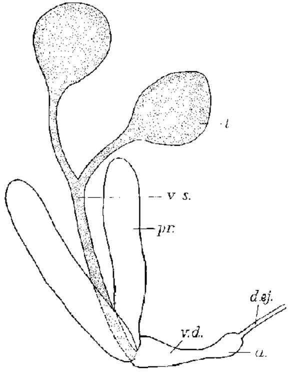

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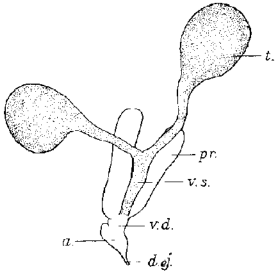

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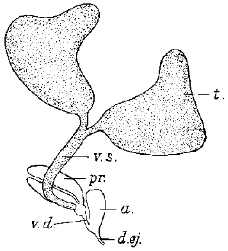

Fig. 10

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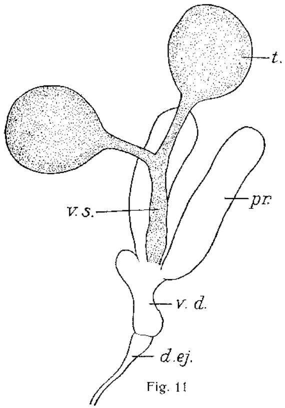

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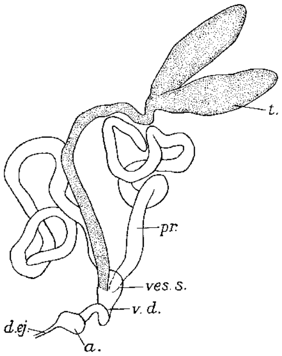

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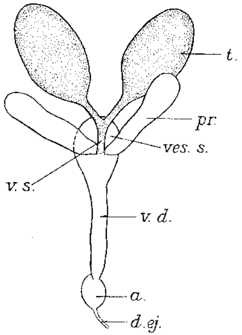

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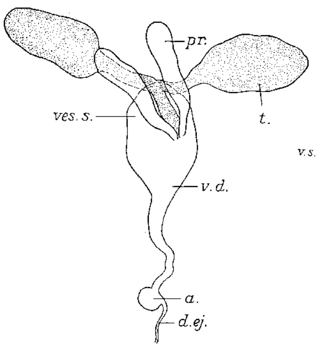

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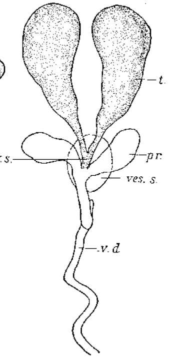

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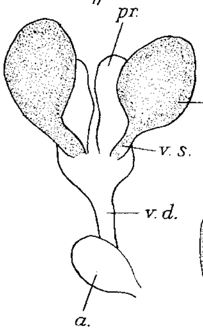

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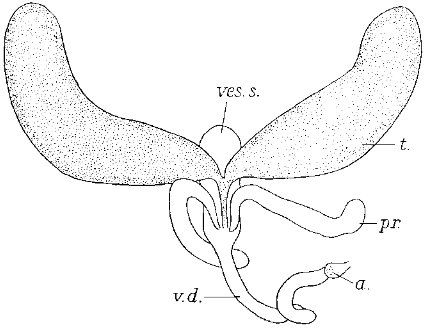

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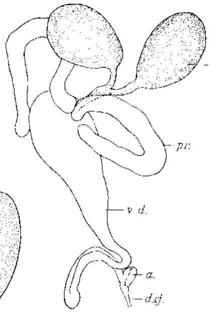

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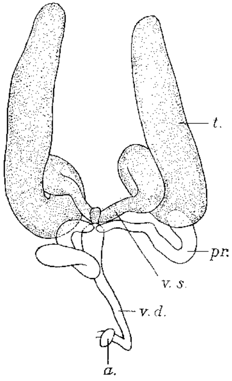

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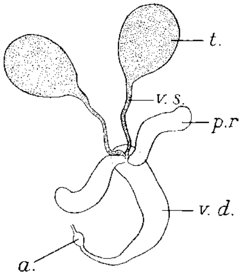

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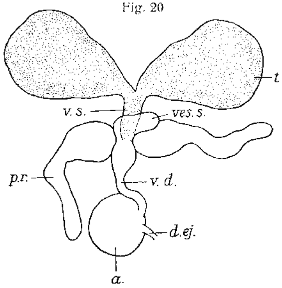

Fig. 21

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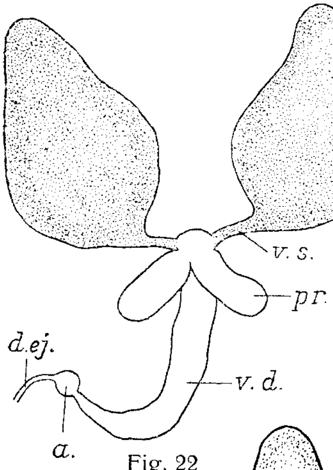

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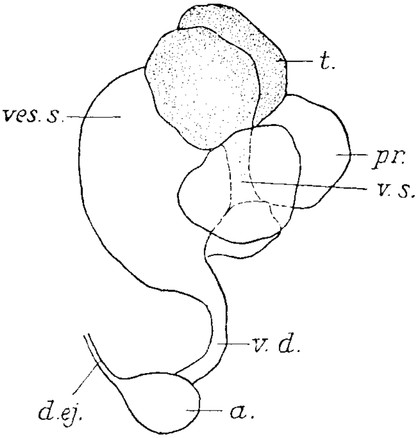

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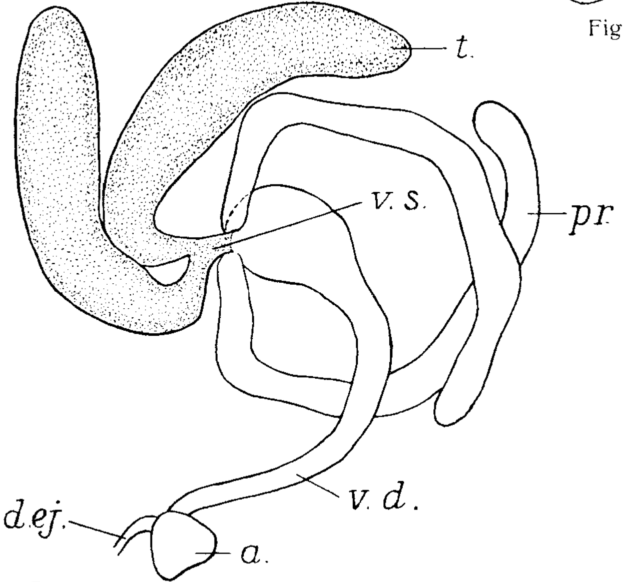

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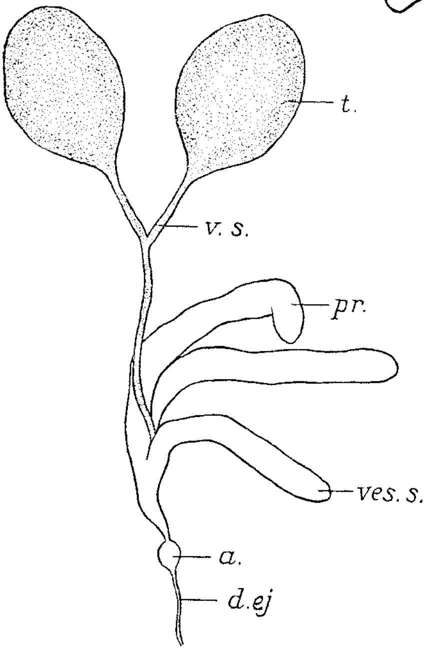

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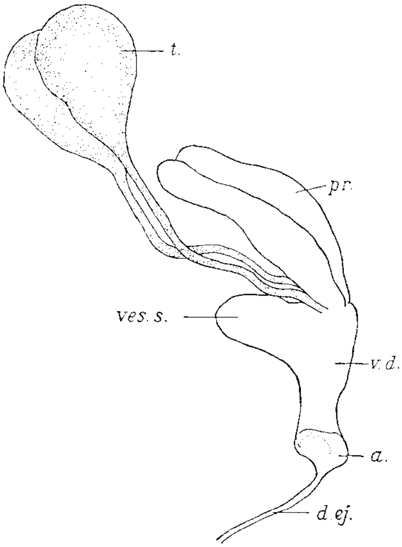

Fig. 26