A Recent Modification of the Species-Idea.[1]

By Dr. A. B. DROOGLEEVER FORTUYN.

IN view of the necessity of naming every organism, and from the fact that such a name often must be corrected when new biological facts become known, it follows that taxonomic systems are always changing. Even the species-idea, which is the basis of taxonomy, is changing. The question which group of organisms has a right to be called a species has been answered in different manners in different times. It seems to me that the question is always answered in agreement with the development of biology in general.

Lamarck and Darwin founded the species-idea upon organs and their changes as revealed by morphology and physiology. Mendel was the first to discover a means of analysing the organism through other than morphological and physiological concepts. He detected the now well-known hereditary units or genes, these being the more natural units than organs.

Because genes represented a new principle in the analysis of the organism they also came to be used as a new basis for the species-idea. This was done by Hugo de Vries in his mutation-theory, in which the existing species-idea of Lamarck and Darwin was partly changed and partly consolidated. A species from the point of view of de Vries—and I believe I may say that this is the prevalent species-idea at the present time—is a group of organisms possessing the same hereditary qualities, the same set of genes, and thought to be genetically pure. In recent years the work of Johannsen and others has given us more insight into the question of what really constitutes a group of organisms that is pure in respect to heredity. Johannsen has termed groups of genetically identical organisms pure lines and a mixture of them a population. Pure lines are not the species of Nature, though they can be isolated from the latter.

We cannot define a species as a group of organisms having the same genotype,[2] for it is known that often the male and the female of one species differ in the number of their chromosomes and in the number of their genes. Thus our idea of species must be wide enough to include organisms with genetical differences, as Dr. Hagedoorn and his wife, Dr. Vorstheuvel la Brand, have so ably shown in their book, "The relative Value of the Processes causing Evolution," The Hague, Martinus Nijhoff, 1921.

The Hagedoorns urge us to remember that a species is a natural phenomenon and not a theoretical conception. Species, as found in Nature, are mixtures of genotypes, so if we follow Johannsen and term such a mixture of genotypes a population, a species is a population, but not every population is a species. In order to be a species the individuals of a group must interbreed. Groups of organisms unable to propagate with one another do not belong to the same species. Therefore a species is a mixture of genotypes freely interbreeding and containing some types of homozygotes as well as several types of heterozygotes or hybrids.

Just because there is free interbreeding the group as a whole will have more or less constant composition and features, the type of the species. The absence of complete constancy in the character of a species doubtless renders it sometimes difficult to define, but on the other hand, as we know that species in Nature are changing and unstable, our definition must take this fact into consideration.

Independent of the work of the Hagedoorns such ideas are rising in the minds of several investigators to-day. E. S. Goodrich, for example ("Living Organisms," Oxford, Clarendon Press, 1924, p. 151), called a species "an assemblage of closely allied and interbreeding races, differing from each other by small factorial differences, and representing as a whole its present phase of evolution." The great plasticity of such a definition of the species is obvious.

So far as I know, no one has worked out this new idea of inconstant and impure species more in detail than the Hagedoorns, who have done so with much success. Although a species is inconstant and genetically impure (that is, composed of many genotypes and their hybrids), it always tends to become more constant and more pure because in the struggle for existence an elimination of ill-adapted genotypes takes place, and because new genotypes may only be introduced through rare cases of mutation or of crossing with other species. Therefore in accordance with the Hagedoorns we may call a species "a population which is so situated and constituted that it tends automatically to reduce its variability."

Under domestication so-called varieties exist side by side with the species to which they belong, though in Nature this is not the case. Among the sparrows, for example, we find now and then a white specimen; but these albinos propagate with gray sparrows and return in their offspring to the species. According to the Hagedoorns varieties do not exist outside a species, but within it. They call a variety "those individuals together which differ in some marked way from the common type, when there is nothing in the circumstances which isolates these organisms and prevents them from crossing freely with typical ones."

If a species be composed of many genotypes, the addition of one new genotype will not much alter the species. Therefore even a mutation will not always obviously change a species, but mutation remains a source for new genes and consequently for new genotypes, so it remains in this way one of the origins of species. On the other hand, new species may arise, apart from mutation and hybridisation, by mere isolation.

If a continental peninsula be transformed into an island and some members of a species originally continental thus become isolated, then the mixture of genotypes represented by the individuals on the island may be different from that obtaining among the individuals remaining on the continent. Both mixtures will move towards their own equilibrium, and therefore so long as they are isolated the island and the continent will each have its own species. These species would have arisen suddenly and without adaptation. In this way the fact may be explained that islands like the Galapagos having similar climate and conditions but being isolated from one another by deep seas have each their own closely related species of many types of animals and plants, a fact which Darwin failed to explain.

This new species-idea is of importance because it shows that there is no reason for specific discrimination among the individuals of a group freely interbreeding. Take, for example, the house-rat. Be it presumed that from Norway to Manchuria, through Europe and Asia, all house-rats are freely inter-

[1] From the Department of Anatomy, Peking Union Medical College, Peking, China. Substance of a communication read before the Anatomical and Anthropological Section of the China Medical Association in Peking, September 1926.

[2] Genotype here means type of a set of genes, not the type of a genus.

breeding. In that case they belong to one species, *Mus decumanus* or *Mus norvegicus*. There is no reason to call the rat of Manchuria, even if it differs from the European rat, a sub-species (*Epimys norvegicus caraco*) or even a different species (*Mus caraco*) as has been done. Variation is found everywhere, for the very reason that a species is a population of many genotypes. If one wants a pure genotype one will not find it in Nature, but one may isolate it from the natural stock by breeding the rats scientifically. Therefore in research work it is often advisable either to use the impure species as such or to work with material which has been artifically and thoroughly purified, but not with an arbitrary impure portion of the whole impure species.

A taxonomic name represents a phenotype, although it always suggests a genotype. In how far it really represents a genotype may only be detected after scientific breeding. Whether it represents a species may only be decided after a careful study in Nature of the life of the individuals indicated by the name. For these reasons palæontological names can never be proved to indicate more than phenotypes.

This new species-idea is also of significance in the field of anthropology, for if mankind as a whole be freely interbreeding, then biologically speaking, mankind is only one species. It is a species so much the more because it tends to reduce its own variability by the extinction of some minor races and by other means. Pure lines are absent in man, while hybrids, on the other hand, are numerous, because even the children of a man with brown and a woman with blue eyes must be called hybrids. The groups recognised by anthropology as races certainly are heterogeneous portions of a heterogeneous whole, and their true nature cannot be fully understood without a thorough genotypical analysis.

Hydrography of the South Atlantic.

THE cruise of the ex-gunboat *Meteor* terminated at Wilhelmshaven at the end of May last, after traversing 67,535 sea miles and crossing the South Atlantic thirteen times between Africa and the South American continent. This is the only survey of the physical and chemical conditions of an ocean on such an extensive scale.

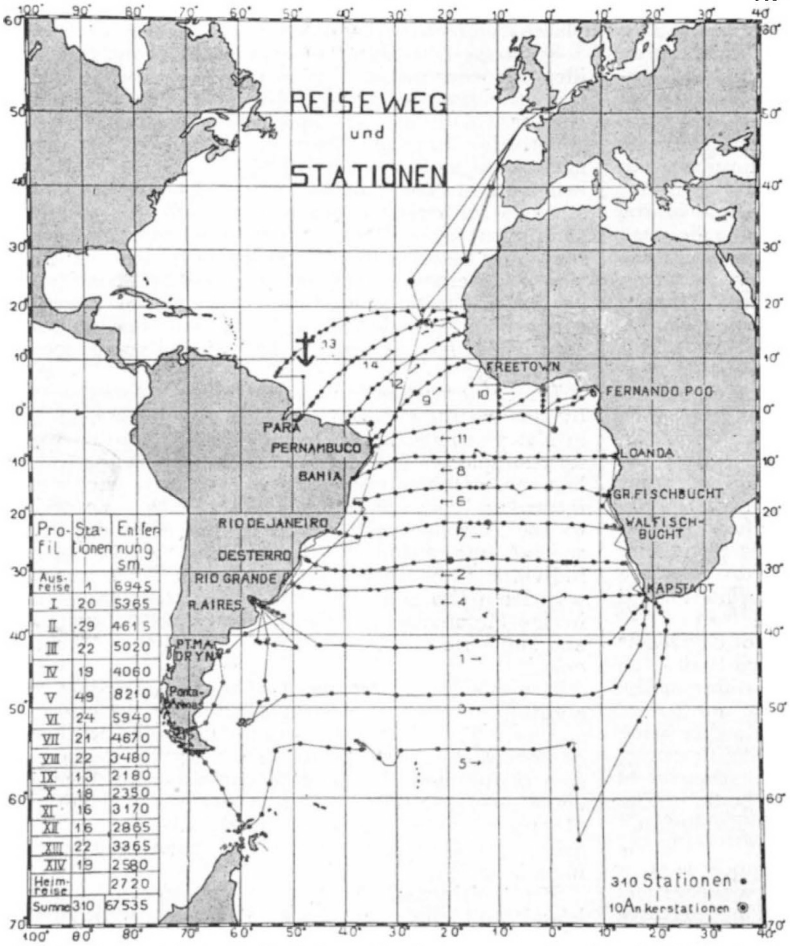

FIG. 1.—Track and hydrographic stations of the *Meteor*. From "Die Deutsche Atlantische Expedition auf dem *Meteor*."

The fourth and final report of the expedition [1] shows that the programme of work, drawn up by the late Dr. Mertz, has been very completely carried out, in spite of difficulties incidental to work of this nature. When the results of the observations are worked up and finally published, they will form a considerable addition to our knowledge of physical oceanography, and in all probability fundamental principles will emerge having applications of practical value. Whether this happens or not, scientific exploration of this nature is an effective way of 'showing the flag,' an exceptional experience for the naval officers employed, and sound training for apprentices and seamen.

Since H.M.S. *Challenger* was sent in 1872 on a voyage of exploration of the conditions and life within the oceans, Germany has added much to our knowledge through the expeditions of the *Valdivia*, *National*, *Planet*, *Deutschland*, and now of the *Meteor*. After the voyage of the *Challenger*, interest in the physical conditions of the oceans centred mainly in the drift of warm Atlantic water towards the north-west seaboard of Europe. Observations, mostly by the Scandinavians, led to the inference that this moved slowly towards the Norwegian coast, the drift being stronger in some years and weaker in others, and that these fluctuations in strength of the drift ran hand in hand with fluctuations in general weather conditions and affected the fisheries, most of which are seasonal and sometimes fail. It is to be hoped that an investigation, on a scale commensurate with the German South Atlantic Expedition, may sometime be possible in the North Atlantic, and particularly in the area to the westward of France and Ireland. A wide field for inquiry still remains open.

The report deals mostly with the programme of work carried out rather than with the results obtained. Undulatory movements in the water layers below the surface were found by A. Defant, most marked at and below the thermocline. Similar

[1] "Die Deutsche Atlantische Expedition auf dem *Meteor*." IV. Bericht. *Zeit. des Gesells. für Erdkunde*, Berlin, 1927, Nr. 5/6.