Dr. J. Argyll Campbell, junior assistant to Professor Schäfer at Edinburgh University, has been appointed professor of physiology in the University of Singapore.

W. Dawson, M.A., D.Sc. (Agr.), has been appointed to succeed Mr. A. Henry as reader in forestry at Cambridge University. Mr. Dawson has held a similar position at Aberdeen University.

Professor Strasburger, of Breslau, has accepted the position of director of the newly-established medical policlinic and therapeutic course at Frankfort-on-the-Main, which are to be considered a department of the proposed university.

Professor Kaiserling, of Berlin, has accepted the appointment as successor of Professor Henke at the Cologne Institute of Pathology.

DISCUSSION AND CORRESPONDENCE

TYPES OF SPECIES IN BOTANICAL TAXONOMY

It is becoming more and more evident that only by the use of the method of types[1] can any stability be secured in taxonomy. In spite of a growing realization of this fact there has been no adequate appreciation on the part of botanists of the great advantages offered by plants over animals in the facilities they afford for the multiplication of type material.

Primary Types

Although the author of a new species usually has at his disposal several different specimens upon which he bases his description, nevertheless only a single twig or shoot together with any organs borne on it can be considered to be the true type specimen. It is not permissible to accept as parts of the type other twigs or stems, for it often happens that they were not collected from the plant that yielded the true type specimen and subsequent research may show them to belong to a different variety or even to a different species. Experience has shown that the author of a species is far from infallible, and that to accept his verdict on this point may give rise to a complete misunderstanding of the species on the part of later investigators and cause endless confusion in the subsequent literature.

Even in case of diœcious or polymorphous plants where it is obviously impossible for a single specimen to represent all of the essential characters of the species, the twigs cut from different forms are not to be considered as parts of the type specimen. It is easy to see that where several species occur in the same region it is not always possible for the author of the species to be sure that the different sexes or castes[2] represented in the material at his disposal really belong to one and the same species. It is necessary to designate some one specimen as the type and to associate with it as paratypes additional specimens of the other sex or of the other castes that seem undoubtedly to belong to the same species Usually the pistillate specimen will be designated as the type.[3]

Even in case of a number of specimens presumably cut from the same plant it is unsafe to consider more than one of them as the type since there is always the chance that two plants growing close together were not distinguished. Abnormalities or bud variations on the type plant might also be overlooked, particularly if the collector, not realizing that he was dealing with a new species, exercised no unusual care.

The type specimen is therefore unique, and can not exist in duplicate. Types are the

[1] Cook, O. F., 1898, "The Method of Types," in Science (N. S.), 8: 513–516, No. 198, October 14. Cook, O. F., 1900, "The Method of Types in Botanical Nomenclature," in Science (N. S.), 12: 475–481, No. 300, September 28.

[2] Cook has discussed in some detail the various castes of plants having definitely specialized heterism (ropism). Cook, O. F., 1907, "Aspects of Kinetic Evolution," in *Proceed. Wash. Acad. Sci.*, 8: 369–378, February 13.

[3] The term allotype, although proposed for paleontological material, might very properly be applied to any paratype possessing some very important organ or distinctive feature not present in the type itself. Burling, Lancaster D., 1912, "The Nomenclature of Types," in *Journ. Wash. Acad. Sci.*, 2: 519–520, No. 21, December 19.

most valuable possession of museums and constantly increase in value as years elapse. They should not be left in the herbarium with the ordinary specimens, but should be so mounted as to be protected from injury in handling[4] and should be kept in fire-proof cases, if possible in a special room where they may be consulted in the presence of a custodian who can help to preserve all fragments of the type material.

The type plant from which the type specimen was secured has a far greater importance than a type animal. Very often additional specimens almost exactly duplicating the type can be secured from it. These are merotypes[5] and if used by the author of the species in drawing up the original description become paratypes as well. Carefully selected merotypes collected at the same time as the type specimen and used by the author as paratypes are, properly speaking, duplicate types, having practically the same value from a taxonomic standpoint as the type itself, and should receive the same treatment in museums.

If the original type is lost during the life of the author of the species it is often possible to secure substitute types collected from the very spot where the type was secured. It is sometimes possible to secure merotypes from the plant that yielded the original type. As a rule no such satisfactory substitute types can be obtained after the death of the author of the species.

Besides merotypes proper, cut from the type plant as it stands, it is often possible to secure specimens from its vegetatively propagated offspring. Such clonotypes,[6] as they have been called, may be secured from plants that reproduce naturally by bulbs, offshoots, tubers, etc., as well as from those propagated artificially by grafts or cuttings. Clonotypes can thus be obtained in unlimited numbers and are usually only slightly less representative than merotypes proper.

Specimens taken from seedlings of the type plant have been called spermotypes. They are of interest in case of short-lived species too small to furnish many merotypes and unable to yield clonotypes. Such seedlings if compared with the type and found to agree with it in all essential characters yield spermotypes almost as representative as clonotypes or merotypes. Spermotypes of dicœcious or polymorphic species have unusual value since the seeds obtained from the female plant that yielded the type specimen can usually be depended upon to reproduce the species unchanged, with of course both the constituent sexes or all the polymorphic forms represented among the seedlings.

Reproduced Types

Besides the additional material obtained through the subdivision of the type plant or by its propagation vegetatively or from seed there are other important means for the wide distribution of type material.

Photographs may be taken of the type specimens and, inasmuch as the camera is able to reproduce all the detail visible to the unaided eye and does it mechanically, these phototypes,[7] as they have been called, are of much value, especially as they can be reproduced indefinitely.

Phototypes are rendered still more valuable if they can be supplemented by a fragment of the type taken from a position definitely marked on the photograph. Such specimens have been called clastotypes. They can have, of course, only a limited distribution, since very few fragments can be spared from a type specimen.

[4] Kellerman, Maude, 1912, "A Method of Preserving Type Specimens," in *Journ. Wash. Acad. Sci.*, 2: 222–223, No. 9, May 4.

[5] Swingle, Walter T., 1912, "Merotypes as a Means of Multiplying Botanical Types," in *Journal Wash. Acad. Sci.*, 2: 220–222, No. 9, May 4.

[6] Swingle, Walter T., 1912, "Clastotypes, Clonotypes and Spermotypes, Means for Multiplying Botanical Type Material," in the *Journal Wash. Acad. Sci.*, 2: 337–339, No. 14, August 19.

[7] Kellerman, Maude, 1912, "Phototypes, Means for Wide Distribution of Type Material," in *Journal Wash. Acad. Sci.*, 2: 339–40, No. 13, August 19.

A representative merotype properly authenticated may be illustrated by nature prints, discovered by Auer and Worring and so beautifully applied by Ettinghausen and Pokorny,[8] whereby all the minute details of venation are shown in exact mechanical reproduction, and an indefinite number of copies can be made for distribution. This method, marvellous as it is, can not be used for the type itself, as the specimen may be destroyed or at least injured in the process of making the plate.[9]

Such a nature print, for which the term piesmotype[10] is suggested, is eminently adapted for the reproduction of an authentic merotype. This piesmotype, together with a phototype, gives an authentic, unbiased and very vivid picture of the type of the species.

Finally, in case of cones, nuts, or other organs showing relief sculpture, casts may be taken; these are the plastotypes of Schuchert.[11] They are probably of greatest value in reproducing types of fossil plants, although they can be made from almost any glabrous plant organ.

Syntypes and Paratypes

If, as is usually the case, several specimens from distinct plants and often from different localities are used by the author in describing his species the type material belongs to one of two categories. Either the author did not directly or indirectly designate a type and therefore all the specimens are syntypes,[12] or a type was designated, in which case the other specimens studied by the author are paratypes.[13]

What are here called syntypes are also known as cotypes,[14] but unfortunately the latter word is also very commonly, though erroneously, used to designate paratypes. In earlier times when the author of a new species rarely designated a type all of the specimens were very properly known as cotypes. It was easy to continue to apply the name to the specimens, even when the author had designated one of them as a type. Such a practise leads to confusion and should be abandoned, and a more precise and definite terminology used.

Although syntypes are usually segregated sooner or later into a type (lectotype[15]) and paratypes, it is nevertheless important to avoid any confusion in type material such as is likely to result from using the term cotype. It would, indeed, be better to abandon altogether the word cotype.

The rules that have been formulated for the typification of species, particularly those given in the American code of botanical no-

[8] Ettingshausen, C., and Pokorny, A., 1856, "Physiotypia plantarum austriacarum. Der Naturselbstdruck in seiner Anwendung auf die Gefässpflanzen des oesterreichischen Kaiserstaates." F°, 5 vols., Wien.

[9] The thoroughly dry herbarium specimen is forced into a plate of soft lead by great pressure exerted by a slow-moving roller, then an electrotype is made in hard metal from the lead original and impressions are made from the electro as is done from an engraved copper plate.

[10] Piesmotype (πιεσμός, pressure; τύπος, type); a picture printed from a plate bearing an imprint made by mechanical means from an authentic merotype.

[11] Schuchert, Charles, 1897, "What is a Type in Natural History," in Science (N. S.), 5: 636–640, No. 121, April 23.

[12] [Bather, F. A.], 1894, "Scientific Volapuk," in *Natural Science*, 4: 57, No. 23, January.

[13] "A *para-type* is a specimen belonging to the original series, but not the type, in cases where the author has himself selected a type. It should, however, be one of the specimens mentioned or enumerated in the original description." Thomas, Oldfield, 1893, "Suggestions for the More Definite Use of the Word 'Type' and its Compounds as Denoting Specimens of a Greater or Less Degree of Authenticity," in *Proc. Zool. Soc.*, 1893, p. 242, Pt. 2, No. 17, August 1.

[14] "A *co-type* is one of two or more specimens together forming the basis of a species, no *type* having been selected. No species would have both type and co-types, but either the former, or two or more of the latter." Thomas, Oldfield, *l. c.*

[15] Schuchert, Charles, in Merrill, Geo. P., 1905, Catalogue of the Type and Figured Specimens of Fossils, Minerals, Rocks and Ores in the Department of Geology, United States National Museum, Bull. 53, Part I., Fossil Invertebrates, p. 12.

menclature, suffice in very many cases to determine which of the syntypes is to be made the lectotype.[16]

Supplementary Typical Material

Besides the type material proper there are the so-called supplementary types (plesiotypes) and typical specimens (topotypes, etc.) which have been treated in detail by Schuchert. These need not be considered here, as they are merely specimens judged, with more or less show of reason, to be like the type. Often, perhaps usually, they do not belong in the type collection at all.

To summarize briefly the different kinds of type material we have:

I. *Type Material Proper*

1. Primary types, specimens used by the author in describing a new species, including either (*a*) the true *type* (with its *clastotypes*) and *paratypes*, or (*b*) the *syntypes*.

2. Additional types, specimens taken from the type plant or from its offspring, including *merotypes, clonotypes* and *spermotypes*.

3. Substitute types, specimens selected as types when the type was not designated, including *lectotypes*.

4. Reproduced types, mechanical reproductions of types, including *phototypes, piesmotypes* and *plastotypes*.

II. *Supplementary Typical Material*

5. Supplementary types, specimens used as a basis for descriptions or figures of previously published species, *plesiotypes*.

6. Typical material, specimens (from the type locality if possible) considered to be like the type, *topotypes*, etc.

WALTER T. SWINGLE

[16] Arthur, J. C., et al., 1907, "American Code of Botanical Nomenclature," in *Bull. Torrey Bot. Club*, 34: 172–174, No. 4, April, published June 11.

MOSQUITOES POLLINATING ORCHIDS

EARLY in July, 1912, Miss Ada K. Dietz, who was doing research work in plant ecology at the University of Michigan Biological Station at Douglas Lake, told me that she had seen in Rees's Bog a mosquito bearing on its head two small yellow masses that looked like pollen. I went to the bog and found many mosquitoes there. In a few minutes I had caught a half dozen or more, all of them females, bearing the yellow masses. On closer examination these proved to be pollinia of the orchid, *Habenaria obtusata* (Pursh.) which was at that time abundant in the bog and in full bloom. Most of the mosquitoes carried one pollinium, some had two or three, and one had four pollinia attached to its eyes.

This orchid is small, green and inconspicuous, but very similar in the structure of its flower to *Orchis mascula*, described by Darwin in his book on the "Fertilization of Orchids," and by Müller in "The Fertilization of Flowers." Also, the complex process of pollination as described in the last named book (p. 535) for *O. mascula* might apply almost unchanged for *H. obtusata* with mosquitoes instead of bees for the pollen-bearers.

I gathered a number of the plants and a few mosquitoes that were free from pollinia and put them together in a glass aquarium jar. In a few days the mosquitoes had removed most of the pollinia from the flowers and now bore them on their eyes exactly as had those caught outside.

I did not learn the name of the mosquito concerned. It was probably not *Culex pipiens*, which is mentioned by Müller as a visitor to the flowers of *Rhamnus Frangula*. So far as I know, this is the only case reported in which mosquitoes seem to be of primary importance as agents of pollination.

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SCIENTIFIC BOOKS

The New Realism: Cooperative Studies in Philosophy. By E. B. HOLT, W. T. MARVIN, W. P. MONTAGUE, R. B. PERRY, W. B. PITKIN and E. G. SPAULDING. New York, The Macmillan Company. 1912.

The World We Live In. By GEORGE STUART FULLERTON. New York, The Macmillan Company. 1912.

The first of these contributions to philos-