bergen." It covers the area bounded westwardly by Belgium and eastern France, southerly and easterly by Switzerland, Galacia and central Russia, to the White Sea, Spitzbergen and Iceland. It thus includes Germany, Belgium, Holland, Denmark, Norway, Sweden, more than one half of Russia, besides parts of Austria and France, and the islands mentioned. Yet in spite of the large area included the book contains only 524 small octavo pages. It should serve as a good model for our North American manuals.

MISS FREDERICA DETMERS has published her dissertation for the doctorate, "An Ecological Study of Buckeye Lake," as a contribution to the phytogeography of Ohio, constituting a pamphlet of 138 pages. This artificial lake, a little more than seven miles long, and from a quarter of a mile to a mile and a half in width, was constructed eighty years or more ago on the site of an impassable swamp. Some interesting studies were made by Miss Detmers, and these are recorded in her paper. There is an annotated list of plants collected in and about the lake, and a good bibliography.

THE New Jersey Forest Park Reservation Commission has issued a useful pamphlet entitled "The Planting and Care of Shade Trees" which may interest botanists, and certainly will do so for those who are interested in trees. The second half of the book is devoted to "Insects Injurious to Shade Trees," by the state entomologist, J. B. Smith, and "Diseases of Shade and Forest Trees," by the state plant pathologist, M. T. Cook. Many good "half-tone" reproductions of photographs add much to the value of the report.

ALLIED to the foregoing is the paper on "Cultivation of Native Ornamental Plants," by Miss Eloise Butler, in the October *Minnesota Horticulturist.* In it the author enthusiastically urges the use of a large number of wild plants, listing them under the following heads, Trees, Shrubs, Woody Vines, Herbaceous Vines, Shade Plants, Early Flowering Herbs (chiefly shade plants), Flowering Herbs that will grow in Full Sun. On reading the paper one is filled with a desire to make a little wild garden in one's back yard.

HERE we may notice briefly Professor Henry Kraemer's "Outlines of Courses in Botany, Microscopy and Pharmacognosy" for pharmacy students. The "first year's work" (botany) as here outlined is one of the best we have seen.

A DOZEN years ago Professor Selby, of the Ohio Agricultural Experiment Station, published a bulletin (No. 121) entitled "A Condensed Handbook of Diseases of Cultivated Plants in Ohio," which proved to be so useful that a demand sprang up for it all over the country. Two years ago he published in pamphlet form a revised and enlarged edition (No. 214) under practically the same title, and now we have a bound book with essentially the same matter as the second edition but with the title "Handbook of Diseases of Cultivated Plants." This also is issued by the Experiment Station, and is numbered as before (214). In its present form it is a handy book of somewhat more than one hundred and fifty pages of text and includes one hundred and six text illustrations. We may hope that in time this may grow into a still more complete handbook of plant diseases, the need of which is suggested by the demand shown for this bulletin.

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THE AGE OF PICANTHROPUS ERECTUS

JUST twenty years ago Dubois startled the scientific world by his announcement of the discovery of the skeletal remains of an ape-man, *Pithecanthropus erectus,* near the hamlet of Trinil in east central Java. The age was supposed to be Pliocene, and recently Dubois has reiterated his belief in the Pliocene age of this unique material, in which he is confirmed by Stremme and others. Discussion of the age of these remains has been the basis for a considerable volume of literature and the recent tendency has been toward considering *Pithecanthropus* younger rather than older. Thus Martin and Elbert assign it to the old

Pleistocene while Volz, Carthaus, etc., consider it middle Pleistocene. The two Selenka expeditions to Java in 1906–07 and 1908 made rather extensive excavations at Trinil and brought back large collections of fossil plants. These have now been described by Schuster,[1] of Munich, and as the results are important the readers of SCIENCE should have their attention called to Schuster's conclusions.

The exposure of the *Pithecanthropus*-schichten at Trinil at the locality where the human remains were found in 1893 is about 25 meters in thickness and consists of interbedded conglomeratic tuffs, lapilli, ash-beds and clays, partially fluvial or lacustrine and probably partly eolian. Plant remains either as leaf-impressions, lignite or petrified wood are scattered throughout the section, occurring most abundantly, however, in stratum No. 6 in the lower half of the section and at the level at which *Pithecanthropus erectus* was found. Eight species of fresh-water gastropods were collected from member No. 4 above the main plant bed, and waterworn bones occur in member No. 5 which is above, and No. 9 which is below, the main plant bed. The main bone stratum, No. 9, contains a meager fauna which is said to show affinities with the Pliocene Siwalik fauna of northern India.

The flora described by Schuster comprises fifty-four species, none of which are extinct, distributed among twenty-two families. The most abundant families are the Moraceæ and Anonaceæ each with eight species, and the Lauraceæ with six species. The geographical distribution of these fifty-four species in the existing flora is somewhat different from what it was at the time of *Pithecanthropus*. Only ten still flourish in the immediate vicinity of Trinil although thirty-two or 62 per cent. are still found on the Island of Java. Twenty-nine or 57 per cent. are mainly Indo-Chinese in the modern flora and one species, *Uvaria zeylanica* of the Anonaceæ, is confined to Malabar, Ceylon and India. Schuster concludes that this flora is of Pleistocene and not Pliocene age, and there can be no question of the correctness of this conclusion, since all the forms are still existing, while in the upper Pliocene flora of Mogi described by Nathorst from this same general region 40 per cent. of the species are extinct. Moreover none of the Pliocene plants described by Crié from Java are present in the present collection. Schuster considers that this Pleistocene flora indicates an annual rainfall of about 400 cm. and a mean temperature of 64 to 68 degrees Fahrenheit. If these deductions are legitimate they show that temperatures were somewhat lower than present-day Javan temperatures, while the rainfall was somewhat greater than it is at the present time. Schuster considers that this Pleistocene flora flourished during a pluvial period which corresponds to the Mindel or second glacial period of Alpine glaciation according to Penck's nomenclature, and that *Pithecanthropus erectus* is slightly older than *Homo heidelbergensis* discovered in 1907 by Schoetensack at Mauer near Heidelberg, Germany. Just how this exact correlation is reached it is difficult to understand; in fact I hardly see how there can be any reliable data for such a long range correlation. It seems to me that the exact stage in the Pleistocene is undeterminable. According to Schuster's correlation the age is lower middle Pleistocene, although he calls it old Pleistocene. In the temperate zone a fossil flora with no extinct species indicates a late middle or upper Pleistocene age, but very likely this does not apply with equal force to tropical regions where the physical conditions have been more uniform than in the temperate zone.

The three largest of the Sunda Islands—Java, Borneo and Sumatra—are separated from the Indo-Chinese mainland and from each other by shallow seas less than one hundred fathoms in depth and for the most part not deeper than fifty fathoms. These seas date from the submergence in the late Pleistocene. In spite of this fact and the further fact that the mountain axis of Sumatra also

[1] Schuster, "Monographie der fossilen Flora der Pithecanthropus-Schichten," *Abh. k. Bayer. Akad. Wiss., math.-physik. Klasse*, 26 Band, 6 Abhandl., 1911.

forms the backbone of Java, the intervening Sunda Strait being only fifteen miles across, the existing flora and fauna of Java are less like those of Sumatra than those of the latter are like those of Borneo. The biota of Java is, on the other hand, much more like that of the Siamese peninsula and northern India, and it is very interesting to find similar and apparently anomalous affinities shown as long ago as the Pleistocene and certainly before the submergence which gave the region its present physical geography.

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SPECIAL ARTICLES

SOME RELATIONS BETWEEN ROOT CHARACTERS, GROUND WATER AND SPECIES DISTRIBUTION

Observations on the root habits of desert shrubs indicate that the root-type of any species may be of importance in limiting the distribution of the species. This has been found to be especially clear in the case of plants having obligate tap roots, which, as a rule, are confined to relatively deep soils. Such shrubs as have a generalized root-system, on the other hand, have a wide local distribution, which may be correlated with the fact that the roots of these plants are capable of a large degree of modification in conformity with the pressure of the soil environment. But the rôle of the superficial type of roots, such as is typical of species with water storage capacity, is not so well defined. It is known that the fleshy cacti, for example, are most highly developed where the rainfall is a periodic one, occurring, perhaps, twice each year, but that these plants occur sparsely where the precipitation takes place once annually. Whatever may be the reason for this limitation, it is noteworthy that the larger mass of absorbing roots of species having a water balance lie within 10 cm. of the surface of the ground. The superficial soil layer is subject to the most intense desiccation, and, hence, carries moisture in sufficient amount for the use of plants for the shortest period only, so that plants depending on this stratum for moisture must either be short-lived or have the capacity of storing up water against the following period of drought. What the minimum absorption time of fleshy plants is, has probably not been determined, but it is evident, from their distribution, that the amount of available moisture in the superficial soils derived from a single rainy season each year is not sufficient. To put the case in another way, it is apparent that the general and local distribution of the fleshy cacti would be other than it now is, if such plants had another type of root-system, for instance, if there was an obligate deeply penetrating root-system, in place of the superficial one they now have. Such a change, were it possible, would, in the first place, limit the local distribution to flood plains or to other areas having deep soil, and, in the second place, it would permit a wider general distribution. This suggestion makes it evident that the root-soil moisture relation may be an important factor among those which determine the survival of a species.

Such observations as have been made on the root habits of trees indicate that in these large-bodied plants the root character may also be of importance among the factors which operate to influence their distribution.

It is now well established, at least for a portion of the Southwest, that there may be a very intimate relation between the occurrence of certain species of trees and the character of their roots, having regard to the depth at which perennial water may be found. Here trees occur along streamways, while the nearby upland may be treeless. The humidity of the two areas may not be very unlike, nor the rainfall, nor yet the temperature. The great difference, which is often striking, lies mainly in the soil conditions, particularly with regard to the depth to the ground water. On the bottoms the water table lies within reach of the roots of trees, while on the more elevated land it is far below them.

The depth to the level of ground water, or to the soil that is moistened from the water table, is usually not great. In the eastern portion of the United States, in lands of mod-