weapons. On the contrary, there is no premium on invention, intelligence, or self-adaptation in mammals of any kind living in warm forests.

Granting all the very strong *circumstantial* evidence in favor of the ape-man theory, which has been piled mountain high by investigators since the time of Darwin and has been recently revived and stimulated to new force by the attacks of the fundamentalists on the whole evolution theory, we must look for the direct evidence which can come only from geology and palæontology. The final solution of this problem of problems therefore rests with the fossil hunter and explorer, whose task is an extremely difficult one because fossil remains of Primates, always scarce, are becoming increasingly scarce as the Primates rise in the scale of intelligence. I do not know the exact figures, but I think it is safe to say that 50,000 to 1 is about the ratio of probability of discovery of fossil remains of lower orders to fossil remains of Primates in Tertiary time.

Meanwhile, the circumstantial evidence of geology and of geography is all in favor of the theory that the pro-man stock was well established in Oligocene time, now conservatively estimated at sixteen million years ago. At this time occurred the first *modernization* of the entire mammalian kingdom. So far as we can observe geologically, this modernization was due to the first great wave of aridity concurrent with the complete elevation of great continental plateaus, especially in central Asia and in the western region of North America.

This wave of aridity and of elevation caused a profound cleavage in the mammalian world, the first great natural divorce between the warm forest-loving types developed during the preceding Eocene period and the temperate plains and plateau-loving types which apparently invaded the great Oligocene belt of the 40th parallel from the north. This cleavage profoundly affected the whole mammalian world of this region; not only the horses, rhinoceroses, tapirs, and even-toed animals like the progenitors of the deer, the cattle, and the camel families had to make their choice between forest regions and the plains, but the carnivorous enemies—wolves and foxes and the progenitors of the greater carnivores in the cat family—were compelled to go forest-ward or plains-ward. It is not at all probable that the Primates—lemurs, North and South American monkeys and the hypothetic division of pro-man—were exempt from this compelling and fateful decision. Why was it postponed by the progressive progenitors of man when adopted by all the progressive elements in the remaining mammalian world? Why theoretically postpone this fateful decision on the part of our primate ancestors to Miocene or Pliocene time, as is still done by many conservative writers who continue to adhere to the abandoned conceptions of the period of Charles Darwin's speculation partly because of loyalty to him and reverence for his classic contribution to anthropology?

This concludes the seventh address which I have devoted to this absorbing subject. In the succeeding or eighth address I shall continue the attack and try to demonstrate that while the anatomical and embryological evidence for the *kinship* of the apes to man is overwhelming, the same evidence, when closely analyzed and subjected to conditions of modern principles of phylogeny discovered since Darwin's time, compels us to replace the ape-man hypothesis by the new pro-Dawn Man theory.

HENRY FAIRFIELD OSBORN

THE USE OF CHARTS IN THE NATURAL SCIENCES

OLD teachers of natural science subjects will remember the time when charts were used extensively in classroom and laboratory instruction. That was before the general introduction and universal use of the lantern, now the principal means of classroom demonstration. The lantern slide has almost completely driven out the chart, and many university departments of zoology, anatomy, physiology, bacteriology and botany have practically no charts at all, or whatever they have is antiquated material or homemade, crude and unattractive.

A recent inspection of new German charts suggested the question whether we have not gone too far in our abandonment of the use of the chart and have deprived ourselves of a help, which the lantern-slide can not and will not render. In Germany it was undoubtedly the reason of economy which prompted the continuous use of charts instead of slides. Under present circumstances no German university institute could afford to equip each classroom with a lantern or to have enough portable lanterns on hand to put one at the disposal of each lecturer or laboratory instructor. Of course there are some lanterns in German universities, but they are few and far between. The same is true to a still higher degree of French educational institutions. Also, the high perfection in graphic arts in Germany and the comparatively low cost of publishing charts of a high artistic value have contributed in a large degree to the universal demand for charts in German classrooms.

Sometimes the lantern-slide is superior to the chart. It allows a much greater variety of illustrations. It is handy to use and every biological laboratory has the equipment to make lantern-slides from

micro-photographs, from field-photographs, from book illustrations and drawings. The costs are comparatively low, and it is easy to build up a collection of thousands of slides in the course of years. When the classroom is darkened and the lantern in operation, it is easy to run through a series of sixty to seventy-five slides during a classroom period of one hour. But there is one great disadvantage connected with this form of instruction. It invites haste and superficiality and the attention of the student is purely voluntary and frequently very inadequate. He looks upon the lantern-slide demonstration as an entertainment which he may follow or not. Since he can not take any notes in the dark classroom and can make no drawings from lantern-slides, he has no record and he knows that he can not be examined about the material shown in this way. He is also deprived of a chance to review these pictures at his convenience after class. Also the lantern-slide can never be used for laboratory purposes, since a continuous comparison between object and picture is impossible. In spite of these drawbacks the lantern-slide will undoubtedly continue to hold its place as a means of convenient and rapid demonstration.

Where the lantern-slide fails, the chart can take its place to greater advantage. If charts are used in a class, the student can make notes of the lecture and if he has enough time he can accompany these notes by drawings. If the charts are left in the room, the student may use them for additional notes, drawings and reviews after recitation. Charts can be exhibited in a laboratory and left there during the entire laboratory period and the student can constantly compare what he sees in the microscope or what he has on his dissecting table with the information supplied by the chart. Good charts will emphasize certain features of an object and omit details which make a photographic picture frequently less lucid. Also, the charts can picture objects of which photographs are hard or impossible to obtain and maybe the results of a teaching experience which is not available for many instructors. These are sufficient reasons to suggest a revision of our present abandonment of charts and to consider seriously whether departments of zoology, botany, physiology, anatomy, general biology, not to mention geography and geology, should not give very serious attention to charts, as means of rounding out their equipment for illustrative material.

Of the many new charts which have recently been published, mostly in Germany, a few of the outstanding sets will be discussed in the following.

In the field of general biology should be noted Haecker's Wandtafeln zur allgemeinen Biologie. Among other subjects they illustrate Mendel's law, the De Vries' theory of mutation, also the protective coloring of insects and the influence of temperature on insect colors. Matzdorf's Lebensbeziehungen und Gewohnheiten der Tiere shows the effects of mimicry in animals and their different habitats. The life of protozoa is illustrated in Täuber's Mikroskopische Wandtafeln.

In zoology the front rank is still held by Leuckart and Nitsche's Zoologische Wandtafeln. This large series has one hundred sixteen large-sized charts and covers the whole ground which may be taken up by any general zoology course dealing with invertebrates. These charts are masterpieces of accuracy and scientific detail and supply inexhaustible material for laboratory study.

Among the other charts in general zoology two main groups may be observed, one in which the animals are pictured detached and without reference to biological features, like habitats or ecologic relation to man, and the other where the animal is considered as part of its natural surroundings. The first group is represented by such collections as Jung, Koch and Quentel's Neue Wandtafeln für den Unterricht in der Naturgeschichte, Schroeder and Kull's Biologische Wandtafeln zur Tierkunde, Pfurtscheller's Zoologische Wandtafeln, or Engleder's Wandtafeln für den naturkundlichen Unterricht (Tierkunde). There is another group as mentioned above which pictures the animals with their natural background. These charts are mostly of high artistic value, having been executed by painters of ability following the advice of scientists. Many of these charts are so beautiful that they could be used for decorative purposes and might find permanent places in museum rooms, classrooms and corridors. Here should be mentioned Täuber's Zoologische Wandbilder, Schmeil's Zoologische Wandtafeln, and Lehmann-Leutemann's Zoologischer Atlas. For instruction in animal anatomy should be mentioned Brass-Lehmann's Zootomische Wandtafeln and Täuber's Zootomische Wandtafeln.

A very attractive series of instruction in embryology and histology is represented by Smalian's Histologische embryologische Tafeln.

Among various entomological charts may be mentioned Schlüter's Schädlingstafeln der Deutschen Gesellschaft für Angewandte Entomologie. On fourteen charts the most important harmful insects are given in relation to their human and plant hosts. Another interesting set describing entomological objects are Meinhold-Pascal's Biologische Charakterbilder der Niederen Tiere. This set of seventeen charts deals with representative types without reference to harm-

fulness and shows them in their natural surroundings and activities.

For bacteriology two sets of charts have been published by F. Lucksch. Series I shows the general forms, structure, sheaths and cilia of bacteria. Series II deals with pathogenic bacteria.

The best set of charts ever produced on human anatomy are unquestionably the American Frohse Life-Size Anatomical Charts. These eight charts are the most valuable means of instruction in human anatomy and are known to all medical men. A smaller set along the same lines is formed by Zschommler's Buntfärbige Röntgenbilder, in which the human body is pictured as if seen transparent. In this way the bones and softer organs can be seen in their natural relation to each other. The set consists only of two charts and gives the front and rear view of the body. Other sets of charts dealing with human anatomy are Fiedler and Hoelemann's Anatomische Wandtafeln and K. G. Lutz's Anatomische Wandtafeln. There is also a French series of charts, the Deyrolle, on human anatomy, but it does not compare in any way with the American or German publications.

It is especially the science of botany where the German charts excel, although a slight disadvantage is the difference in species which characterizes the North American and the German floras. This difference is not large enough to form a serious handicap for the use of the foreign charts, since a great many species are common or internationally known.

The most important series in general botany are L. Kny's Botanische Wandtafeln. The former is a set of 120 charts and represents an extensive botany course in itself. Its complete study would take at least a year for any beginning class in botany, but many of these charts could also be used in various advanced courses dealing with anatomy or morphology of plants. The manual which is published with these charts covers 563 octavo pages of German text. Other large sets illustrating botany are Balslev-Warming's Botanische Wandtafeln and Engleder's Wandtafeln für den naturkundlichen Unterricht, Pflanzenkunde. The two last-mentioned sets do not deal with general botany but are more or less useful for courses in local floras and in plant taxonomy. A very beautiful set of charts illustrating the principal tree types are Hartinger's Wandtafeln: Bäume. The set pictures on twenty-five charts the most important tree types of the temperate zones. The execution of the charts is so beautiful that every one of them could be used for exhibition. They give the local background and natural setting of the trees.

The modern botanical subject of plant ecology is well represented in Potonié-Gotham's Vegetationsbilder der Jetzt- und Vorzeit. Six of these charts deal with the different ecologic types of modern vegetation as climax forest, swamp vegetation, mural flora, alpine flora, prairie vegetation and high moor flora. Two other charts are reconstructions of ancient floras and are unique in their way, being devised by men who were thoroughly familiar with plant paleontology and executed by prominent artists. One of these two charts represents a late Paleozoic swamp forest from the coal age while the other chart pictures a Mesozoic forest probably from the Jurassic period. The Potonié-Gotham charts are 50 x 38 inches and their size makes them highly acceptable for decorative purposes in classrooms and museums. A number of sets are devoted exclusively to the subject of plant anatomy. Among these is most complete the collection of Frank and Tschirch's Wandtafeln für den Unterricht in der Pflanzenphysiologie. This set pays special attention to plant anatomy from the viewpoint of physiology. A much smaller series containing only eight charts brings out some of the most important data of plant anatomy as different types of cells and tissues.

There are two well-known sets dealing with the subject of plant pathology, one in French and one in German. The first one is Fron's Maladies des Plantes Cultivées et leur Traitement. It contains only a limited number of charts dealing with important diseases of agricultural plants. A much more complete treatment of the same subject is found in Appel-Riehm's Atlas der Krankheiten der Landwirtschaftlichen Kulturpflanzen. This collection of rather small charts ($11\frac{1}{2}$ x $17\frac{1}{2}$) commends itself not only for classroom purposes but also as a laboratory text-book and field guide. The illustrations are excellent and picture the different diseases of cereals, vegetables, fruit and seed plants.

There are several sets of charts dealing with foreign useful plants, mostly tropical. Since the charts are published in Germany, the American cotton and tobacco figure amongst the foreign plants. One series of charts along these lines is Zippel's Ausländische Kulturpflanzen. There are sixty-seven charts divided into three series in the set, and the plants are shown on black background with analytic drawings of various organs as insets. Another series on the same subject is Goehring-Schmidt's Die wichtigsten ausländischen Kulturpflanzen. The charts of this series show the plants in their natural setting and with their human relations and therefore are also valuable for geographic instruction. The coloring and design are very beautiful. Apparently the

Goehring-Schmidt charts have been drawn from first-hand information because all details with regard to plantations, to natives and to the preparation of plant products are true to nature and not made from imagination. The entire series is one of the most attractive sets of charts that has ever been produced.

Recently a number of geological and paleontological charts have come to the writer's attention. Very useful for the teaching of historical geology are Lindner's Wandtafel zur Erdgeschichte. The chart summarizes the principal facts of earth history and can be used not only for an introductory lecture but would also be valuable for permanent use during such courses in zoology and botany where constant reference to geologic epochs must be made. It is a chart which the students should carefully study provided that they know enough German to understand a limited number of geologic terms. The chart is divided in columns which deal with the different epochs and their subdivisions, with the distribution of sedimentary and igneous rocks in geologic time, with the history of structural changes, climates and organic developments, and with the varying distributions of land and water during the earth's history.

An attractive set of charts on paleontology is Fraas' Die Entwicklung der Erde und ihrer Bewohner, in seven colored charts, representing the most important epochs in the history of the earth. Each chart contains in its upper part a reconstruction of the principal animal and plant types arranged in an ideal landscape picture, with a legend in the left-hand upper corner, while the lower half of the chart shows the geologic profile of the rock formation on the right side, and a plate with index fossils of the respective period on the left side. The ideal landscape represents merely life at a given moment during the formation in question, but the profile generalizes the geologic sections through all important horizons of the entire period. Therefore the profiles of the different charts, taken together, give a continuous sequence of the geologic deposits through the earth's crust. It is obvious that this series would prove not only useful in introductory courses in the earth's history but would be very profitable for a short series of historical lectures connected with courses in evolution.

Physiography is a subject which leads from geology into geography. It is well represented in a series of charts by Fraas, Die Naturerscheinungen der Erde. The charts deal with the phenomena and the effects of volcanic action, the mechanical forces of water and air, the rôle which ice is playing to-day on the surface of the earth and with such physiographic character types as the prairie, the coral reef, and the desert.

There are numerous charts devoted to the teaching of geography, especially human ecology. Let us select as a representative series for this discussion Wünsche's Land und Leben. In forty beautifully executed pictures, scenes from cities, harbors, rivers, primitive forests, jungles, prairies, all over the world are shown, with groups of people in their peculiar activities. There is an immense geographic information accumulated in these pictures which seem to have all been prepared by artists on the basis of first hand knowledge. They all look so real and are in no way a product of imagination or second-hand information.

With the exception of one set which is American, and two sets which are French, the charts mentioned in this article are all "made in Germany." They are well executed in colors, in high type of German graphic workmanship. Each set is accompanied by a manual written in Germany and only in very few instances this manual contains an English and French translation. The fact that the manual is written in a foreign language is unquestionably a disadvantage, but it also reminds the American scientist that he can get only the full benefit of the world's treasure of information if he is able to read German with sufficient fluency. There seems to be no escape from this fact in spite of the idea which sprang up during the Great War that the German language can be counted out of the necessary equipment of a scientist. At least it won't be true as long as the Germans continue to publish information of general usefulness.

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SCIENTIFIC EVENTS

AN INTERNATIONAL COMMITTEE FOR RESEARCH ON INFANTILE PARALYSIS

AN international committee for the study of infantile paralysis has recently been formed under the chairmanship of Dr. W. H. Park, director of the bureau of laboratories of the New York City Health Department. Arrangements have been made for a concerted three-year attack on the difficult problems of prevention and therapy presented by this formidable and crippling disease. To enable research to be conducted at a number of centers in the United States and in Europe, a sum of $250,000 has been contributed by Mr. Jeremiah Milbank, a New York financier, who takes an active personal interest in hospitals and charities. The following centers have been chosen for the proposed researches: Bureau of Laboratories, New York City Health Department; the pathological laboratories of Columbia, Harvard and Chicago Universities; the Pasteur Institute, Brussels, and the Lister