us far enough out of the present rut to show that there are better paths within access. At present we are content to pay homage to Steinmetz, Pupin and Tesla, while making no effort to offer at home the thorough training these men obtained elsewhere.

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WHAT IS A PLANT?

A PLANT is a living thing, typically green, possessing a green pigment, chlorophyll, by means of which it absorbs a part of the energy of the sunlight; by means of this energy it decomposes carbon dioxide; it uses the carbon, with water, to form its carbohydrate food; since its necessary food is everywhere, it does not have to have the power of locomotion; and since it does not have to move, it can protect itself with rigid walls of cellulose. . . .

But,

there are animals which during the most of their lives are fixed in one place as securely as typical plants are fixed. Some plants at all stages of their lives, and many plants at some time in their lives, have the power of locomotion, or at any rate are freely moved about. While plants are typically green, it is not impossible that the time will come when more kinds of plants are known without chlorophyll than with it. . . .

Why, then, are they called plants? Not because they have the majority of the characteristics of plants; for they are not green, and can not use carbon dioxide as food, and they may have the power of motion and be destitute of cellulose. Yet they are plants. The reason goes back to the idea that the plant kingdom is a group of creatures which are really related, which have common ancestors. Any living thing which is descended from the ancestor of the plant kingdom is itself a plant, whether or not it has retained the typical characters of plants.

Still farther back, there was doubtless a common ancestor of both plants and animals; and there are living things in the world which are less related to plants than animals are, and less related to animals than plants are.

This is commonplace, indeed; so elementary that it can be quoted from an old text for beginners averaging perhaps sixteen years in age. It is intruded on the—perhaps bored—attention of the professional botanist and teacher, because, as logical as a good lawyer, and hardly less the slave of precedent, he constantly ignores its consequences. Quoting still from the same very elementary text:

The plants and animals which we see about us seem very different indeed. A man or a horse differs from an orchid or a sunflower as widely as the time that plants and animals have existed upon the earth has permitted the difference between living things to become. If we follow the line of plant development backward or downward from the sunflower, we will find the characters which make up our usual idea of a plant gradually to disappear. The first to go is the showy structure of the flower. . . . The seed goes next. No seeds are found among the Archegoniates. Leaves are still present, but if we move downward to the next lower group, we shall lose them also. . . . If we follow the line down to the lowest Algae, we come to plants which no longer show any suggestion of a distinction of roots and shoots. . . . Still, these lowest Algae are plants. . . . If we begin at the top to follow down the line of development of the animal kingdom, we shall see the characteristic structures of the higher animals, hair first, then bones, etc., disappear, as did the flowers, seeds and leaves of the higher plants. At the bottom of the animal kingdom, we come again to organisms each of which consists of a single cell, but this cell still an animal. However unlike the higher animals and the higher plants may be, when we come to the examination of the plants and animals which are single cells, we find that these one-celled organisms, plants and animals are infinitely more like each other than either is like the highly developed creatures which have descended and been developed from them. The animal kingdom, like the plant kingdom, may well be pictured as a tree, and we have come now to the point where it must seem exceedingly probable that the two trunks grow from a common root.

There are many one-celled plants, and many one-celled animals. . . . Some of these share the characters of the two groups so impartially that the question, which they really belong to, is merely one of definition. The definition of a plant may be made to include them, and so may the definition of an animal. Neither is the question, to which kingdom they belong, of any real importance. If two trunks grow from a common root, who shall decide to which trunk the root belongs?

This much we can say: from green flagellates the plants are descended, and from colorless flagellates, the animals. Since the plant kingdom is reasonably spoken of as constituting a vast group of living things for the sole reason that all of these living things have a common descent from the green flagellates, it follows that there can be no possible good reason for calling any living thing a plant, unless it is descended from these green flagellates.

There are alternatives, to which we will return.

There is no reason why other lines of development should not have arisen from the fundamental flagellate stock; and the flagellates themselves are not so primitive, but that they must in turn have had their ancestors; and these ancestors ought not to be included in plants or in animals. There are a large number of organisms known, which, for one or the other of these reasons, must be regarded as neither plants nor animals. . . . For instance, the group of the Chytridineae, which usually have been included among the Fungi, seem very probably to be descended directly from the flagellates, independently of the line of primitive Algae from which the plant kingdom has developed. If this is the case, they are not, in the sense of systematic botany, plants at all, but a distinct group of living things.

Beside the two great trunks which grow from the common flagellate stock, other shoots have evidently started. There may well have been many of these, which disappeared from the face of the earth. There are probably several which still exist, but none of these have been able to develop into great kingdoms as have the two main trunks, the plants and the animals. . . .

"The most primitive living things of which we have knowledge, and therefore the most probable ancestors of all the living things in the world . . . are certain of the Schizophytes"—those able to live independently of other living things or their products. The text quoted goes on to treat of the Schizophytes as a distinct kingdom of living things, less conspicuous than plants and animals, but probably first in the number of individuals and of really great importance in its relations to humanity.

Besides these three great kingdoms, there is a whole list of "The Minor Kingdoms of Living Things." Here are listed the Flagellata: The Protozoa, including the rhizopods, Heliozoa, Foraminifera, Infusoria and others, not farther discussed because, by settled usage, they are subjects of the zoologist: Myxomycetes, which receive the usual couple of pages; Chytridineae: Peridineae: Phaeophyceae, treated in their aspects of general interest, but without any such detail as is usual when they are regarded as true plants: Diatoms: and Volvocineae. The Florideae and Conjugatae would as well have been added to this list. This was not done, because the guiding principle in the setting up of the minor kingdoms was not the lack of evident relationship to the plants, but rather the more or less established direct connection with organisms lower than those recognized as plants.

I have quoted the old text, in preference to presenting the same matter anew and perhaps better, because it is in contrast with other texts. The function of a text is to present the subject acceptably. Up to a decade ago, perhaps five hundred students were given the presentation quoted: three score of them have been sufficiently attracted to scientific work to take master's degrees, and two dozen have doctor's degrees. No new argument could carry any such force of demonstrated effectiveness.

In the light of time, the old text looks quite dogmatic. There is no logical necessity of drawing the bottom line of the plant kingdom between the flagellates and the algae. There are two evident alternatives. The line of recognized plants may be carried down to the beginning of life, in which case animals are to be recognized as a branch of the plant kingdom; this alternative has always been open and evident, but has made no general appeal. Or, a bottom line might be drawn somewhere else. The line is arbitrary, wherever drawn. On general principles, the most primitive green flagellate makes an attractive parent of the plant kingdom; but the breaking up of flagellata into natural groups, whether or not based on color, seems to be decidedly more difficult than the recognition of a line between the group as a whole and the algae.

The choice of any one of the elementary texts in common use, to illustrate the contrast with the presentation given here, would be invidious. The commonest basic guide of their authors is almost certainly Engler's classification, most compactly presented in the "Syllabus der Pflanzenfamilien." No boundary of the plant kingdom seems to be fixed, except by inference. In the ninth and tenth edition, 1924, pp. XXXVI and XXXVII, are listed thirteen divisions. In the body of the book, the first ten are treated on thirty-eight pages, while the remaining three take up 335. Comments under these first ten are:

(1) Schizophyta: "No direct connection with higher plants."

(2) Myxomycetes: "No connection with higher plants."

(3) Flagellatae: "Related to Dinoflagellates, Silicoflagellates, Diatoms, Conjugatae, Chlorophyceae and Phaeophyceae."

(4) Dinoflagellates or Peridineae: "Connected with Diatoms."

(5) Diatoms: "No connection with the higher divisions."

(6) Conjugatae: "Connected downward with the Flagellatae, without connections upward."

(7) Chlorophyceae: "Connected downward with the Flagellatae; upward, a step to the lower Embryophyta."

(8) Charophyta: "Very isolated."

(9) Phaeophyceae: "Connected downward with the Flagellatae; no connection with higher divisions."

(10) Rhodophyceae: "Very isolated," but descent from Schizophyta suggested.

The remaining three divisions are fungi, embryophyta asiphonagama and embryophyta siphonagama, the last two more familiar as archegoniates and spermatophytes.

Seven of these are avowedly unrelated to plants, if the "higher divisions" represent what plants really are. Four constitute a group of clearly related organisms—the things every man recognizes as plants. I would add to these the charophyta, until it is shown to belong elsewhere. And the only objection to adding the flagellatae is that the result is an increase of difficulty in definition and natural classification. But why are the unrelated seven divisions to be included? To do so clearly violates the principle of phylogeny, which Engler constantly and rightly emphasizes as the guiding principle of his treatment and of all rational taxonomy.

If one suggestion of Engler's is adopted, the violence done to the guiding principle of phylogeny is still worse than if currently accepted views are correct. "Mir scheint die Annahme berechtigt, dass bei der Entstehung einzelliger Organismen gleich anfangs mit verschiedenen Genen ausgestattete Schizophyten, Schizomyceten und Schizophyceen, Myxomyceten, Flagellaten, Dinoflagellaten, Bacillariaceen und Conjugaten entstanden." This appears to propose that all these divisions arose independently from inorganic matter. A plant kingdom, including them, is then no more "natural" than a kingdom of the stones.

These various creatures do not disappear from the course in botany, just because they are not plants. To the extent that they are subjects of interest, this is still the most convenient place to become acquainted with them. Also, some knowledge of them is necessary for the understanding of real plants; just as one would begin with Chinese art and literature if his subject of study were Japanese civilization, and as the historian of a war must first picture its background. Anthoceros is not regarded as a fern, however important a knowledge of its life history is for the understanding of theirs.

The most of the differences between different texts and different courses are very unimportant. It is, however, very important that common sense, consistency, reasonableness, never be ignored. There is no other one thing so important in systematic biology as the fact that the grouping of organisms reflects and expresses their true relationships. It is inconsistent and unreasonable to begin the course in botany by doing violence to this basic principle.

Summary: The living things are not all plants or animals. Nature has been more resourceful, more thorough in trying out the possibilities. Another kingdom, that of the bacteria, using the word in an inexact sense, is likewise world-wide in distribution, probably most numerous in individuals and very important in its human relations. And, beside these three major kingdoms, there are a number of minor kingdoms, not unsuccessful, but much less successful lines of evolution from the primitive beginnings of life.

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SCIENTIFIC EVENTS

THE NEW OXFORD SCHOOL OF PATHOLOGY

THE Sir William Dunn school of pathology at Oxford University, which has been three years building and has cost £70,000, was handed over on March 11 by the Sir William Dunn trustees, the directors of the Commercial Union Assurance Company, to the university. The opening ceremony was attended by many leading scientists, as well as by practically all the senior members of the university.

The new building will be under the direction of Professor Georges Dreyer, who has been professor of pathology at Oxford University since 1907. It has been designed to give the best modern facilities for teaching and research. In the old department there was somewhat inferior accommodation for about twenty-eight students. In the new building there is room for at least fifty, with every modern facility. Though by no means the largest, it is one of the best equipped institutions of its kind in the world. The old department could not house more than ten research workers, some of them with inadequate quarters. Here there is ample accommodation for twenty-five, and each is equipped with a large room, electric light and power and the latest appliances and fittings.

The general design of the building aims at simplicity. There are three corridors, one above the other, running the entire length of the building. Research will occupy the eastern and teaching the western wing, and at the rear there is modern accommodation for animals. The study of the effect of light and of X-rays on living matter, the chemistry research and the biochemistry research are each furnished with special apartments.

In the basement is a low-pressure chamber, which was designed during the war by Captain H. F. Pierce, now associate in physiology in Columbia University, built in the United States in 1917, and taken to France for testing air pilots. It was acquired by Professor Dreyer at the armistice from the American air force, and has since been used in a number of physiological experiments on the effect of altitude in producing mountain sickness and other disturbances and for other experiments. The school has on the ground floor an ample provision of space for the development of a fine departmental library.

Mr. C. D. Seligman, who made the presentation, said in part:

> The trustees felt strongly that it was far better, in the interests of mankind, to get at the primary causes of disease than to deal with disease when it had manifested itself. It was essential for this purpose that there should be a continued and sustained supply of men and women of the kind whose minds lent themselves to research, and what better place could they have for assembling such minds than the great seats of learning? While the Sir William Dunn Trustees had endowed a school of biochemistry at Cambridge and a school of pathology at Oxford, the Rockefeller trustees had endowed a school of biochemistry at Oxford and a school of pathology at Cambridge.