

zones in the Rocky Mountains, it would seem that the latter might be expected to have twice as many species. Switzerland has, of course, been more thoroughly investigated, but the large number of species given is not due to the inclusion of the "critical" forms, for the authors tell us in the preface that these are all to be given separately in a subsequent volume, the "Flore Critique." In the 1909 volume the species are supposed to be such in the ordinary sense, and a special mark is appended to those (and they are very numerous) of which segregates are known, the account of these being promised in the later work.

There is no doubt that the separation of the ordinary from the "critical" flora, after the manner of Schinz and Keller, is convenient to the numerous class of botanists who are not specialists in taxonomy. Professor Nelson's work corresponds to the Swiss volume before me while Dr. Rydberg's book on the plants of the same region, expected in about a year, will really be a "Flore Critique," at least to a considerable extent. American workers are at present roughly divided into two groups, of which a modern European botanist would say that one failed to discriminate the lesser types, many of which are of the highest interest from a biological standpoint, while the other, recognizing minor segregates, treated them all as species, without any attempt to indicate in the nomenclature their various kinds and degrees of relationship to the species of the older school. We venture to hope and believe that at length a middle ground will be found in a system of classification more like that of advanced European workers, which permits the presentation of the most minute details, without seriously disturbing the current conception of species.

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Umwelt und Innenwelt der Tiere. Von J. VON UEXKÜLL, Dr. med. hon. c. Berlin. Verlag von Julius Springer. 1909. 8vo, pp. 259.

The bold and original investigations of von Uexküll have culminated in his "Umwelt und Innenwelt der Tiere"; culminated, not because there are reasons to suppose that this will be

his last contribution to science, or perhaps even his best, but because he has synthesized into a coherent whole the results of earlier work, and with the addition of fresh materials, and maturer judgments, has sketched in the outlines of a reformed biology.

Large sections of the book must be left to those who have made certain protozoa, coelenterates, annelids, molluscs, crustaceans and insects, subjects of prolonged study, yet as a whole, the work should appeal to every biologist, no matter what group of animals or facts he knows best. It is these matters of general appeal that concern us.

First of all, a living thing is neither a bundle of anatomical details nor a collection of physiological processes, nor both of these together, for things that live, live in an environment. To cultivate either anatomy or physiology exclusively is as futile as the study of environments with all the animals left out, for the business of the biologist is to know, not merely structure or function, but what the vital machinery is, how it works and the circumstances under which the work is done.

The organism, von Uexküll teaches, must be studied, not as a congeries of anatomical or physiological abstractions, but as a piece of machinery, at work among external conditions. Our analyses, so far, have been by no means exhaustive, for we have largely neglected the fact that the organism makes its surroundings. It is true that environment includes the sum total of everything outside the individual, and, within these limits, is the same for all living things. Yet this is wholly misleading, for environment is both essential and unessential, and only the former counts practically in the shaping of biological destinies. The shark, the jellyfish and the pluteus, that swim side by side at the base of a wharf-pile, under uniform conditions of salinity, temperature, light and mechanical agitation, have each a different effective environment, and to this extent live in different worlds. Only when the receptors, through which external conditions make their appeal, are alike, are the outside conditions similar, but as the stimulated organs vary, so do the

several environments. Even within the same group these differ.

One need but glance at the pictures of Holbein to realize that the world in which he lived was far richer than our own. The simplest things are endowed by him with a reality that makes the objects we see pale.

The embryologist who has reared the eggs of the oyster, the starfish and the sea-urchin, within the same tumbler of sea-water, each into its proper larva, can testify strongly in favor of von Uexküll's view. Nevertheless, it does not follow that the organism which by selection makes its environment, is the all-important thing. Our author himself does not contend that it is, but there are those who do. It may not be amiss, therefore, to point out that an animal adapted to an environment of which factors A , B , C and D , constitute the practical portion, may be transferred suddenly to surroundings in which A is represented by $A + 1$; B by $B + 1$; C by $C + 1$; and D by $D + 2$. If $A + 1$ can serve for A , the substitution is made, and similarly $B + 1$ and $C + 1$, may take the places, respectively, of B and C . On the other hand, $D + 2$ may be beyond the range of the organism unless introduced to it, through the medium of $A + 1$, $B + 1$ and $C + 1$. If under these conditions $D + 2$ is selected, it follows that the new environment has made the animal over, and von Uexküll's dictum, therefore, can be enlarged to read, The organism makes the environment, and, reciprocally, the environment makes the organism.

The discussion of the environment leads by a natural step to a subject sadly in need of sunshine and fresh air.

Dictionaries define "organization" as "specifically the constitution of an animal or vegetable body, or of one of its parts," and many biologists use the word in this sense. Were they consistent, no one would object, or be the worse for the substitution of "organization" for "structure," but the word is as versatile as the men who use it, and the synonym transforms before our eyes into a brief formula for that unity in action which comes with transcendent complexity. Not only this, but many, gifted with the power of making

things more difficult than they really are, would have us believe that the organization is inside the thing organized!

The discovery that organized things come from eggs has led us to look in eggs for the method of origin. The creatures that come from eggs, however, are organized, not because they have a particular structure, or form, but because the parts that compose them are wonderfully related. One of the most beautiful examples of organization in nature is the bee-hive, a thing marvelously related to its environment, and hardly less marvelous abstractly, for its members act not only for their own welfare, but especially for that of the community and the race. It would be futile to study serial sections for this organization, since only honey, wax and the fragments of bees would greet the investigator's eyes. No less futile is the search in eggs, for organization is not a material thing, but the sum of the interrelations between material things. From this standpoint, reversals of polarity or symmetry are in the same category with the evolutions of a company of soldiers, and, like the orderly facing about of a well-drilled body of infantry, are possible only under conditions dependent on structure, yet themselves not structural. Physiological interrelations do not exist in space. As well try to dissect the digestion out of the duodenum, as to search with anatomical methods for organization, in this sense, in the egg!

If the point of view presented seems wholesome, the impetus so gained, in favor of von Uexküll's opinions, is nevertheless insufficient to carry us over the vitalistic bumper which he has thrown across the biological roadway. The argument is this: Living things are machines, but they are not all machinery. The hand and foot, the arm and leg, the stomach and heart, are machines, but they come from the egg, and the power to differentiate machines is itself super-mechanical. Reproduction, regeneration and certain kinds of regulation, occur in no machines known to man, and hence any machines that reproduce, regenerate or regulate are to this extent "über-maschinelle."

The logical weakness of this argument is at once supported by the circumstance that the protoplasm which differentiates the machinery is a liquid, and as all stresses and strains in a fluid are instantly equalized, liquid machines are physical impossibilities. The protoplasm of the egg is, therefore, no machine, and is forever beyond the reach of mechanical investigations. Physiology, anatomy, chemistry and physics are all powerless to grapple with this problem. The essence of a living thing is that it is vital, and this attribute, if accessible to the human intellect at all, can be understood only by the aid of "reine Erkenntnislehre."

Whether vitalism will triumph ultimately, is one of the many things that most biologists do not know, although von Uexküll considers victory inevitable. Lack of philosophical insight is held responsible for the bankrupt condition of our science, but however this may be, to restore confidence in biological currency by means of an inflation of vitalistic values seems a doubtful undertaking even if liquid machines are impossible. But is protoplasm a liquid?

The naked amœbæ are the most fluid of all animals, nevertheless their outer layers are visibly different from the interior, and there is every reason to believe that the ectosarc subserves many of the functions performed by the firmer boundaries of other cells. Among these functions is that of being a barrier which prevents the animal from becoming infinitely diluted in the medium in which it lives. Furthermore, the ectosarc, like the cell membrane, allows certain substances to pass in and out, and in this way insures differences in chemical composition between the amœba and its surroundings, while at other times it is the gate through which the equalization of differences is brought about. As long as protoplasm does not exist abstractly, but always occurs in nature behind a barrier that makes possible interrelations with the environment, and prevents fusion and identity with it, arguments based on a liquid as it isn't, can have no bearing on the case of vitalism *vs.* mechanism.

We will suppose, however, that the optical differences between the ectosarc and the endosarc are illusory; that the outer layers of the most fluid of all amœbæ are not physiologically the equivalents of cell-membranes; and finally that we are in reality dealing with liquids entirely uniform. We will endow these microscopic Franksteins with life. Are they machines?

Abstractly—no; concretely—yes, for our imaginary creatures exist in an environment, and interaction between the two is the one condition under which life is possible. As long as such interaction occurs, as long as metabolism takes place, we have differences of potential, stresses and strains; as long as anything happens, and life is a happening, we have a mechanism, a machine, but the machinery is neither the amœba nor the environment, but the two together. Von Uexküll's own contention that an organism devoid of environment is an absurdity, harmonizes so completely with this criticism, that it is difficult to see how the road which he has traveled could ever have led him into the vitalistic man-trap.

To make a good book, however, does not require infallibility. Thought, honesty and clearness are the necessary ingredients, and a writer who commands these fertilizes the minds of his readers, and where wrong, furnishes the materials for the correction of his own mistakes. Even though von Uexküll seems to have failed in some of his undertakings, he is nevertheless an author thoroughly worthy to be read.

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Handbuch der Klimatologie. Band II., Klimatographie. I. Teil, Klima der Tropenzone. Dritte, wesentlich umgearbeitete und vermehrte Auflage. Von Dr. JULIUS HANN. 8vo, pp. x + 426, figs. 7. Stuttgart, J. Engelhorn. 1910. Preis 14 M.

The first part of the second volume of the third edition of Hann's monumental work—revised, enlarged, up to date—the unique storehouse of climatological fact and description; the indispensable reference book for all who