in botanical work generally throughout the country. To accomplish this, it is realized that the aid and cooperation of all other botanical societies should be secured. No question is raised as to the value and necessity of other botanical organizations. We do not believe that there are too many of them, but that there is a woeful lack of proper unification and coordination was shown at the last Washington meeting, where the number of papers presented was so great that it was impossible for visiting botanists to take anything like advantage of them. In the future it is hoped and believed that existing botanical organizations can be continued and their integrity and independence maintained, but at the same time it would seem highly important that some steps be taken toward unification. There would seem no reason why the Botanical Society of America should not be the medium for bringing this about, and why, through its efforts, there should not be effected an organization representing the various botanical societies throughout the country which would affiliate with this society and assist in shaping a general policy on all matters affecting the welfare of the science.

The time seems ripe for bringing about this result. Never was botany more prosperous, never more aggressive. On the threshold of the twentieth century we stand, knowing our strength and only needing to weld it into harmonious action to make it vital and lasting. Let us join hands and do our best to bring this about.

Beverly T. Galloway.

*VITALISM AND MECHANISM IN BIOLOGY AND MEDICINE.**

Until some sixty years ago the prevalent view was that nearly all life phenomena were guided essentially by an all-pervading vital force. Even after the discovery by Wöhler in 1828 of the possibility of producing synthetically such an organic substance as urea, such a universal mind as that of Johannes Müller was still clinging to the belief in the all-powerful force as the creator and harmonizer of the various mechanisms of the living body. The belief in the omnipresence of an all-creating vital force furnished little stimulus for laborious studies of the innumerable mechanisms of life. In the forties of the last century, however, there came a change. With the improvement of the methods of investigation, with the rapid progress in organic chemistry, with the establishment of the law of conservation of energy in physics, with the successful application of physical and chemical laws to some of the intricate problems of life, the conviction developed that a great many of the mysteries of life will resolve themselves into physics and chemistry, and this belief gradually grew in some quarters into a theory that all life phenomena are nothing else but complex phenomena of the inorganic world. As just in those days it was recognized in physics that all energies can be converted into motion, and that the mechanical energy is the essential principle in the inorganic world, the new theory which made no distinction between the animate and inanimate phenomena became known as the mechanical theory of life. Right or wrong, this theory was of incalculable benefit to the progress of the biological sciences. The conviction that all parts of life are accessible to an analysis by the methods employed in natural science, stimulated then and stimulates now thousands of patient investigators in their indefatigable attempts to unravel an infinitely small fraction of the mysteries of life. Vitalism had a paralyzing effect. The mechanical conception of the life phenomena

* Introductory remarks made at the D. W. Harrington lectures on 'Œdema, a Consideration of the Physiological and Pathological Factors Concerned in its Formation,' delivered at the University of Buffalo, November 30, December 1, 2 and 3, 1903.

as a working hypothesis is a marvelous stimulus. But it did not remain a working hypothesis.

Men of letters with a transcendental bent of mind have turned it soon into a philosophical system and have extended it to regions which can never become the domain of natural science. Some of the extravagances proclaimed in the name of the mechanical theory brought undeserved discredit upon it. I need only to remind you of the statement that ideas are secreted by the nerve cells just as urine is secreted by the kidney epithelium. Assertions of this kind initiated a reaction against the entire theory. The theory of natural selection by Darwin, which, during its rise, lent its glory to our theory, since in the minds of the literary public the two were naturally linked together, subsequently also brought some discredit to it during its slow descent in the favor of that public. Furthermore, the very incessant activity in the investigation of biological problems which was stimulated by the mechanical theory soon brought out the unmistakable fact that, so far, comparatively only a small fraction of life phenomena are accessible to interpretation by the physics and chemistry of our day, and the enthusiastic originators of the mechanical theory have inadvertently proclaimed that the physics and chemistry of their day would explain all life phenomena. What a failure! say now the growing number of vitalists, or 'neo vitalists,' as they choose to call themselves. Since the middle of the eighties of the last century a reaction set in against the mechanical theory. In all branches of biology an increasing number of writers of first standing are coming out, veiled or open, against the mechanical theory of life. We meet them in physiological chemistry, in general biology, and we meet them in the writings on medicine, the science as well as the practice of medicine. We meet them in the writings on the very subjects I am going to discuss before you, on the subjects of the production of lymph and formation of œdema. And withal the vitalism of our day is not such a modest or conservative creation as the prefix 'neo' would lead us to believe. For instance, because only certain substances are absorbed within the intestines, a selection that can not be explained by the laws of diffusion and osmosis as we know them to-day, it is assumed by some writers that the epithelium of the intestinal mucosa has a selective power. But, instead of considering this assumption merely as a temporary resting place, until we know something more of physics and chemistry, the conclusion is drawn by Neumeister, a distinguished physiological chemist, that the epithelium possesses as much sensation, as much judicial power to know what is good for the body, as the nerve cells of the cortex. In what essential respect does this statement differ from the one of Carl Vogt, which was quoted above and which had such a shocking effect upon his contemporaries, namely, that there is not one difference between the nerve cells which secrete ideas and the kidney epithelium which excretes urine?

The point is that Vogt as well as Neumeister, though both excellent scientists, have not made their assertions as naturalists but as philosophers, who are dealing with transcendental problems. The discussion which is going on between the vitalists and mechanists and which has not only a theoretical but also a very important practical bearing upon many problems in biology and medicine, suffers, in my opinion, from a confusion of conceptions with regard to the questions to be answered. Permit me to discuss here the problems of vitalism and mechanism from my own point of view.

The phenomena of life are apparently different from those of the inorganic world.

We wish to recognize as much of them as our human faculties will permit, and wish to study them by methods of investigation which proved to be reliable in the investigations of the phenomena of the inorganic world. Then there are some preliminary questions to be answered.

TRANSCENDENTAL VITALISM AND MECHANISM.

The first question is: Suppose there will come a time when all laws of the inorganic world and also all structures and laws of the animated world, as far as they are accessible to the human faculties, will be completely known—will it then be found that the phenomena of life can be completely solved, or will it be found that life has still an element which is inconceivable, inaccessible to the grasp of human faculties. This is the concise question between mechanism and vitalism. What should be our position with regard to that question? To this I say it is wholly a transcendental question and not one for physiology and biology to deal with. Since from the point of view of the natural or rather biological sciences we wish to investigate only that which is accessible to human faculties and by methods approved in the natural sciences, we can obviously have no scientific opinions on a subject which is admittedly above the human faculties. An answer in the mechanistic sense is not a whit more scientific than an answer in favor of vitalism would be.

This position, however, should not be interpreted as denying the right to entertain such a question. It is certainly a perfectly legitimate problem in pure philosophy. Neither do I mean to deny the naturalist the right to discuss philosophical problems. But in such a case the discussion in both domains ought to be carried on strictly separately, otherwise, as experience teaches us, a harmful confusion will be unavoidable.

To repeat again, we consider the problem formulated in the preceding question as a transcendental one, and we shall, therefore, designate the theories contained in the answers to it as transcendental vitalism or transcendental mechanism.

NATURAL VITALISM AND MECHANISM.

The second question is: Suppose there shall come a time when all laws of the inorganic world as well as the structures and laws of the animated world shall be perfectly known to us. Would it then be found that the animated world is governed exactly by the same laws as the inanimate one, *i. e.*, by the laws of physics and chemistry, as they will then be known; or will it be found that the vital phenomena, in addition to the chemicophysical forces, are pervaded by separate energies, separate forces which are specific for living matter? It must be admitted that this question is a perfectly legitimate one and within the bounds of natural science. It is perfectly conceivable that one group of natural phenomena might possess energies which other groups do not possess and that vital phenomena might differ, indeed, from the phenomena of the inorganic world by a plus of specific energies. In contradistinction to the transcendental theories of life we might designate the theories contained in the answers to the second question as natural mechanism and natural vitalism. In other words, then, the theory of natural mechanism assumes that all the conceivable laws of life will prove to be nothing but physics and chemistry, and the theory of natural vitalism assumes that all vital phenomena are directed by specific energies besides those which are found also in the physical world. A little consideration will show that the natural and transcendental theories are perfectly independent of one another. For instance, the transcendental vitalist can easily accept the

theory of natural mechanism, and the defender of the theory of natural vitalism may accept the theory of transcendental mechanism. I shall, however, certainly not dwell here on the particulars of this point.

What shall be our position with regard to the problem involved in the second question? It seems to me that the state of our present knowledge does not permit us yet to decide the question in one way or another with any degree of probability, and that for a great many years to come any decision of this problem will have to be considered as an arbitrary hypothesis without a sufficient scientific basis. The argument in favor of vitalism, brought forward recently by Bunge, Neumeister, Stacke, Kassowitz and many others, consists in the statement that the further the investigation in biology progresses, the more facts are brought to light which can not be explained by physics and chemistry. But what does this signify? Our present knowledge of physics and chemistry surely is a most minute fraction of that which we shall know of the laws of the inorganic world in the thousands of years to come. Considering the length of human history we have to admit that even the science of physics is only in its very infancy. Why, it is only recently that they have tortured the father of physics for stating that the earth is turning around the sun, because it hurt their feelings to acknowledge that the abode of man is not the center of the universe. And it hurts the feelings of men to be told that the mysteries of life are only unrecognized chemistry—hence the passionate crusade in some circles against mechanism in biology. In our very day undreamt of discoveries are made in physics and in chemistry. Think of the rays discovered by Roentgen which penetrate heart and kidneys. Think of the marvelous results of stereochemistry, of the laws of osmosis, of the ionization of solutions, etc., all discoveries of our time. Why should we already now positively deny the possibility that chemistry and physics might not finally elucidate a great many, and perhaps all the facts in biology? Furthermore, the attempts properly and systematically to apply physics and chemistry to the interpretation of biological phenomena are hardly older than half a century. Those among the crusaders who themselves lent a hand to such studies should know with what immense difficulties the physiologist has to struggle. He has to create his own physics and chemistry; he has to master a difficult and difficile technique, and then the difficulties in obtaining and handling living material. The physicist and the chemist had always the aid of gold-seeking people. There is no gold for physiology, but plenty of obstruction on its onward way, placed by the sentimentalist, the ignorant and the wicked. With all the obstacles, physiology has already succeeded, in a great measure, to apply physics and chemistry to a good many biological phenomena, and the outlook for the future is brighter than ever. Think of the astonishing discovery in our country by Jacques Loeb of artificial parthenogenesis by simple changes in the osmotic pressure in the surrounding medium of the ovum, a fact which was never dreamt of before!

No, the crusaders against mechanism are wrong in their pessimistic views. There is nothing in the present stage of our knowledge discouraging for the hopes of those who believe in the ultimate solution of the problems of vital phenomena by the physics and chemistry of a far-off future. But it is also true that the success attained at present is, in comparison with what has yet to be attained, too minute, too insignificant to justify a prediction with any degree of probability.

Transcendental mechanism and vitalism

have no place within the domain of natural science. Natural mechanism and vitalism are insufficiently supported by accumulated evidence to be considered as well-established scientific theories.

VITALISM AS A WORKING HYPOTHESIS.

But there is still another question. There are already numerous well-established biological facts which can not be explained for the present by physics and chemistry, and we have no means of knowing whether they will ever be explained that way—what are we to do with these facts? Here is the answer: Vitalism as a storage place is indispensable. We should continue to call these facts vital phenomena until we discover a way to explain them by laws governing the inanimate bodies. But I shall still go further. I believe that vitalism as a working hypothesis is of great advantage to the progress of biology. The belief that only those biological facts which can be reduced to physics and chemistry can be considered as scientifically understood, combined with the misleading and harmful notion to elevate physiology to an exact science, confined the activity of this biologic division to some favored domains—to its own detriment. The sterility of some parts of physiology is due to this inappropriate exclusiveness. The relation of the internal secretion of the thyroid to myxœdema and cretinism and of the pancreas to diabetes, was discovered without any reference to physics and chemistry and was discovered by medical men, and not by physiologists. The important fact of the marvelous effect of the extract of the suprarenal capsule upon the circulation was discovered by physiologists without any reference to physics and chemistry. Surely physiology ought to search for the physics and chemistry of the vital processes as much as possible, but it ought to do more. It ought to unearth vital phenomena, study their characters by methods peculiar to themselves, and establish their laws aside from any relation to physics and chemistry of the inorganic world. That this can be successfully done is shown by the marvelous results obtained in the discoveries and the precise studies of toxines, antitoxines, hæmolysines, cytolysines and their like without much regard for physics and chemistry. Especially medical men have reason to ask for such physiological studies. The experiments which nature is continually making upon human beings and which physicians are called upon to interpret and to mend are not confined to domains which are accessible to interpretations by physics and chemistry. And it is to such a far-seeing, liberal, broad physiology that the science and practice of medicine is looking for a delivery from the firm grasp of the one-sided teachings of pathological anatomy.

S. J. Melzer.

SCIENTIFIC BOOKS.

Mammalian Anatomy, with special reference to the Cat. By Alvin Davison, Ph.D. Philadelphia, P. Blakiston's Son & Co. 1903. 8vo. Pp. xi + 250; 108 figs.

Another book on the anatomy of the cat can not but awaken suspicion as to its utility, but an examination of this one shows the suspicion to be unfounded. It is designed to fill the gap between the more detailed works and those which are merely laboratory guides, and to afford the student who can not pursue a lengthy course of zoological study, a general idea of the structure of a mammal and of the principles of mammalian anatomy.

In writing such a work the important point is to determine what is to be omitted, and Professor Davison has treated his subject with an admirable perspective. Occasionally, as in the description of the peritoneum, a somewhat fuller development of the subject would have been advisable, and occasionally, also, a brevity of statement tends to convey a somewhat erroneous impression. But such errors