assumes that all eggs and every sperm carry the potentialities of both sexes; there are no male and no female eggs, no male or female sperm, in the sense that each carries only one set of characters, but every germ cell is a sex-hybrid, and the fertilized egg is a double-barreled sex-hybrid. This view maintains that the sex of the embryo is determined by an internal condition that is present in the egg or sperm, which leads to the domination of one of the two possible alternatives. This is modern epigenesis as I understand it; predetermination, perhaps, but not preformation through the separation of contrasted characters. From this point of view we can imagine that sex-determination may be reached in more than one way. It may be due to conditions that are present in the sperm or in the egg, or as a result of the union of egg and sperm, for any internal, or even external, condition, that turns the balance one way or the other is a sex determinant.

It now appears probable that the problem of sex determination is to be sought in the same mechanism that accounts for alternative inheritance in general, Mendelian or otherwise. Strasburger, Bateson and Castle have pointed out the close parallel that seems to exist between the two cases. In Mendelian inheritance also we have to face the alternatives of preformation and epigenesis. The currently accepted interpretation of Mendelian inheritance is strictly one of preformation. Alternative characters are treated as entities in the germ cells that may be shuffled, but seldom get mixed. With each new deal the characters are separated, one germ cell getting one character and another the contrasted character.

If we take the opposite point of view, that of epigenetic development, the outcome, wherever alternative or contrasted characters are involved, is not due to separation, but to alternative dominance and recession, which need not give three types, but only two, if selective fertilization occurs, or, if only the egg or the sperm contains the internal factor that determines, that one or the other of the alternative sex characters shall predominate.

Which of these general points of view, preformation or epigenesis, we may think more profitable as a working hypothesis is, I believe, the question of the hour. My own preference—or prejudice, perhaps—is for the epigenetic interpretation, but the whole truth may lie somewhere between these two forms of thought that are the Scylla and Charybdis of biological speculation.

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SCIENTIFIC BOOKS

Abhandlungen ueber theoretische Physik. Von H. A. Lorentz. Leipsic, B. G. Teubner. 1906.

This work of Professor Lorentz is the result of a request of the publishers asking that a new edition of his articles on theoretical physics be prepared. The first part of the first volume appeared in 1906, and the complete work will consist of two volumes. The titles of the chapters in the first part of the first volume will be given below, together with some remarks indicating the nature and scope of the work.

Chapter I.—Some Considerations on the Principles of Dynamics in connection with Hertz's 'Prinzipien der Mechanik.' Starting with the principle upon which Hertz causes the whole science of dynamics to rest, viz., that a material system moves with constant velocity in a path of least curvature, Professor Lorentz investigates the question as to how far the method of Hertz is advantageous if one disregards Hertz's hypotheses concerning hidden motions and considers the system under the action of forces in the usual sense of the word.

After presenting in his own clear and concise way the fundamental notions of Hertz, the author shows how they lead to the general

dynamical principles of d'Alembert, Hamilton and Jacobi, expressed in the familiar way; and concludes by discussing certain well-known propositions relating to holonomic systems.

Chapter II.—Ein allgemeiner Satz, die Bewegung einer reibenden Flüssigkeit betreffend, nebst einigen Anwendungen desselben. Proceeding from the fundamental equations of motion and the equation of continuity of a viscous incompressible fluid, the author derives a general reciprocal theorem expressing a relation between any two states of the fluid satisfying the fundamental equations of motion. This theorem is shown to be capable of very extensive application, and is shown in operation through the consideration of several problems.

Chapter III.—Ueber die Entstehung turbulenter Flüssigkeitsbewegungen und über den Einfluss dieser Bewegungen bei der Strömung durch Röhren. In this chapter is found a discussion of the motion of a viscous fluid when the velocity has reached a value which has been called by Osborne Reynolds the 'critical velocity.' After this velocity has been reached turbulent motion may arise. The general equations of motion for an incompressible viscous fluid furnish the starting point in this investigation. The question as to whether or not turbulent motion arises is referred to that of the stability or instability of the regular motion. Upon the regular motion small variations are imagined superimposed, the kinetic energy of which is found, and the time derivative of this quantity is used as a criterion of stability of the regular motion. Several particular cases which submit readily to extended discussion are then taken up, among them being the case of stationary motion in a cylindrical tube.

Chapter IV.—Les équations du movement des gaz et la propagation du son suivant la théorie cinétique des gaz. The discussion given in this chapter was apparently instigated by a criticism of Jochmann of the first paper of Clausius on the molecular theory of gases. In his criticism Jochmann remarked that it appeared difficult on the views of Clausius to account for the propagation of sound waves. Professor Lorentz points out that Jochmann's difficulty arose from his failing to note that the element of volume with which the mathematical physicist deals is not infinitesimal in the rigorous sense of the word. He then proceeds to a general discussion of the subject, following in the main the methods of Boltzmann.

Chapter V.—Ueber die Anwendung des Satzes vom Virial in der kinetischen Theorie der Gase. The equation of van der Waals, $(p + a/v^2)(v - b) = R(1 + \alpha t)$, wherein p, v, t are, respectively, the pressure, volume and temperature of a gas and R, a, b are constants depending on the nature of the gas, is here the subject of discussion. This equation is derived from the so-called Principle of Virial first employed by Clausius. The principle is expressed by the equation $\Sigma(Xx + Yy + Zz) = -\Sigma\frac{1}{2}mu^2$, for the case of equilibrium, wherein X, Y, Z are the components of the total force acting on a molecule of mass m whose center of mass is given by the coordinates x, y, z, u is the velocity of the center of mass of the molecule, and the summations are extended to all the molecules.

Restricting himself to the case where the density is not too great, the author is led to the equation given by van der Waals. A similar restriction was tacitly made by van der Waals himself, who used, however, a somewhat different method in deriving his equation.

Chapter VI.—Ueber das Gleichgewicht der lebendigen Kraft unter Gasmolekülen. A criticism is made of an assumption made by Boltzmann in his treatment of the question of thermal equilibrium of multi-atomic gas molecules. Boltzmann's assumption is, that in a collision between two molecules, whose states of motion may be designated by A and B, *if* A' and B' are the new states assumed after impact, then, conversely, if the two molecules have the states of motion A' and B' they can after collision assume the states A and B. The author takes exception to this general assumption and proceeds to give his reasons therefor. Then follows a simple proof that in the case of mon-atomic gases the distribution of velocities given by Maxwell's law is the only possible one. Finally a discussion of

the multi-atomic case is given, under a certain hypothesis, viz., that when the gas has assumed a stationary condition, for every group of molecules with a state of motion A there is another with the opposite state of motion A (—).

Chapter VII.—Ueber die Grösse von Gebieten in einer n-fachen Mannigfaltigkeit. Here is found a short mathematical discussion leading to results which are of importance in connection with their bearing on the kinetic theory of gases.

Chapter VIII.—Ueber die Entropie eines Gases.—In his treatment of the kinetic theory of gases Boltzmann was led to the consideration of a certain function, H, depending on the motion of the molecules, which in consequence of their collisions can only decrease. The author points out that for a stationary state the function $-H$ and the entropy stand in close connection. He then proceeds to show how in processes which progress infinitely slowly this function behaves in the same way as the entropy function.

Chapter IX.—Sur la théorie moléculaire des dissolutions diluées. On account of the simplicity of the laws of osmotic pressure and allied phenomena, Professor Lorentz has attempted with considerable success to derive them directly from kinetic theory without the aid of thermodynamics. The results of his investigations in this direction are the subject matter of this chapter.

Chapter X.—Bemerkungen zum Virialtheorem. This chapter is an article which appeared in the Boltzmann-Festschrift, 1904, p. 721. A method is described, very similar to the 'Virial' method of Clausius, which leads to the same results in the kinetic theory of gases. Application of the 'Virial' theorem is made to the case of the motion of an electron in the field of an electric doublet.

Chapter XI.—Ueber den zweiten Hauptsatz der Thermodynamik und dessen Beziehung zu den Molekulartheorien. This, the last chapter of the book, is by far the most extensive, comprehending the last one hundred pages. The author claims to give here nothing essentially new, apart from the method of presentation. The clearness with which the subject is treated, however, must appeal strongly to all readers.

Professor Lorentz begins at the beginning, and treats concisely, yet comprehensively, the fundamental principles of the subject, and arrives shortly at the expression of the second law through the entropy function. The discussion is limited practically throughout to the case of reversible processes. The thermodynamic relations of a general system of bodies are expressed through generalized parameters. The laws in connection with entropy, free energy and thermodynamic potential are derived, particular stress being laid upon the importance of the free energy principle in the solution of problems. Applications of this principle in the case of a perfect gas, and of liquid mixtures, are given in considerable detail; and the case of osmotic pressure is also worked out through this principle.

The general conditions for equilibrium among any number of different phases of a system are derived by the method of free energy, also by the method of thermodynamic potential. Attention is called to the importance of graphical methods in the treatment of various problems of phase relations.

Perhaps the most interesting part of this last chapter is the section dealing with problems of equilibrium by means of molecular theory. After some general remarks concerning the beautiful results obtained by treating the subject by the two methods, the thermodynamic and the molecular, the author makes the following cogent comment: "Bei dieser Sachlage kann mann, wie mir scheint, kaum daran zweifeln, dass die beiden Betrachtungsweisen, die thermodynamische und die molekulartheoretische, gleich berechtigt sind und dass wirkliche Wiedersprüche zwischen den beiden auf die Dauer nicht bestehen können; einer Meinung, in der wir durch die Tatsache bestärkt werden, dass mann wenigstens einen Teil der Folgerungen, die sich aus den thermodynamischen Sätzen ergeben, auch molekulartheoretisch, mit Hilfe gewisser Vorstellungen über den Mechanismus der Erscheinungen begrunden kann." A few examples showing the coincident results derived from the two methods are then given.

An extended discussion follows, showing how the second law of thermodynamics may be referred back to the principles of mechanics.

As is readily seen from the above brief survey, the various chapters of the book are not very intimately related; but at the same time the author in his arrangement of the subject matter has brought it into a form which approaches as near to continuity as the diverse nature of the topics treated will admit.

A. P. WILLS

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for February is an unusually good number. It opens with a description of 'An automatic Aerating device for Aquaria,' by Louis Murbach, which seems to be easily made and to work well. C. D. Durnford makes another interesting and (to most) convincing contribution to 'The Flying-fish Problem.' As he says, an extraordinary thing about the discussion is the unexplained power therein of the negative to quench the positive. It may also be noted that while the ordinary fish kicks about when laid on a vessel's deck that the flying-fish flaps its 'wings' with great rapidity, '*e pur si muove.*' L. B. Walton presents the first of a series of 'Contributions to Museum Technique. Cataloguing Museum Specimens.' It is greatly to be doubted if the detailed method advocated by Mr. Walton could be carried out in the average museum; it will be found practicable only where the staff is large, or the collections small. Also in a modified form (less sub-division and cross referencing) it has long been in use in various departments of the U. S. National Museum. James Murray describes 'Some South American Rotifers' including a few new species and varieties. J. S. Kingsley discusses 'Meristic Homologies in Vertebrates,' pointing out various difficulties in the way. To add another query to those propounded we would ask why there should not be an actual shifting of the pelvic girdle in long-bodied amphibians? We know that on one side the pelvis may be attached, say, to the twentieth vertebra and on the other to the twenty-first, and if half may shift why not the whole?

R. W. Shufeldt contributes an article on 'The Osteology of the Tubinares' with a scheme of classification. Oddly enough the first taxonomic character assigned, the posession of a large supraorbital, glandular fossa, is purely physiological and found in most sea fowl that dive. The gannets and cormorants which lack the supraorbital glands also lack nostrils and so have no need for them.

The American Museum Journal for February notices the unveiling of the busts of American men of science recently placed in the foyer; the 'Exhibition of the Progress of Science,' and the 'Expedition to the Desert of Fayoum, Egypt.' This region has yielded so much that American paleontologists will await with great interest the results of Professor Osborn's expedition. The number contains the table of contents for the Bulletin of the American Museum for 1906 and the lecture announcements for February and March.

The Museums Gazette of Great Britain for January has an article by Dr. A. B. Meyer on 'The Structure, Position and Illumination of Museum Cases.' As Dr. Meyer is the apostle of the iron case he naturally expresses himself in favor of that material. The last word on the subject is, however, yet to be said, and only in a few instances has any attention been paid to making cases and their contents harmonize. When the millenium comes and the wicked architect ceases from troubling and the weary curator has something to say about the construction of museums the halls will be left plain and finished when it is decided what is to go in them; then case, hall and specimens will be in accord. The balance of the number contains many notes and much information concerning museums in various parts of the world.

UNDER the title 'From Stone to Steel' the Horniman Museum, London, has issued a little handbook to the collections illustrating the ages of stone, bronze and iron. This, by H. S. Harrison, is a clear and concise statement of our knowledge of stone and bronze implements, will be most useful to curators and should be in demand by the public. It discusses the form and distribution of stone