were further extended and applied in a paper read at the Washington meeting of the Physical Society. An outline of a few of the more important results may be of interest to the readers of SCIENCE on account of their bearing on physico-chemical experiments frequently performed in a laboratory, and involving quantities often made the subject of accurate determinations.

It is shown that the internal heat of mixing h_m, or the increase in internal energy on mixing a number of substances, is zero, or

$$h_m = 0$$

at the absolute zero of temperature, if the substances and resultant mixture are under the pressures of their vapors. It is also shown that

$$\frac{dh_m}{dT} = 0$$

$$\text{and } \frac{d^2h_m}{dT^2} = 0$$

where T denotes absolute temperature. Hence if h_m can be expanded in powers of T by Taylor's Theorem

$$h_m = aT^3,$$

near the absolute zero of temperature, where a is a constant. This result could be investigated experimentally without great difficulty. It would involve measurements of the change in temperature on mixing a number of substances near the absolute zero of temperature, and a determination of the corresponding specific heats of the substances and the resultant mixture. The quantities H_m and A are shown to possess similar properties, where H_m denotes the heat absorbed on reversibly mixing the substances and A the maximum work done during the process.

In the first paper on the subject it was shown that the controllable internal energy and entropy, which are functions of the controllable variables v and T, are zero for any substance or mixture in the condensed state under their vapor pressures at the absolute zero of temperature. If several substances are simultaneously considered another controllable operation becomes possible, namely that of mixing some of them. From the way the foregoing result was established it does not follow directly that there will be no change in internal energy or entropy on mixing the substances under their vapor pressures at the absolute zero of temperature. It is now shown that no change takes place. With this result as basis it is further shown that the well-known formulae

$$\Delta U = h_m$$

$$T \Delta S = \Delta U + A = h_m + A = H_m$$

$$\Delta U = T\left(\frac{\partial A}{\partial T}\right)_v - A$$

hold also if U and S represent the controllable internal energy and entropy respectively. Since these quantities can be calculated from experimental data a method is afforded of testing the truth of the method of deduction of the various results obtained, and also of testing the truth of the first and second law of thermodynamics on which all the results are fundamentally based.

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[2] Read at the New York meeting of the Physical Society; SCIENCE, April 29.

DOUBLE COVEY OF CALIFORNIA VALLEY QUAIL

IT is common knowledge that the males of many species of birds assist in the protection and care of the young birds. During the week of June 12–18, the following interesting observations were made by Mr. R. A. Holley, of Fillmore, California, on what was apparently a double covey of California Valley quail or partridge (*Lophortyx californicus vallicola* (Ridgw.)). In the early part of the week he flushed a large flock of quail in an orchard. The covey consisted of twenty-three young quail of two distinct sizes and two adult males, one of which had a crippled leg, but no adult females. Approximately one half of the young quail were about one third grown, the rest were of uniform size but somewhat larger.

The following day the same covey was seen again. The crippled male was acting as sentinel while the other male was feeding with the young ones. When the sentinel was approached the covey flew a short distance away. It was then noted that the crippled male had taken his place with the young on the ground and that the other male was acting as the sentinel from the fence post. This same covey of two males, one a cripple, and the twenty-three young belonging to two size groups were seen on four successive days in the same orchard. Apparently the females of the two adult pairs had been killed and the two males with their respective broods had joined forces. This alliance had made it possible for the males to alternate as sentinels and warn the combined broods of any impending danger.

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SCIENTIFIC BOOKS

Man not a Machine. By E. RIGNANO. London. Kegan Paul, French, Trubner & Co., 1926. 77 pp.

IN this handy little volume Rignano discusses in a brief but suggestive way the mechanistic and the

vitalistic interpretations of life, especially of the life of man. The subject matter is considered under nine heads, such as metabolism, adaptation, behavior, instincts, mentality, social relations, and the like. The author concludes that in all nine aspects there is an irreducible residuum that can not be explained away on mechanistic grounds. This irreducible element, always present, is of a purposive character. Having thus shown the insufficiency of the mechanistic interpretation, Rignano concludes that a vitalistic interpretation of life is the only one tenable. To the reviewer this step seems to be a *non sequitur*, for in addition to vitalism and mechanism there are other possible ways of considering life, witness that embodied in emergent evolution. Thus the view of life from the standpoint of emergent evolution avoids the obvious limitations of the mechanistic conception and yet differs radically from vitalism. It may be, therefore, a much more truthful interpretation of life than either vitalism or mechanism. It is to be regretted that this aspect of the subject has not been discussed by Rignano, whose book, however, affords good reading, suggestive and stimulating.

G. H. PARKER

Traité de Geographie Physique par EMMANUEL DE MURTONNE, professeur à la Sorbonne. Tome troisième: Biographie (en collaboration avec A. CHEVALIER ET L. CUÉNOT) Un Vol. in 8°, 464 pages, 94 figures dans le texte, 24 photographies hors texte. Librairie Armand Colin, Paris.

THE first edition of the "Traité de Geographie Physique" appeared twenty years ago and a second edition later. The author has remodeled his work, which has now been published in a third edition. Volume III devoted to biogeography completes the work, and in it there are 404 pages of text, instead of 154 pages in the first edition, 94 figures in place of 62, and 25 pages of bibliography instead of 10 pages. The growing complexity of the subject, and the abundance of technical studies devoted to biogeography have been such as to necessitate the association of two other scientists: MM. Chevalier, director of the laboratory of colonial agronomy, and Cuénot, professor of zoology in the University of Nancy. The volume is a single complete treatise on biogeography and is based on current and recently pursued research on the subject. A chapter is devoted to general principles, as common to botanical and zoological geography.

Five chapters are devoted to phytogeography. One of them deals with the science of the soil, another to plant sociology, where are given in a detailed manner the most recent investigation of plant associations and their evolution. Another important chapter considers the influence of man on vegetation with an essay on the classification of the systems of cultivation.

Three chapters deal with zoogeography and are filled with matters of great interest to zoologists, such as the origin of species and their adaptation to diverse surroundings. For geographers, this book is a mine of information. It ought to appeal to agriculturists, economists, colonial experimenters and the public in general.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ACCURATELY TIMED INTERMITTENT LIGHTING

IN many types of biological work a dependable, home-made apparatus for providing accurately timed alternate periods of light and darkness is desirable. Commercial machines are generally so high priced as to be out of the question in small laboratories.

The apparatus here described, which has the advantage of cheapness, consists of a revolving drum on the surface of which are made contact and break surfaces. A thermograph is readily adapted to this purpose, as illustrated in figure 1. The thermograph is insulated

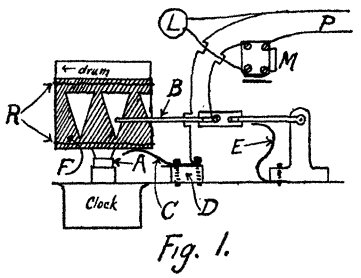

Fig. 1.

at A by a cone of fiber paper, and at the point D by fiber board. The lower end and the outer wall of the drum are brightened to make contact with B and C. Then a band of fiber paper F is held in place around the drum by two rubber bands R. Seven triangular pieces are cut from this band of fiber paper as shown in figure 1, to allow the point B to make contact with the drum. When this point comes in contact with the drum, the magnetic switch, No. 2829653Z2 General Electric, M closes the power circuit P, and the lights are on. As the point B runs onto the fiber paper breaking the control circuit the magnet is demagnetized, and the lights are turned off.