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