CHONDRODYSTROPHY IN THE CHICK EMBRYO PRODUCED BY A MINERAL DEFICIENCY IN THE DIET OF THE HEN

THE report of Wilgus and coworkers[1] on the preventive action of manganese, aluminum, zinc and iron on the occurrence of slipped tendon (perosis) in young growing chicks, together with our observations of a number of chicks hatched with slipped tendon, led us to study the effects on embryonic development and hatchability of feeding a slipped-tendon-producing ration to laying hens.

Eggs from hens that had been fed such a ration for two months gave a hatchability of less than 10 per cent. Those embryos that were sufficiently developed before death for observation showed, without exception, very short legs and wings and "parrot beak." The few chicks that hatched, although having short legs, did not have slipped tendon. Another group of hens fed the same ration plus 40 ppm each of manganese and zinc, as the respective sulfates, and 100 ppm of iron, as ferrous ammonium sulfate, produced eggs giving good hatchability and all normal chicks. Embryos that died showed normal development of appendages and mandibles.

The eggs from the hens fed the slipped-tendon-producing ration contained much less manganese than those from the hens fed the same ration plus the mineral supplements indicated above. As a result of these analyses and of our studies[2] on slipped tendon, we were inclined to attribute this condition to a manganese deficiency. This was proved to be correct by the injection of 0.03 mgs of manganese directly into the albumen of such eggs just prior to incubation, which resulted in normal development of the embryos and in an increase in hatchability.

The metatarsi, tibiae and humeri of the chicks and 20–21-day embryos from the injected eggs were 52, 44 and 40 per cent. longer, respectively, than the same bones of those from the eggs which were not injected with manganese. The injection of .03 mgs of zinc into the albumen of the egg had no appreciable preventive effect on this disorder.

These findings may offer some insight into the mechanism which produces slipped tendon in the growing chick. Further studies on this problem are in progress. This work will be published in detail elsewhere.

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[1] H. S. Wilgus, L. C. Norris and G. F. Heuser, SCIENCE, 84: 252, 1936.
[2] Unpublished data, Kentucky Agricultural Experiment Station.

HEAD MOVEMENTS IN BIRDS

IN a recent issue of SCIENCE[1] Austin H. Clark has advanced a theory as to the visual value of avian head movements which, to the writer's mind, appears quite untenable. Clark suggests that stereopsis results from the fusion of images perceived at the extremes of a vertical or horizontal movement, the image being "blotted out" (*i.e.*, centrally suppressed?) during the movement.

That suppression does occur during human ocular movements is well known to any one who has ever tried to see his eyes move in a mirror; but it is quite unsafe to assume that such suppression occurs in any animal during *head* movements as such.

Again, if the images at the extremes of a movement could be fused stereoptically, we should long since have had "stereomovies" made by printing alternately the frames from two films exposed simultaneously through lenses separated by the inter-pupillary distance. Many workers in visual phenomena get the notion of such "movies" and a few take the trouble to try it out; but few if any have bothered to mention their failure in print.

The vertical and horizontal head movements of birds, and probably also the nodding movements of certain lizards, can aid in the judgment of distance only by the principle of parallax, as does the process of "rapid peering" to which Clark alludes. *All* the advantages of binocular vision are afforded only by binocular vision.

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DRIFT BOTTLES RELEASED OFF COAST OF SOUTHERN CALIFORNIA

SIX thousand drift bottles have been released off the coast of southern California from the research vessel *Bluefin* by the State Fisheries Laboratory of the California Division of Fish and Game in an effort to trace the drift of the pelagic eggs and larvae of the California sardine. A cooperative program was undertaken by the laboratory and the Scripps Institution of Oceanography to make a study of surface currents during the spring of 1937 in the waters between Point Conception and San Diego, the major spawning region of the sardine. The drift bottles were prepared and released by the Fisheries Laboratory, and water samples and the subsequent dynamic computations were made by the Scripps Institution.

The bottles were twelve-ounce wine bottles, corked, sealed and ballasted with sand. Each bottle contained the usual "break the bottle" label, a sheet of instructions and a return post-card. Although most of these

[1] A. H. Clark, SCIENCE, 86: 223–224, 1937.

bottles have been out only a very short time, 150 have already been recovered. The longest drift so far recorded is that of a bottle released off Port San Luis, California, and recovered by a fishing vessel at Guadalupe Island, Lower California, thirty-eight days later. This bottle had traveled some four hundred miles at an average speed of about ten miles per day.

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SCIENTIFIC BOOKS

Atomic Spectra and the Vector Model. By A. C. CANDLER. 2 vols.: Vol. I, vi + 237 pp., 4 plates; Vol. II, 279 pp., 4 plates. Cambridge: at the University Press. New York: The Macmillan Company. 1937. Set $8.50.

THE quantum-mechanical interpretation of the nuclear atom-model, in a fairly satisfactory state at the present time, has been presented in a number of treatises of varying simplicity. Such volumes are entirely adequate for those research workers and students who possess the necessary mathematical background. There is, however, a group of physicists and astrophysicists who prefer an account in terms of an easily visualized model. For such a treatment, Fowler's *Report* and Hund's *Linienspektren* are no longer adequate, since their notations are now antiquated, and since there have been a host of new developments in the realm of atomic spectra during the past decade.

To meet the needs of practical workers in the field, Mr. Candler has presented the work of Fowler and of Hund from the standpoint of the vector model, using modern notation, and with the inclusion of much of the more recent work on atomic spectra. The keynote of the presentation is simplicity and complete freedom from mathematical complexity. There are copious references to the results of laboratory investigations; these results are freely compared with vector-model expectations, and frequent comparisons are made with the predictions of quantum mechanics.

Volume I deals with series in line spectra, particularly with the important researches of Fowler, Millikan and Bowen, and Landé on the spectra of the alkali doublets and alkaline earths. The treatment of Zeeman and Paschen-Back effects is fairly complete and is recommended for its clarity and simplicity. Two short chapters on "Atomic Magnetism" and the Stark effect are followed by a detailed account of the ordering of the elements in the Periodic Table, and the explanation in terms of electronic structures and the Pauli exclusion principle.

Volume II describes the results of laboratory analyses of complex spectra and their vector-model interpretation. There is a useful description of the methods of coupling the various electrons of a configuration to yield the resultant set of terms, and a comparison of Hund's empirical rules with the observational results from the short and long periods of the elements. In addition the author describes the intensity measurements of Ornstein and Burger, Harrison and others on the lines of complex spectra, and the theoretical intensity relationships in multiplets and supermultiplets. The volume is concluded by a not too up-to-date discussion of Hund's limits, and by chapters on hyperfine and nuclear structure, quadripole radiation and fluorescent crystals.

It is to be regretted, in view of the potential usefulness of a work so free of mathematical techniques, that so many errors and omissions occur throughout the two volumes. It is perhaps difficult to avoid a good many typographical errors in a first printing, but the numerous incorrect statements that are present are more serious. To mention a few of the most objectionable ones: in volume II, p. 136, the author makes the statement that intermediate coupling has no advantage over the simpler jj coupling in accounting for "abnormal" spectra. To say that jj coupling is "the only alternative to that postulated by Russell and Saunders," even for purposes of simplification, is to exhibit a total disregard for the good agreement with experiment achieved by Shortley and others in calculations based on the theory of intermediate coupling. In the chapter on quadripole radiation, one reads that all violations of the Laporte parity rule are due to quadripole transitions. There is no mention of magnetic dipole radiation, which quite frequently violates the Laporte rule. In the chapter on "Intensity Relations," it is stated that the simple Kronig formulae "should compare the intensities of any two lines arising in a transition from one configuration to another. . . ." The formulae by themselves are applicable *only* to lines within a multiplet. Also, it seems strange that nothing is said concerning the recent work of Shortley, Condon and Ufford, Johnson and others in deriving formulae for the relative strengths of multiplets in a transition array in LS coupling. There are occasional lesser errors. It is puzzling to read that "More than a century ago Fraunhofer named a number of dark lines which Newton had noticed in the spectrum of the sun." Wollaston was the first to call attention to the dark lines in 1802. There is no evidence that Newton ever observed more than the continuous spectrum.

Viewed broadly, Mr. Candler's work will be welcomed by those who wish to see the results of physical investigations expressed in simple language, unham-