readily came to the conclusion that the iodine of the salt was the effective agent in preventing enlarged thyroids.

Furthermore, he noted that those subject to goiter usually lived at high altitudes and drank glacial water. He also claimed that the Indian natives were not subject to goiter.

Not only did Boussingault point out the value of iodized salt, but he also suggested that iodine be added to deficient salt and suggested a test to estimate the amount present in order to avoid a toxic level. Furthermore, he noted that sea salt tended to lose its iodine as it passed through the channels of commerce to the consumer.

Unfortunately, this interesting early contribution was not even mentioned, as far as we can find, by Chatin, who wrote so many papers in this field about the middle of the last century. It seems also to have escaped the notice of such reviewers as Von Fellenberg.[2]

One can only speculate concerning the human suffering that might have been evaded if some eminent physician had noted this contribution of the French chemist at an early date.

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A NEW COSMIC PHENOMENON

READERS of SCIENCE may be interested in the possible occurrence of a cosmic phenomenon between October 21 and 25. The phenomenon has evinced itself as a remarkable vagary of radio transmission occurring recently at regular intervals, separated in time by twice the sun's rotation period. It is a world-wide phenomenon, or more accurately semi-worldwide, as it involves all high-frequency radio transmission over the illuminated half of the globe and not the dark half. Depending apparently on some solar emanation lasting only a few minutes, its thorough elucidation appears to call for the study of such cosmic data as solar activity, terrestrial magnetism, atmospheric ionization, aurora, earth currents, etc., as well as high-frequency radio reception.

The radio evidence of the phenomenon is a sudden disappearance of high-frequency long-distance radio signals for several minutes, the complete process of fading out and reappearing occupying about 15 minutes. It occurred on March 20, May 12, July 6 and August 30. The time intervals between these dates are close to 54 days, twice the period of rotation of the sun; the next such occurrence should therefore be around October 21 to 25.

It is suggested to those concerned with observations in the above fields that they make special efforts to make continuous observations on these dates. I would be very glad if any one observing any marked anomalies occurring in a period of a few minutes would communicate with me.

J. H. DELLINGER,
Chief, Radio Section
NATIONAL BUREAU OF STANDARDS

SCIENTIFIC BOOKS

AMERICAN BIRDS

The American Eagle. A Study in Natural and Civil History. By FRANCIS HOBART HERRICK. xx + 267 pp., 94 figs. D. Appleton-Century Company, New York, 1934. $3.50.

Wild Birds at Home. By FRANCIS HOBART HERRICK. xxiv + 345 pp., 138 figs. D. Appleton-Century Company, New York, 1935. $4.00.

THESE two books by the same author are very different in scope. The first is, in a sense, a monument to one majestic bird, which is our national emblem. The second is an important contribution to philosophic ornithology presented in popular form.

"The American Eagle" is a study, primarily of the home life, of the bald eagle (*Haliæetus leucocephalus*) made at Vermilion, Ohio, on the shore of Lake Erie. As an observation post an open-work steel tower ninety feet high was erected beside a nest or eyrie, and by its means a large amount of data and a remarkable and beautiful series of photographs, here reproduced, were obtained from a distance of some thirty-eight feet.

With most wild birds, the nest is merely a cradle for the young, and being built in spring or early summer in the north temperate zone, it is seldom occupied more than two or three weeks. . . . The eagle's eyrie is not only cradle and bed-chamber for the young during the better part of three months, but it is the home and castle of the mated pair, for many years, it may be, or for as long as the eyrie endures. The eagle's union is believed to be a life partnership, and their eyrie is built upon each year until, with many annual increments, it may become an enormous structure. There is the remarkable record of the eagles at Vermilion, Ohio, whose Great Eyrie was occupied thirty-six years without a break and attained an estimated weight of two tons.

For the eaglets the eyrie serves a much wider purpose than that just intimated, for it is also their gymnasium and flying practice-field, to which its great size and par-

[2] Von Fellenberg, *Ergeb. d. Physiol.*, 25: 182, 1926.

ticularly the large superficial area of its top are obviously well adapted. By his daily flying and jumping exercises and the later trial flights over the nest, the young eagle becomes lusty and strong and a master of the flying art. . . . The eaglets, after their first independent venture on the air, are prone to return to their old home, and this they continue to do, not for a few days only, as might a martin or a pewee flycatcher, but sometimes for upwards of three months, or as long as they remain in the neighborhood. Not only do the old eagles continue the practice of carrying prey to the nest and there sharing it with their offspring, but the eyrie is their rendezvous, their lookout point, and the one safe retreat to which they can repair for peace and refreshment at all times, even when the ground is covered with snow.

It will be seen then that the nesting pattern of the bald eagle is quite unlike that of most bird species which are more available for study. The nesting pattern of birds in general is so complex that it is not easily interpreted, and can be best understood by comparing that of one species with that of another, for contrasts frequently clarify. It is also true that factors which go to make up the pattern may in one case be quite obvious, in another insignificant and easily overlooked though yet present. Hence this detailed study of the eagle is not only interesting in itself but should advance our knowledge of the whole subject in bird behavior, the more so as the difficulties which had to be overcome in obtaining nesting data concerning a bird of this kind result in little such data being available.

Whereas it follows more or less the progress of the nesting cycle as observed, this volume aims to give a general picture of the eagle in nature and in story, for final chapters deal with it as emblem, on coins and in apotheosis. It is written as a rambling narrative with frequent digressions, and is easy to read but hard to refer to.

"Wild Birds at Home" contains much of interest and value for the nature lover, the ornithologist and the critical student of animal behavior. It describes the already more or less familiar technique of approaching nesting birds with blind and camera to obtain knowledge of the details of their behavior, or more tangible photographs of the birds themselves. Much of it is written in the form of rambling essays which reflect the pleasures of association with birds out of doors, and will add to these pleasures by giving us a better understanding of the birds.

In it we find an abundance of miscellaneous ornithological data. The remarkable peculiarities of the young American cuckoo which the author has observed are well worth consideration, but the general discussion of parasitism to which they lead is weak. There is consideration of comprehensive observations in a colony of nesting herring gulls. A classification and study of birds' nests on the basis of their construction, with reference to adaptation to the environment and nest-building instincts, is of primary scientific interest. The building of four types of nests, represented by the robin, barn swallow, vireo and oriole, is described from personal observation and discussed very fully. It is shown how the basic instinctive or inherited nest-building pattern of each species has but minor more or less adaptive variations peculiar to or involving choice on the part of the individual. Comparatively little exact and complete data of this sort on nest-building have been recorded, and one realizes that there is here a wide field for investigation.

The author's main theme is the reproductive cycle, mating, nest-building, brooding the eggs and caring for the young in sequence. He says: "The principal activities of the reproductive cycle are instinctive and therefore independent of individual experience. They are periodic and rhythmical. They are also serial, and they are normally harmonized or attuned in the two sexes of each successful breeding pair. Certain of the major activities, as seen in mating, in constructing the nest, or in the feeding or sanitation of young, however varied in detail, follow their own specific patterns with remarkable uniformity." Each phase of the cycle expresses itself in diverse instincts and behavior appropriate to that phase, waxes and then wanes, to be followed by the next. The cyclic instincts normally dominate or replace such extra-cyclic instincts of self-preservation as hunger or fear, sufficiently to keep the cycle intact; and if it is broken by some accident, the normal thing is to start again at the beginning. Meanwhile the cyclic instincts are sufficiently elastic to allow of individual choice in details, which tends to become fixed by memory as habit, forming an adaptive more or less intelligent balance wheel for the basically inherited behavior pattern. An excellent case is made for this view of the matter, as each of the great variety of observation described of more or less complex behavior is susceptible of such an explanation. That it is the hypothesis on which the author's successful technique in approaching his subjects within arm's reach, without deflecting their behavior, rests, also gives it an empirical endorsement. Though the conclusions are in the main based on personal observations, to complete the picture of bird behavior a very wide and varied literature bearing on the subject has been drawn on in scholarly fashion and is cited in footnotes. Such of this cited material, however, as is more than simple matters of fact has not been treated sufficiently critically to add much of value beyond a useful list of references.

The modern science of animal behavior, steeped in

experimentalism, is advancing rapidly with a keen analytical point of view freed from the sometimes misleading haze of words which has been the traditional nature writer's contact with the public. But what it builds is sometimes based on intensive rather than extensive knowledge, and is also at times, though thoroughly sophisticated, relatively meaningless from not resting on a broad enough foundation. Disregarding the matter therein not pertinent to the case, one can recommend this book of Professor Herrick's as an excellent background for bird behavior studies.

J. T. NICHOLS

AMERICAN MUSEUM OF NATURAL HISTORY

SPECIAL ARTICLES

CULTIVATION OF HUMAN INFLUENZA VIRUS IN AN ARTIFICIAL MEDIUM[1]

THE recovery of a filterable virus from cases of human influenza in Puerto Rico and Philadelphia[2,3] has been reported previously. These strains of virus were transmitted serially in ferrets and mice by the intranasal instillation of bacteria-free suspensions of infected animal lungs or of Berkefeld filtrates of such suspensions. In this manner the Puerto Rico strain (P. R. 8) has been carried through 43 passages in ferrets and 48 passages in Swiss mice without demonstrable alteration in its immunological characteristics.

After the virus had been found to be comparatively stable in its behavior in experimental animals, attempts were made to promote the multiplication of the agent in artificial media *in vitro*. In the media used for ordinary bacterial cultures no evidence of multiplication of the virus was obtained. Cultivation experiments were then undertaken in which living tissue cells were included in the culture medium. The technique devised by Li and Rivers[4] was employed, in which pieces of minced 10- to 14-day chick embryo suspended in Tyrode's solution in a Rivers flask are used.

Only the P. R. 8 strain of human influenza virus was used in this experiment. A titration of the virus content of the lungs of mice dying in the 42nd passage of this strain of virus was made with dilutions of a centrifugated but unfiltered suspension. All mice receiving the 1:1,000 dilution, based upon the weight of the original mouse lungs, showed advanced pulmonary lesions in 6 days; all that received the 1:10,000 dilution had mild lesions, while those receiving the 1:100,000 dilution presented no pulmonary lesions. The titer of the unfiltered virus as measured by the production of visible pulmonary lesions in white mice was considered to be 1:10,000.

The lungs of the mice of the 44th virus passage were then removed, ground and diluted to make a 10 per cent. suspension in Tyrode's solution. After centrifugation at 1,500 r.p.m. for 20 minutes, the supernatant fluid was filtered through a Berkefeld V candle. Cultures of this material in ordinary media revealed no bacteria. Flasks containing 4.5 cc of chick embryo Tyrode's medium were inoculated with 0.5 cc of the filtrate. Serial subcultures were made at 48-hour intervals by the transfer of 0.5 cc of the supernatant fluid of the culture to a flask containing 4.5 cc of fresh medium. Bacteria have not been demonstrated in the cultures, with aerobic and anaerobic methods of cultivation, or in stained microscopic films, except in a few instances in which gross bacterial contamination occurred.

Mice were inoculated intranasally with undiluted fluid of the first, third and of each subsequent subculture. In most instances the mice died in from 4 to 6 days with advanced pulmonary lesions. With the sixth generation culture, determinations of the concentration of the infectious agent in the culture fluid, taken after different intervals of incubation, were made by the inoculation of white mice with serial dilutions of the culture fluid. After 48 hours incubation, 0.05 cc of the culture diluted 1:1,000 produced distinct pulmonary lesions in mice, while 2 of the 3 mice receiving the 1:10,000 dilution showed suggestive lesions. After 72 hours' incubation of the culture, the mice which received a 1:1,000 dilution developed pulmonary lesions, but weaker dilutions were ineffective. After 5 days' incubation, the undiluted culture was still found to contain the infectious agent, but in diminished concentration. Titration of the tenth transfer of the culture yielded similar results. The mice which received culture diluted 1:1,000 developed pulmonary lesions, while those which received the 1:10,000 dilution did not.

From the lungs of the mice which were infected with the first generation culture fluid, a 10 per cent. suspension was made and filtered through a Berkefeld V candle. This filtrate, which contained active virus, was again introduced into the chick embryo medium, and through 20 successive subcultures the virus has retained its infectivity for mice. Thus the infectious

[1] From the Hospital of the Rockefeller Institute for Medical Research, New York, N. Y.

[2] T. Francis, Jr., SCIENCE, 80: 457, 1934.

[3] T. Francis, Jr., *Proc. Soc. Exp. Biol. and Med.*, 32: 1172, 1935.

[4] C. P. Li and T. M. Rivers, *Jour. Exp. Med.*, 52: 465, 1930.