birds (see paragraph No. 4) has been shown by experiment.

(7) The percentage of mortality among the birds made sick experimentally has been much greater than what occurs in the field. This is due partly to the excessive doses administered in early work; and partly to the fact that the great majority of sick birds brought in from the field for observation are sublethal cases. Birds given reduced doses, however, recover in the same manner and in about the same time as do those collected in the field.

(8) The faithfulness and consistency with which duck sickness symptoms are produced by this method has never been even remotely approached in any experimental work that the writer has done through the feeding of natural or synthetic alkalies.

(9) Not only have duck sickness symptoms been conveyed from the body tissues of a bird sick in the field to a healthy experimental bird by the method described, but this second bird has furnished toxic material for a third; the third in turn, for a fourth; and the fourth for a fifth. There seems to be no loss in virulence and, in fact, if any change has taken place, potency has been increased by this process.

(10) An extract of the toxic liver in normal salt solution prepared at the rate of 1 gram of decomposed liver to 5 cc of the solution, which is then filtered or allowed to settle, has permitted the injection of the toxic material into the abdominal cavity with equally typical and even more effective results. By this method material obtained from ducks has produced duck sickness symptoms in gulls, and, strange though it may seem, an extract of the incubated liver of a juvenile prairie falcon served as a means for conveying the trouble in an aberrant and mild form to a chicken and a domestic cat.

(11) Material obtained from the Bear River Marshes at Great Salt Lake has given results identical in every respect with that collected in the Klamath region.

(12) On the basis of a single experiment, it appears that boiling heat for about five minutes at this altitude (4,137 ft.) destroys the toxicity of the material.

(13) Contraction of duck sickness in the field does not establish an immunity to the symptoms as produced by this method, since birds that have recovered from duck sickness have been used two and three times in these experiments with positive results.

(14) An individual experiment performed by Mr. Sperry in 1927 in which he produced what appeared to be duck sickness symptoms by feeding liver to a duck over a period of nearly three weeks becomes explainable through the likelihood that, at some point in the feeding operations, the tissues on hand had "incubated" sufficiently in a period of hot weather.

In the foregoing the writer, an ornithologist, whom circumstances have thrust into the midst of a most baffling pathological problem, has aimed to present only such facts as have been learned from experimentation. Prudence forbids speculating at this time beyond what has actually been demonstrated, even though the results attained are highly suggestive and even though definite theories have been entertained as a help in directing the study. What has been accomplished appears to be just a beginning with much work yet to be done by specialists. Material has been gathered for histological, pathological and bacteriological studies which, as they are pursued during the coming months, may add even more startling chapters to an already intriguing subject.

E. R. KALMBACH

BIOLOGICAL SURVEY,
U. S. DEPARTMENT OF AGRICULTURE

WESTERN DUCK SICKNESS AND BOTULISM

THE symptoms observed in ducks suffering from what is called "duck sickness" are characteristic of botulism as it appears in birds. Several samples of mud and water from an infected area in Tule Lake, California, were collected by one of us with the assistance of Mr. E. R. Kalmbach of the Biological Survey, during the summer of 1930, and while the outbreak of duck sickness was at its height. Bacteriological examination of the mud disclosed the presence of *Clostridium botulinum,* Type C. The primary cultures of the mud produced a toxin of rather high potency for guinea pigs (m.l.d. less than 0.001 cc for a 250 g pig); per os the m.l.d. was 0.05 cc. The m.l.d. for a domestic mallard (per os) was found to be 0.005 cc per gram of body weight.

Furthermore, *C. botulinum,* Type C, has been cultured from the tissues of wild mallards, pintails and ring-billed gulls that had died of or were killed while afflicted with "duck sickness." The clinical picture coupled with the isolation of botulinus organisms from the mud of Tule Lake and the sick birds themselves suggests that duck sickness is produced by the toxin of *Clostridium botulinum,* Type C.

L. T. GILTNER,
J. F. COUCH

BUREAU OF ANIMAL INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

BOOKS RECEIVED

Contributions from the Department of Anatomy of the Peking Union Medical College, Peking, Volume 5, Collected Papers Nos. 84–114.

HARDING, T. SWANN. *Fads, Frauds and Physicians.* Pp. 409. Dial Press. $3.50.

WHEELER, WILLIAM M. *Demons of the Dust.* Pp. xviii + 378. 50 plates. Norton. $5.00.