each given a total of 50 mg of this material intravenously without any observable therapeutic effect.

CONCLUSION

No therapeutic effect on blacktongue was observed from the intravenous administration of 50 mg of an impure preparation of diphosphopyridine nucleotide.

FLOYD S. DAFT
H. F. FRASER
W. H. SEBRELL
MARGARET PITTMAN

NATIONAL INSTITUTE OF HEALTH,
U. S. PUBLIC HEALTH SERVICE

THE NATURE OF THE MUCO-POLYSACCHARIDE OF SYNOVIAL FLUID[1]

THE viscous fluid bathing the joint surfaces and thought to be produced by cells of the synovial epithelium yields on acidification a stringy precipitate which has been called the synovial mucin. By a modification of the methods described for the isolation of chondroitinsulfuric acid from cartilage[2] we have succeeded in obtaining from bovine synovial fluid a sulfur- and phosphorus-free polysaccharide acid of high molecular weight, containing per equivalent weight one equivalent each of nitrogen, hexosamine, acetyl and hexuronic acid. It appears to be identical with hyaluronic acid, the polysaccharide isolated from bovine vitreous humor,[3] from human umbilical cord[4] and from hemolytic streptococcus.[5] This conclusion is based on the similar composition and rotation and on the hydrolysis at a similar rate by the "autolytic enzyme" of pneumococcus.[6] We have obtained about 200 to 250 mg of the acid per liter of cattle synovial fluid, and 225 mg per liter from 160 cc of a human knee exudate. Like other acid polysaccharides the carbohydrate in synovial fluid occurs as a salt and not bound to protein. Solutions of the isolated polysaccharide are extremely viscous and the substance apparently is responsible for most of the viscosity of the native fluid even though present in a low concentration. It is of interest that the same polysaccharide is elaborated by hemolytic streptococci (Group A, Lancefield), by the ciliary epithelium and by the synovial tissue. It may be of further interest that hemolytic streptococcal infection is frequently incriminated in inflammatory conditions affecting those tissues in which the polysaccharide is found.

KARL MEYER
ELIZABETH M. SMYTH
MARTIN H. DAWSON

THE LAND-SNAIL AN INTERMEDIATE HOST OF THE CECAE FLUKE OF POULTRY

THE life history of *Postharmostomum gallinum* has heretofore been unreported. Experiments conducted during the past year have revealed that land snails, *Eulota similaris,* are the common carriers of this fluke under natural conditions. Snails collected in fluke-endemic poultry farms near Honolulu have been found heavily infected with larval flukes (adolescercariae); the largest of these flukes measured 0.87 mm long and 0.39 mm wide, and possessed well-developed suckers and ceca closely resembling those of the adult fluke. When three two-month-old laboratory-raised cockerels were fed such infected snails and killed one month later, adult *P. gallinum* flukes 5 to 6 mm long by 2 mm wide were recovered from the ceca. Control birds under the same laboratory conditions, but not fed infected snails remained free from all helminths. The results reported here are of importance from the control standpoint, in view of the common occurrence of these flukes in poultry in Hawaii.

JOSEPH E. ALICATA
DEPARTMENT OF PARASITOLOGY,
UNIVERSITY OF HAWAII

SCIENTIFIC BOOKS

LOW TEMPERATURE PHYSICS

Low Temperature Physics. By M. and B. RUHEMANN. Cambridge: at the University Press; New York: The Macmillan Company, 1937. ix + 313 pp. Price, $5.00.

KAMMERLINGH ONNES, the acknowledged father of low temperature research, frequently compared his investigations to a polar expedition. Lengthy and careful preparation was a preliminary. The actual work had to be carried on by a large group highly organized, a squad of technicians to operate the hydrogen liquefier, another for the helium liquefier, a group of observers at galvanometers, others at manometers and so on. Then, when the low temperature region was entered, it was a kind of "never-never" land in which the ordinary rules of behavior were suspended. Electrical and thermal conductivity took on outlandish values, radiation disappeared, and vapor pressures vanished.

It is this character found in all low-temperature

[1] From the Department of Ophthalmology of the College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology of the Presbyterian Hospital, and from the Edward Daniels Faulkner Arthritis Clinic of the Presbyterian Hospital, New York.

[2] K. Meyer and E. M. Smyth, *Jour. Biol. Chem.,* 119: 507, 1937.

[3] Recently the identical polysaccharide has also been isolated from pig vitreous humor.

[4] K. Meyer and J. W. Palmer, *Jour. Biol. Chem.,* 114: 689, 1936.

[5] F. E. Kendall, M. Heidelberger and M. H. Dawson, *Jour. Biol. Chem.,* 118: 61, 1937.

[6] K. Meyer, R. Dubos and E. M. Smyth, *Jour. Biol. Chem.,* 118: 71, 1937.

research which gives the field a kind of unity and which fully justifies this interesting monograph by one of the leading "explorers" of our day. Because of the variety of observations which are now carried on below one hundred degrees absolute it has been impossible in a small book to do more than pick out and describe briefly a few of the more striking examples in each line of work. As stated in the preface: "Though this book may be of some use to the specialist, we have had in mind as prospective readers rather physicists specializing in other fields . . ." For this purpose the material is admirably selected.

The book is divided into four parts, the first and longest being entitled "Phase Equilibrium" and dealing with the history and recent developments in liquefaction, measurements of low temperatures and phase diagram studies. The early work of Pictet, Dewar and Linde is graphically described with many quotations from original letters and papers. Unfortunately, the date of Kammerlingh Onnes' death is given as 1924 instead of 1926. The second part deals with the "Solid State," x-ray methods, thermal energy, the "Third Law of Thermodynamics." The third part covers "Orbit and Spin," the production of temperatures of the order of one hundredth of a degree by the Giauque method. The fourth part, "The 'Free' Electron," deals with superconductivity. There is an excellent bibliography covering the literature up to May, 1937.

The work described undoubtedly constitutes one of the most exciting chapters in modern science and the authors have presented the material in a vigorous and interesting manner. As a reference book, it could have been made much more valuable by the more careful labelling of equations and figures with units.

DONALD H. ANDREWS
THE JOHNS HOPKINS UNIVERSITY

SOUND WAVES, THEIR SHAPE AND SPEED

Sound Waves, Their Shape and Speed. By DAYTON C. MILLER. The Macmillan Company. 1937.

PROFESSOR MILLER in this small book gives us an account of certain work which he has done some time ago and never before fully reported. The first research here treated included the development of his phonodeik, the instrument with which he obtained by purely mechanical means most satisfactory photographic records of the form of sound waves. The second major item deals with a series of experiments in which apparatus somewhat like the phonodeik was used to measure the velocity of sound from high-power guns, the form of their sound-waves, and the pressures produced by them at various distances. In addition, there is an important chapter on spark-photography of sound waves, and of bullets in flight, and one on the velocity of sound in air.

The account which Professor Miller gives of these studies is a model of clarity, and the research itself is a model of thoroughness and scientific accuracy. Every student of physics should read this book for the interest in the subject-matter and for the example it sets in proper research methods and in the presentation of results.

F. A. SAUNDERS
HARVARD UNIVERSITY

SPECIAL ARTICLES

EXPERIMENTAL INTERSEXUALITY: THE PRODUCTION OF FEMINIZED MALE RATS BY ANTENATAL TREATMENT WITH ESTROGENS[1]

THE production of masculinized female rats by antenatal administration of androgens has been reported.[2,3,4] Until very recently attempts to produce feminized male rats by the antenatal administration of estrogenic substances (estrone, estradiol and estradiol benzoate) have been unsuccessful. Dosages that would conceivably cause feminization of the genetic male fetuses, when administered to pregnant rats, caused resorptions of the pregnancies. However, one full-term litter which showed slight changes in sexual development was obtained. The mother of this litter had been given 0.8 mg estradiol in divided doses from the thirteenth day to the twentieth day of pregnancy. Two new-born males of this litter were serially sectioned, and it was noted that there had been definite inhibition of development of the prostatic diverticula and of the seminal vesicles.

A generous amount of estradiol dipropionate has been made available to us through the courtesy of Dr. Ernst Oppenheimer, of Ciba Pharmaceutical Products, Inc. This compound is very slowly absorbed and consequently has a very prolonged estrogenic effect. Thirty-two pregnant rats have been injected with this compound, usually in single doses of 0.375 mg to 4.0 mg on the thirteenth, fourteenth or fifteenth day of pregnancy. Nineteen of these animals have carried to term and 24 males have been obtained from these litters. Fourteen of these males, the mothers of which had received 2.0 to 4.0 mg of estradiol dipropionate, had grossly visible nipples at birth and were hypospadiac. Normally nipples are not present in the males rats of our colony. Normal new-born males

[1] This work has been supported in part by a grant from the Josiah Macy, Jr., Foundation.

[2] R. R. Greene and A. C. Ivy, SCIENCE, 86: 200, 1937.

[3] R. R. Greene, M. W. Burrill and A. C. Ivy, *Proc. Soc. Exp. Biol. and Med.*, 38: 1, 1938.

[4] R. R. Greene, M. W. Burrill and A. C. Ivy, SCIENCE, 87: 396, 1938.