fishes to that of the first air-breathing animals which can range far from the water for long periods of time, and to the further stages attained in mammals has involved far more than the mere development of lungs. A new motor mechanism, with a highly organized and extremely efficient mechanism of nervous control, has been quite as necessary as the lungs themselves. The muscular changes have been considerable, but the changes in the nervous system have been quite as profound as those in the motor mechanism. But this nervous mechanism, in common with other highly organized machinery, has little possibility of new attainments (Hughlings Jackson) or of learning very much. Truly, the difficulties encountered in the transition from an aquatic to a terrestrial habitat have been great, and the first group to leave the water—the amphibians—has not wholly succeeded in overcoming them.[3]

The new mechanism, as far as I can see at present, first begins to assume a settled and definite form in reptiles. It is my present view, although the experimental evidence is not yet complete, that the respiratory connections with the midbrain, while partly established in amphibians, are first adequately established in reptiles. This seems only one more fact pointing to the importance of the reptilian group for the comparative physiologist who wishes to approach the study of the problems of organic evolution from the point of view of experimental physiology.

F. H. PIKE

COLUMBIA UNIVERSITY

A NEW FORMULA FOR THE ELECTRICAL RESISTANCE OF CERTAIN INHOMOGENEOUS SYSTEMS

IN the February number of the *Journal of Infectious Diseases* there is a paper by Dr. R. G. Green and myself dealing with the electrical conductance of systems of the following type: a suspension of yeast cells in a salt solution. In that paper we gave an approximate expression for the resistance of the suspension in terms of the volume occupied by the suspended particles and the specific resistances of the menstruum and of the suspended materials. I have recently arrived at a relation which I believe to be much more accurate.

Let c be the constant of the cell in which the resistances are measured; s, the specific resistance of the suspended material; a, the fraction of the total volume occupied by the suspended cells (assumed to be spherical); R, the resistance of the suspension; and M, the resistance when the salt solution alone fills the apparatus. Let $S = cs$.

Then the new equation is

$$R = M\left[\frac{1 + a\left(\frac{S-M}{2S+M}\right)}{1 - 2a\left(\frac{S-M}{2S+M}\right)}\right] \text{ or}$$

$$a = \frac{(R-M)(2S+M)}{(2R+M)(S-M)}$$

For the case in which the suspended particles have an infinite resistivity,

$$R = M\left(\frac{1+\frac{a}{2}}{1-a}\right) \quad \text{and} \quad a = \frac{2(R-M)}{2R+M}$$

Dr. Green and I will submit for publication in the near future a paper in which we shall undertake to prove the correctness of the formulae given above, and in which we shall apply them to experimental data old and new.

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THE AMERICAN PHILOSOPHICAL SOCIETY

THE American Philosophical Society held its annual meeting in Philadelphia on April 24, 25 and 26, with the following program:

THURSDAY, APRIL 25

The fate of the soul of the elect in Manichaeism: A. V. WILLIAMS JACKSON, professor of Indo-Iranian Languages, Columbia University.

The Bornholm dialect of Danish: JOHN DYNELEY PRINCE, envoy extraordinary and minister plenipotentiary to Denmark.

Balder and the Golden Age: HERMANN COLLITZ, professor of Germanic philology, Johns Hopkins University.

Some effects of baths on man: H. C. BAZETT, B.Ch. (Oxon.), professor of physiology, University of Pennsylvania.

Differential permeability and cell reaction: M. H. JACOBS, Ph.D., professor of general physiology, University of Pennsylvania.

Pneumonia in Pittsburgh: EWALD TOMANEK, M.D., and EDWIN B. WILSON, Harvard School of Public Health.

The amending provision of the Federal Constitution in practice: HERMAN V. AMES, professor of history, University of Pennsylvania.

On the authorship of the anonymous pamphlet published in London, in 1760, entitled "The interest of Great Britain considered with regard to her colonies": I. MINIS HAYS, of Philadelphia.

The nation's transportation problem: EMORY R. JOHNSON, professor of transportation, University of Pennsylvania.

[3] I am indebted to Dr. G. K. Noble for much information on the various adaptations and shifts which these forms have tried in the first attempt at terrestrial life. I would appreciate data bearing on peculiar means of respiration in other forms.

Obstacles to international commerce: LEWIS M. HAUPT, of Philadelphia.

The scientist and an international language: ROLAND G. KENT, professor of comparative philology, University of Pennsylvania.

THURSDAY, APRIL 26

Morning Session

Inheritance by tetrad sibs in Sphaerocarpos: CHARLES E. ALLEN, professor of botany, Columbia University.

The behavior of Oenothera neo-Lamarckiana in selfed line through six generations: BRADLEY M. DAVIS, professor of botany, University of Michigan.

Types and variants in certain coenobic plants: ROBERT A. HARPER, M.A., Ph.D., professor of botany, Columbia University.

A second independently inherited factor in the evening primroses (Oenothera): GEORGE H. SHULL, professor of botany and genetics, Princeton University.

Arrangement and action of material in the plasmatic layers and cell walls of plants: D. T. MACDOUGAL, director of the department of botanical research, Desert Botanical Laboratory, Carnegie Institution.

The curve of population growth: RAYMOND PEARL, professor of biometry and vital statistics, School of Hygiene and Public Health, Johns Hopkins University.

Faunal life zones of Mongolia—Jurassic to Upper Pliocene: HENRY F. OSBORN, research professor of zoology, Columbia University, and president of the American Museum of Natural History.

Fauna of the Santa Cruz beds of Patagonia: WILLIAM B. SCOTT, professor of geology, Princeton University.

Fauna of the concretionary zone of the Oreodon beds of the White River Oligocene: W. J. SINCLAIR, assistant professor of geology, Princeton University.

Afternoon Session

Presentation of a Tablet in Memory of HENRY LABARRE JAYNE, ESQ., late treasurer of the society.

SYMPOSIUM

Are the various races of man potentially equal? FRANZ BOAS, professor of anthropology, Columbia University; GEORGE GRANT MACCURDY, assistant professor prehistoric archeology and curator of anthropological section, Peabody Museum, Yale University; H. U. HALL, curator general ethnology, University Museum, University of Pennsylvania; ALEXANDER GOLDENWEISER, professor of anthropology, New School for Social Research, New York City.

SATURDAY, APRIL 26

Morning Session

The effect of temperature on the rate of embryonic development of certain orthoptera: J. H. BODINE, A.B., Ph.D., instructor in zoology, University of Pennsylvania. (Introduced by Dr. McClung.)

Symbiotic luminous bacteria as used by fishes: ULRIC DAHLGREN, professor of biology, Princeton University.

Transplantation of the spinal cord: SAMUEL R. DETWILER, Ph.D., assistant professor of zoology, Harvard University. (Introduced by Dr. Donaldson.)

The fishes used against yellow fever in Columbia: CARL H. EIGENMANN, professor of zoology, Indiana University.

The amount of carbon dioxide excreted by one centimeter of frog nerve fiber: GEORGE H. PARKER, director of the Museum of Comparative Zoology, Harvard University.

Sex in the right and left sides of the bird's body: OSCAR RIDDLE, research staff, Carnegie Station for Experimental Evolution, Cold Spring Harbor. (Introduced by Dr. Eigenmann.)

The prediction of the basal metabolism of girls: FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution.

Some phases of the life of Gambetta: CHARLES DOWNER HAZEN, professor of history, Columbia University.

Vicarious Atonement: PAUL HAUPT, professor of Semitic languages, Johns Hopkins University.

Afternoon Session

The sonic depth finder: HARVEY C. HAYES, U. S. Naval Experiment Station, Annapolis. (Introduced by Mr. Bryant.)

Some new experiments in gravitation (Fourth Paper): CHARLES F. BRUSH, of Cleveland.

Further results concerning the earth's magnetic and electric fields: LOUIS A. BAUER, director of the Department of Terrestrial Magnetism, Carnegie Institution.

Abnormal under-voltage arcs in gases: C. B. BAZZONI, A.M., Ph.D., professor of experimental physics, and J. T. LAY, research associate, University of Pennsylvania. (Introduced by Professor Goodspeed.)

Application of positive ray analysis to problems of ionization: H. D. SMYTH, Ph.D., research fellow, Princeton University. (Introduced by Professor Karl T. Compton.)

Some properties of simple electric conducting net works: A. E. KENNELLY, A.M., Sc.D., professor of electrical engineering, Harvard University.

Wave lengths of iron lines in the vacuum Arc (By Title); *On the shift of the solar lines predicted by the theory of relativity:* KEIVIN BURNS, astronomer, Allegheny Observatory. (Introduced by Dr. H. D. Curtis.)

On the light deflections in the sun's gravitational field: ROBERT J. TRUMPLER, assistant astronomer at Lick Observatory. (Introduced by Dr. W. W. Campbell.)

Exploring the solar atmosphere: CHARLES E. ST. JOHN, Ph.D., astronomer, Mt. Wilson Observatory. (Introduced by Dr. John A. Miller.)

The present periodic table of the atoms: MONROE B. SNYDER, director emeritus of the Philadelphia Observatory.

On Friday evening there was a reception from 8 to 11 o'clock, at which Dr. Dayton C. Miller, professor of physics, Case School of Applied Science, Cleveland, spoke on "Visible sound" (experimentally illustrated).

The annual dinner was held on Saturday evening.