pounds is placed in an arc or flame. They are degraded to the longer wave-lengths in common with the less refrangible bands.

A short time ago the writer established the identity of PbO as the emitter of the yellow-green bands through an observation of the isotope effect.[2] Grebe and Konen's isotope effect in the blue region points also to PbO as the emitter. In order to aid in the vibrational quantum number assignment, an isotope effect was sought for and found in the ultra-violet. The spectrum of this region was photographed in the second order of a twenty-one-foot Rowland grating, first using ordinary lead in an arc and then repeating with uranium lead of atomic weight 206.1. About three grams of this material, a portion of the nugget of uranium lead used in the previous experiment, was placed in the arc. Both exposures were twenty hours long.

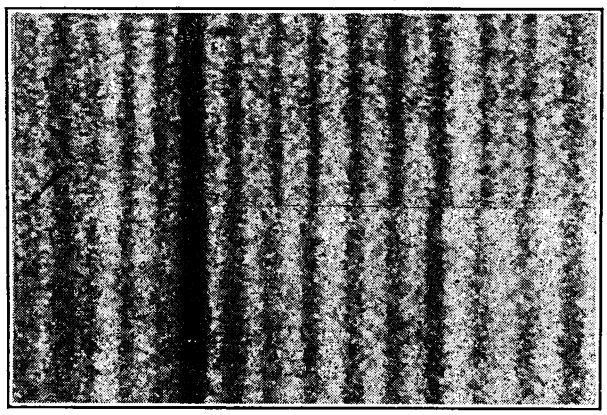

FIG. 1

Fig. 1 illustrates the experimental results near the head of the λ3485.7 band. The spectrum in the upper half of the picture consists of the sharp band lines of $Pb_{206}O$. The lower half shows the corresponding lines in the oxide spectrum of ordinary lead, $Pb_{208,207,206}O$. These are wide and unresolved, and in marked contrast to the isotopic triplets observed in the λ5678 band. The lines of $Pb_{206}O$ are displaced .037 ± .006 Å to the longer wave-lengths. The strong reference line is an iron arc line of wave-length 3490.577 Å. The enlargement of the original plates (dispersion 1.316 Å/mm) is about twenty-three fold. The wave-lengths increase from left to right in the figure.

In order to secure accurate measurements of the wave-lengths of the heads of these ultra-violet band spectra, photographs were taken at moderate dispersion with the Hilger E.1 quartz spectrograph (Littrow mounting). It was found that the wave numbers of most of the band heads could be represented to within a few wave numbers by the formula

$$\delta = 30{,}197.0 + [530.6(n' + \tfrac{1}{2}) - 1.1(n' + \tfrac{1}{2})^2] - [722.3(n'' + \tfrac{1}{2}) - 3.7(n'' + \tfrac{1}{2})^2]$$

where n takes the value 0, 1, 2, 3, etc. By comparison with Mecke's formulas for the other systems, it appears that all four have the same final state, which is probably the normal state of the molecule. The wave-lengths of the principal band heads are close to those previously measured by Eder and Valenta. They secured values 3264, 3322, 3342, 3402, and 3491 Å. The new measurements with quantum number assignments include λ3209.2 (2, 0), 3264.4 (1, 0), 3320.7 (0, 0), 3341.8 (1, 1), 3401.9 (0, 1), 3485.7 (0, 2), 3594.2 (1, 4) and a great many weaker bands.

Upon substituting the constants given above into the usual formula,[3] one can calculate the isotope effect to be expected near the head of the λ3485.7Å band, assuming that PbO is the emitter. Neglecting the rotational contribution to the isotope effect, since the origin of the band is close to the head in this case, one calculates .033Å as the separation between the lines of $Pb_{207}O$ and $Pb_{206}O$. This value agrees with the measured displacement of .037 ± .006Å within experimental error. A detailed report on the quantum analysis of the lead oxide band spectra will soon be published.

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THE LIFE-CYCLE OF HAPLOBOTHRIUM GLOBULIFORME COOPER 1914

FIVE out of eight *Ameiurus nebulosus* (common bullhead) taken in the Mississippi River near Homer, Minnesota, have shown the presence of an interesting larval cestode encysted in the liver. The cysts were small, measuring about 0.77 by 0.66 mm, and situated in the superficial tissues. Freed from the cysts they show characters which are unique in a parasite from a fresh-water host. The body is divided into two parts: a long slender anterior portion (0.5 by 0.16 mm) comprising the scolex and neck, and a posterior portion consisting of a spheroidal bladder-like organ (0.5 by 0.5 mm). The scolex contains four protrusile proboscides which measure about 0.42 mm in length when invaginated. The only tapeworm from a fresh-water host to which these larvae bear any resemblance is *Haplobothrium globuliforme*, a cestode of *Amia calva*. There is essential agreement between the larvae from the bullhead and Cooper's description of the plerocercoid of *Haplobothrium globuliforme* (found

[2] S. Bloomenthal, SCIENCE, 69: 229, February 22, 1929; *Physical Review*, 33: 285 (A35), February, 1929.

[3] See R. S. Mulliken, *Physical Review*, 25: 119, 1925; and F. W. Loomis, *Bulletin* of the National Research Council, 57: 262.

in the bowfin's intestinal tract) both in the structure and size of the scolex and in the structure and size of the proboscides. Since the agreement between the two forms is so striking and since no other tapeworm thus far reported from a fresh-water host possesses a scolex with four proboscides, the identity of the larvae from the bullhead and the tapeworm of the bowfin is evident.

The habitat of the bullhead and bowfin is the same; both are in quiet, shallow, muddy regions of lakes and rivers. Since both are nocturnal feeders there is ample opportunity for the bullhead to be captured by the bowfin. Although, as pointed out by Forbes and Richardson (1920),[1] catfishes prey on other species to a greater extent than other species prey on them, yet, in the stomachs of the large- and small-mouth bass and the sand pike, catfishes were found. Since the bowfin is as well equipped to ingest the bullhead as the forms just mentioned, and since about one third of the bowfin's food consists of fishes, it is not unreasonable to suppose that the bullhead forms a part of the bowfin's diet. Forbes and Richardson do not list catfishes as a source of food for the bowfin, but the number (twenty-one) examined by them is not sufficient to include all the forms utilized.

The egg of *Haplobothrium globuliforme* gives rise to a coracidium or ciliated larva which is probably eaten by a copepod, as is the case in all the known life-cycles of Bothriocephalids from fresh-water hosts. Definite information on the various phases of the developmental history of this interesting parasite can be obtained only by experimental methods. More complete knowledge of the development of *Haplobothrium globuliforme* will be of interest from a phylogenetic view-point, since this parasite closely resembles the Trypanorhynchids which are parasitic in Elasmobranch fishes.

Further work is now in progress and a more inclusive account of the development of this parasite will appear later.

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THIRTY-NINTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

THE Ohio Academy of Science, under the presidency of Professor James S. Hine, of Ohio State University, held its thirty-ninth annual meeting under very delightful auspices at Wittenberg College, Springfield, Ohio, on Friday and Saturday, April 26 and 27, 1929. The local committee under the fine leadership of its chairman, Dr. W. C. Beaver, was preeminently successful in anticipating the needs and comfort of the visiting scientists and won universal praise for the completeness and execution of its plans. The attendance was unusually large, the program well balanced and the lectures and papers uniformly good and well received, provoking some lively discussions.

The scientific program was made up of a number of lectures and papers of general interest, some ninety-six sectional papers and a few exhibits and demonstrations. As an indication of the character of the general papers one might mention the presidential address on "The Distribution of Ohio Mammals," by President Hine; "The Application of X-rays to the Study of the Structure of Crystals," by Dr. F. C. Blake, of Ohio State University; "Life Challenges Science," by David Dietz, science editor of the Cleveland *Press*; "The American Eagle in Action," by Dr. Francis H. Herrick, of Western Reserve University, and the showing of the Canti film with explanatory remarks by Dr. J. Paul Visscher, of Western Reserve University.

Among the business items transacted by the academy may be mentioned the election of sixty-three new members, the restoration of three former members, the elevation of eleven members to fellowship and the election of one patron, namely, George T. Spahr, of Columbus, for "distinguished favors bestowed upon the academy." The president was authorized to appoint a committee of three "to consider the advisability and the ways and means of establishing facilities for encouraging junior scientific effort in Ohio" and report with recommendation at the next annual meeting; also a committee of six "to look into the matter of a more adequate publication of the proceedings of the academy, and of the academy's relation to the *Ohio Journal of Science*.

Upon the recommendation of the nominating committee, the following officers and committeemen were elected for the ensuing year:

President, Dr. F. C. Waite, Western Reserve University; *vice-presidents*—A. Zoology, Dwight M. DeLong; B. Botany, Lewis H. Tiffany; C. Geology, Paris B. Stockdale; D. Medical Sciences, Leonard B. Nice; E. Psychology, Martin L. Reymert; F. Physical Sciences, Frederick C. Blake; *secretary*, William H. Alexander; *treasurer*, A. E. Waller; *elective members of executive committee*, C. G. Shatzer and E. N. Transeau; *Trustees Research Fund*, Herbert Osborn; *publications committee*, E. L. Moseley, F. O. Grover, F. C. Blake; *library committee*, Mrs. Ethel M. Miller; *committee on state parks*, J. E. Carman, E. L. Wickliff, Roscoe W. Franks.

W. H. ALEXANDER,
Secretary

[1] "The Fishes of Illinois." Ichthyology, Illinois State Laboratory of Natural History, Volume III.