After discussing the mode of occurrence, conditions of preservation, manner of life including method of progression, food, defense and offense, the author describes species with appendages, which include besides the genera already mentioned, *Kootenia dawsoni* (Walcott), two species of *Ptychoparia* including a new one *P. permulta* from the Burgess shale quarry, *Odonotopleura trentonensis* (Hall), *Trinucleus concentricus* Eaton, and an unidentified Ordovician crustacean leg. The work of C. E. Beecher with *Triarthrus* is reviewed in some detail, and a different conclusion arrived at in certain features.

In section two of the paper the structure of the trilobite receives attention, the author again referring to Beecher and other writers including Jaekel, Beyrich, Barrande and de Volborth. He then discusses in detail the appendages, summarizing them as follows:

Cephalic: (1) Antennules, (2) antennæ, (3) mandibles, (4) maxillula, (5) maxilla.

Thoracic:

Abdominal:

Caudal rami:

Further comparisons are with the recent *Anaspides tasmaniæ* G. M. Thomson, a Malacostracan from Tasmania, *Koonunga cursor* Sayce, and *Paranaspides lacustris* Smith, also the parasitic crustacean *Cyamus scammoni* Dall, illustrations of all of which are given. After the extraordinary interest of the finely developed specimens in the plates representing *Neolenus,* attention will be drawn by those of *Isotelus, Triarthrus becki* Green, and other Ordovician trilobites, together with the sections of Cambrian and Ordovician trilobites, and finally the author's conclusions as expressed by several diagrammatic restorations, also sketches of thoracic limbs of trilobites and recent crustaceans, crustacean limbs, and six plates of tracks and trails of trilobites, each adding evidence to the author's deductions as to the appendages.

Some conclusions drawn are that the trilobite's appendages show him to have been a marine crustacean far more highly developed than would have seemed possible in a period so infinitely remote.

In its younger stages of growth a free moving and swimming animal, it later became a half-burrowing, crawling and sometimes swimming animal and moving at times with the flow of the tides and prevailing currents. Eggs have been found both within and free from the body. . . . It was at home on many kinds of sea-bottom and was able to accommodate itself to muddy as well as clear water.

It was intensely gregarious in some localities and widely scattered in others, depending upon local conditions, and habits of the various species.

Trilobites had an ample system of respiration by setiferous exopodites, epipodites, and exites attached to the cephalic, thoracic and abdominal limbs [as shown in restorations of the limbs on plates 34 and 35].

The structure of the gnathobases of the cephalic limbs indicates soft food such as worms, minute animal life and decomposed algæ. . . . The trilobite persisted from far back in pre-Cambrian time to the close of Carboniferous time . . . and left its remains more or less abundantly through about 75,000 feet of stratified rocks.

The paper is profusely illustrated and carefully indexed.

G. R. Brigham

SPECIAL ARTICLES

PRESOAKING AS A MEANS OF PREVENTING SEED INJURY DUE TO DISINFECTANTS AND OF INCREASING GERMICIDAL EFFICIENCY

In the course of investigations on the bacterial black-chaff disease of wheat, under the direction of Dr. Erwin F. Smith, a new method of seed treatment has been discovered which practically eliminates seed injury due to the use of disinfectants, and at the same time renders pathogens on the seed coats more susceptible to the action of the disinfectant. This is accomplished by allowing the seeds to absorb water for a definite period in advance of treatment. The saturation of the cells and cell-walls with water before treatment, by diluting the full-strength disinfectant beyond the point of injury as it enters the tissues, in accordance with the law of diffusion of dissolved substances, is the explanation of the results obtained. Not only is injury to germination prevented, but the germination of seeds thus treated is stimulated, reducing the danger of

seed infection by soil organisms during the sensitive period of germination.

On the other hand, experiments with wheat seeds infected with the black-chaff organism have shown that this method used with formalin will completely destroy the organism on the kernels. After screening and fanning to remove shrivelled grains, the treatment should be made by soaking infected seeds for ten minutes in water then draining and keeping moist for six hours. They are then soaked ten minutes in formalin 1:400 solution (1 lb. to 50 gallons of water) drained, and covered for six hours; then dried over-night and planted next day. If copper sulfate is used, the presoaked seeds are thoroughly wetted in the 1:80 solution (1 lb. to 10 gallons of water) for ten minutes, drained and kept moist twenty minutes, plunged for a moment into milk of lime, dried over-night and planted. The effect of the presoaking with water, besides preventing seed injury, is to stimulate dried and dormant bacteria on the seed coat, into vegetative activity, thereby rendering them more sensitive to the action of the disinfectant which must be applied at the end of the presoak period and of course before the seeds have begun to germinate. This is fully in accord with the established principle that microorganisms in a vegetative condition are more susceptible to destructive agents than when dry and in a resting stage.

The effect of the presoak method of seed treatment with chemical disinfectants is, therefore, two-fold—first, seed injury is prevented by the dilution of the disinfectant as it enters the presaturated seed tissues; second, the efficiency of the disinfectant on the pathogen is increased. In view of the fact that nine different varieties of wheat, also oats, barley and maize, have been treated by this method, using both formalin and copper sulfate, disinfectants of widely different chemical nature, in strong solutions (formalin 1:320 and copper sulfate 1:80) without appreciable injury to germination, it appears probable that the same physiological principles here utilized can be applied to other chemical disinfectants and to the treatment of other seed-transmitted diseases amenable to control by these disinfectants, with variations of course in the length of the presoak period (which is six hours for wheat, barley and oats, and ten to eighteen hours for maize) and of the subsequent disinfectant period, as found necessary for each kind of seed and pathogen.

The use of this method in farm practise involves no radical change in present procedure other than to keep seeds moist for definite periods before treatment. If the use of the presoak method is found efficient for the cereal smuts and other diseases as well as for the black-chaff disease of wheat, it will result in a saving of most of the seed now lost by present methods of treatment and also in increased germicidal efficiency. The formulation of this method, as here reported and later to be given in detail, opens up a wide field for the reinvestigation of practical seed treatment for the control of seed-transmitted diseases by chemical disinfectants.

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THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the society was held from April 24 to 26 and a program of over fifty papers covering a wide range of subjects was presented. The sessions were presided over by the president, Professor W. B. Scott and by vice-presidents G. E. Hale, H. L. Carson and A. A. Noyes.

Two important features were a symposium on the solar eclipse of June 8, 1918, and one on chemical warfare. In the former special attention was given to photographs and their interpretation of the prominences and the coronal arches and streamers obtained by members of the several expeditions sent from the Lick, the Mount Wilson, the Lowell, the Sproul and the Yerkes observatories.

PROGRAM

Thursday Afternoon, April 24, 2 o'clock

William B. Scott, D.Sc., LL.D., president, in the chair

The cosmic force, radio-action: MONROE B. SNYDER, director of the Philadelphia Observatory.

The conservation of the natural monuments (illustrated): JOHN M. CLARKE, director of depart-