tion stage commonly found in *Ostrea virginica*. The spores were also found in the following pelecypods: *Pecten, Anomia, Ostrea equestris, Modiolus, Venus ziczac* and *Martesia* and in the gastropod, *Urosalpinx*.

The life history and morphology of this sporozoan parasite resembles that of the *Porosporidae* described on the French coast by Leger and Duboscq[2] and Pierre Hatt.[3] It is a heterogenetic gregarine with alternation of hosts, having the vegetative and reproductive phase in the intestine of decapod crustacea and sporogony in molluscs, particularly in lamellibranchs. The resistant, monozoic spores found in *Ostrea* are similar to those first described as *Nematopsis* by Schneider[4] in 1892. The American form, which will be described in detail in a forthcoming paper, is a new species for which the name *Nematopsis ostrearum* is proposed.

Studies of the effect of the parasite on adult oysters were conducted in the laboratory, where heavy infections could be produced by keeping them in close association with mud crabs carrying gametocysts or by the introduction of ripe gymnospores. In bulk experiments with several hundred oysters, losses of 66 to 73 per cent. were obtained over a period of 3 months. Kymograph records of shell movement of 35 heavily infected oysters showed abnormal and frequent contractions of the adductor muscle followed by loss of holding power and death of the molluscs. Retraction of the mantle, cessation of shell growth and weak attachment of the muscle to the shell are also characteristic of mortalities in the field and laboratory. The injury to the oyster host may be due to a toxin given off by the developing sporozoites, particularly in the sensitive mantle tissue, or to actual physical obstruction of the circulation by the masses of enlarged, infected phagocytes found in the blood vessels of the gills and muscle.

Practical prevention of the infection of oysters by this parasite is possible by control of the primary host, the mud crabs, and by exercising care in the selection of uninfected seed oysters for restocking growing and maturing areas. The crabs do not migrate and can be easily removed, before the beds are planted, by the use of dredges or scrapes equipped with fine mesh bags. In certain regions where valuable oyster beds have been abandoned or their productivity seriously reduced because of damage by this microscopic pest it should be possible to reestablish and increase production by the procedure suggested above.

HERBERT F. PRYTHERCH
U. S. FISHERIES BIOLOGICAL STATION,
BEAUFORT, N. C.

2 L. Leger and O. Duboscq, *Trav. Stat. de Wimereux*, T. 9: 126–139, 1925.
3 P. Hatt, *Arch. Zool. Exp.*, T. 72, 341–415, 1931.
4 A. Schneider, *Tabl. Zool.*, T. 2: 1892.

FIELD TRIPS FOR THE TEACHING OF GEOLOGY

FIELD experiences of some kind have long played a part in courses in geology. These experiences vary greatly in amount of time spent, in methods and in results obtained. Since this is the case, it is well to evaluate from time to time such geological experiences in terms of their educational possibilities.

In the endeavor to make his own field class trips most productive for his students, the writer, during a period of years, has made a study of field class procedure. As a result of this study certain conclusions have been reached and are briefly presented here.

Since much of the procedure depends upon the aims or objectives of the field trips, a concise statement of attainable and worth-while objectives is desirable. Objectives for a course in general geology to which carefully planned field trips may contribute are the following:

(1) A genuine interest in the science of geology.
(2) Some ability to correctly interpret certain geological phenomena.
(3) Some appreciation of the geological environment of mankind.
(4) The contribution of earth materials and the substances derived therefrom to man's progress, his pleasure and his comfort.

While each trip will have a part to play in the attainment of these more general objectives, it will also have some specific aim of its own. For example, the major emphasis on one trip may be devoted to only a part of Objective No. 2, yet the trip as a whole will further the realization of Objectives 1, 3 and 4.

The methods employed in the classroom, the laboratory and on the field trips should all contribute to the attainment of the objectives set up for the course. How then shall the field trip be conducted so as to bring about the greatest possible realization of these objectives?

According to the writer's experience the field trip that is to contribute as much as possible to the attainment of the foregoing objectives and which is arranged with them in mind will be such as will require a maximum of participation, interest and industry on the part of each student. Active student participation may be secured most naturally through the use of a carefully planned activity program and selected problems. The use of such a program on a field trip is challenging and highly instructive as well as interesting to students. It directs the attention of each student to the materials for study and gives him an opportunity to independently observe for typical characteristics, to note similarities and differences and to be ready to suggest explanations or interpretations for what he has seen.

After sufficient time has been allowed for the students to make independent observations they are called together and the observations on the assigned area summarized. On the first field trips some individuals will not only have more to report than others, but their findings will be more correct because of the wide range in the natural ability of students to observe critically.

The class is next asked to justify the summarized observations by the geological evidence at hand and by the previous study in the course. Such a procedure provides a discussion in which the students are the active participants, while the instructor serves to keep the subject open until all the evidence is weighed and conclusions reached.

If the previous experience of the class and the evidence at hand are sufficient to justify sound conclusions the problem may be followed through to a complete solution at this time.

If, however, an adequate solution of some of the field problems lies beyond the present state of the students' learning, such problems may well be left open for the present, to be taken up later in the classroom or in the field, when the course work has progressed to the required stage.

One incompletely solved problem may lead to other related ones. It may be used to stimulate student interest in these problems and to challenge their ability to solve them.

The procedure in each case will be such that the instructor serves to direct the students' attention to the problem for study, to stimulate more accurate observation and to see that the discussion comes to sound conclusions. This process of solving a problem is a cooperative venture wherein the observations of all are pooled and evaluated. The thinking of the students is sharpened and their faculties for critical observation and judgment are developed. The field trip becomes a period of discovery for the group as a whole and of development for the individual.

As students are thus given an opportunity to share in the responsibility of solving field problems the trip becomes increasingly purposeful to them and there is marked advance in the attainment of the desired objectives set up for this part of the geological program.

C. S. GWYNNE

IOWA STATE COLLEGE

AGRONOMIC SCIENCE, 1838–1938

ALONG with other scientific contributions of which 1938 marks the centenary, agronomists should not let pass unnoticed those of the Frenchman Boussingault. Just a century has passed since Jean Baptiste Boussingault, adventurer, traveler, chemist and "farmer of Bechelbronn," made his first fundamental contribution toward the solution of the problem of nitrogen assimilation by plants. In two papers published in 1838 in volumes 47 and 49 of *Annales de Chimie et de Physique* he reported results of carefully conducted experiments which showed that certain legumes grown in sterile soil "acquired a very appreciable quantity of nitrogen" and that "wheat and oats (non-legumes) grown in the same circumstances . . . showed no increase in nitrogen after their maturity." A little later Boussingault conducted field experiments with crop rotations, some of which contained legumes. The harvested crops were carefully weighed and analyzed. Boussingault stated, "it was with the purpose of substituting positive facts for mere guesses" that he undertook the work. His experiments virtually mark the beginning of agronomic science.

A. B. BEAUMONT

REPORTS

THE DEPARTMENT OF AGRICULTURE APPROPRIATION ACT, 1939[1]

APPROPRIATIONS made in the act for the support of the Federal Department of Agriculture for the fiscal year ending June 30, 1939, as signed by President Franklin D. Roosevelt on June 16, 1938, aggregated $742,040,279, plus $187,105,000 of reappropriated funds. If to this are added $152,023,958 for the so-called "permanent" appropriations, which automatically become available, $825,000 carried in the Second Deficiency Act, $7,000,000 transferred from the War Department for flood control surveys and $387,000,000 available under the Work Relief and Public Works Appropriation Act of 1938, the total for the year becomes $1,475,994,237. The comparable aggregate for the preceding year, including deficiency appropriations, was $984,005,456, of which $850,794,177 was derived from the appropriation act.

By far the largest allotment is that for the conservation and use of agricultural land resources. The act itself appropriates $345,000,000 and reappropriates $155,000,000, while $356,024,893 additional will be available from other sources for parity payments to producers of wheat, corn, cotton, rice and tobacco and for other price adjustments. Second in size only to these appropriations are the grants for roads. The Bureau of Public Roads receives $187,500,000, an increase of $20,000,000, mainly for more rapid elimi-

[1] From the *Experiment Station Record*.