of the meeting, which was attended by 170 persons, representing 35 colleges.

Various sites of Triassic fossils were visited on Friday afternoon in the vicinity of South Hadley. Dinosaur footprints were viewed at two localities. Specimens of conifer remains were obtained in the Longmeadow sandstone. Miss Christine Lochman was the leader of this trip.

Dr. Balk led a party on Saturday which visited the fossil locality of Bernardston, Mass., from which the only identifiable fossil, according to G. A. Cooper, is *Spirifer divaricatus* of Onondaga age. The relations of the Bernardston formation to the older phyllites and slates were discussed, and the succession of rocks within the Bernardston formation was demonstrated. The rocks crop out mainly on the west side of the Connecticut River, but at a few places, typical phyllite and amphibolite appear east of the river. Outcrops of phyllite, one half mile from outcropping Pelham granitic gneiss (Carboniferous age) shows no effects of injection. A series of metamorphosed sediments east of the Pelham gneiss and outcrops of gneiss along the valley of Millers River were also visited.

R. H. Jahns and M. E. Willard, of the U. S. Geological Survey, conducted an all-day excursion on Saturday to examine sections of Quaternary deposits in the Connecticut Valley between Northampton and Turners Falls. The chief points of interest included outwash forms deposited in, and adjacent to, the great pre-glacial Connecticut valley lake, varved-clay bottom deposits and glacial spillways. The structure and morphology of the deltas and their relations to nearby ice-contact forms were demonstrated and their significance discussed. The relations, areal and vertical, of the glacial spillways to the adjacent outwash deposits were pointed out.

Three excursions were conducted on Sunday, October 12. M. E. Willard led one group in a study of the variations in rock types of the Triassic in the Connecticut Valley north of the Holyoke Range. The significance of these variations as they bear on the nature of the topography of the Triassic floor of deposition was discussed. Data obtained at exposures of a basal Triassic talus breccia together with information obtained from drill records indicate that the Triassic area of deposition is divided into two parts: namely, west of the present Connecticut River there was a deep north-south basin of deposition; and to the east there was a similar, but much shallower basin. It was suggested that the break between these two basins represented a now-buried fault scarp.

Miss Lochman led a group that studied two varved-clay localities. Special attention was directed to the problems of the Pleistocene *vs.* Recent slumping phenomena: the character and mode of formation of the zone of disturbed varves found at the top of each section: the extent and significance of crumpled zones and the significance of different colorations of the clay layers.

A study of the geology of Winsor (Quabbin) dam was conducted by a group led by Dr. Balk on Sunday morning. The contact exposures of a series of chloritic schists and an offshoot of the Belchertown tonalite were studied in the spillway. The general geology of the huge reservoir was described from the observation tower on top of Quabbin Hill. Exposures of metamorphosed volcanics on the northeast slope of the hill and injection gneisses in the eastern portion of the reservoir were also studied.

The 1942 field meeting of the group will be held in eastern Massachusetts under the leadership of Robert Nichols, of Tufts College, and Dr. L. W. Currier, of the U. S. Geological Survey.

LLOYD W. FISHER,
Permanent Secretary

LEWISTON, MAINE

SYMPOSIUM ON FOLSOM-YUMA PROBLEMS

AN informal symposium on the Folsom-Yuma and other problems related to Early Man in North America, especially in the Southwest, was held on September 3 and 4, 1941, at the Laboratory of Anthropology, Santa Fe, New Mexico. To this meeting, sponsored jointly by the University Museum (University of Pennsylvania) and the Laboratory of Anthropology, Santa Fe, were invited those interested in the various phases of this complex of problems. Happily, many amateurs, or local archeologists, as well as the strictly professional men attended.

During the morning (E. B. Howard, *chairman*) and afternoon (F. H. H. Roberts, Jr., *chairman*) sessions on September 3, discussion was primarily directed to the problem of nomenclature of the Folsom, Yuma and similar points. It was proposed, after the discussion, that a committee be chosen to prepare a resolution embodying the conclusions of the informal discussion. This committee, composed of Dr. E. B. Howard, Dr. F. H. H. Roberts, Jr., and Marie Wormington, drew up resolutions, which were passed by unanimous vote at the morning session (Marie Wormington, *chairman*), on September 4.

These resolutions have been circulated among those present at the meeting for further consideration and final approval and to those interested workers who were unable to attend.

During the morning session, September 4, numerous problems were thrown open to general discussion. Such matters as the possible spurious Folsom points, reported especially from southeastern Colorado, and

the importance of detailed geologic interpretation and correlation of archeological sites were considered.

The success of the meeting as an open forum for the discussion of problems relating to Early Man has made all who attended hope for the establishment of an annual summer meeting, for which Santa Fe seems so admirably situated. Especial thanks for the success of this meeting are due Dr. E. B. Howard, of the University Museum, Philadelphia, Pa., who was responsible for the planning and organization, and to the staff of the Laboratory of Anthropology at Santa Fe, who acted as hosts.

LOUIS L. RAY

MICHIGAN STATE COLLEGE

SPECIAL ARTICLES

THE SUSCEPTIBILITY OF THE EASTERN COTTON RAT, SIGMODON HISPIDUS HISPIDUS, TO EUROPEAN TYPHUS

ONE of the outstanding difficulties in the study of typhus fever has been the lack of an animal in which the disease could be reproduced as it occurs in man. With this in mind, a search for more suitable experimental animals for the study of typhus was undertaken, and our results obtained with the eastern cotton rat, *Sigmodon hispidus hispidus,* are presented below. After these studies were under way, we discovered that Gerardo Varela[1] had already tested the susceptibility of these rodents to murine typhus. Although Varela was able to demonstrate the infectivity of the cotton rat brain as late as 5 days after inoculation, the rats themselves apparently remained healthy.

In our experiments the European typhus rickettsiae used were the well-known old Breinl strain and also three new strains isolated from patients in Madrid about 6 months ago during a recent epidemic of typhus.

Yolk sac membranes of developing chick embryos inoculated with typhus rickettsiae according to Cox's technique[2] served as the source of the infectious material for this study. In an experiment using cotton rats between 25 and 30 gm in weight, the smallest volume of a 10 per cent. yolk sac suspension given intraperitoneally which resulted in death was between 0.05 and 0.5 cc. By the intracardial and intranasal routes the minimal lethal dose was approximately 0.01 cc. At autopsy, rickettsiae were found in great abundance in the peritoneal exudate of the rats inoculated intraperitoneally; in the pericardial and mediastinal exudate of those injected intracardially; and in the lungs of those infected intranasally.

A striking relation between age of rats and their susceptibility to typhus was observed. In an experiment with eight cotton rats of different sizes given 0.1 cc of a 10 per cent. yolk sac suspension intracardially, those weighing 20 to 30 gm died in 3 or 4 days, whereas those weighing from 46 to 66 gm recovered from the infection after several days of experimental disease.

To determine whether the fatal infection in young rats could be prevented by a specific immune serum, samples of normal and convalescent human serum were mixed with equal volumes of a 20 per cent. infected yolk sac suspension. The mixtures were incubated for 1 hour at 38° C. and a group of the rats inoculated intracardially with each mixture. The convalescent serum used in this experiment had been obtained from patients 2 weeks after recovery from typical typhus. A portion of the 20 per cent. yolk sac suspension alone was similarly heated for 1 hour at 38° C., after which tenfold dilutions were made and groups of rats inoculated intracardially to serve as infectivity controls. The six rats receiving the convalescent serum survived, whereas the six which received normal serum succumbed 3 or 4 days after inoculation. The titration of the yolk suspension alone showed that the number of minimal lethal doses given each rat in this test with normal or convalescent serum was somewhere between 5 and 50.

In the cotton rats that succumbed to the intracardial injection of infected yolk sac the greatest number of rickettsiae was observed in the mediastinal exudate. The rickettsiae were also numerous in the liver. This organ was chosen as a source material for the serial passages of the infection in the rats. The Madrid-1 strain has now been carried through five passages. After four serial passages it produced fatal infection in all of three rats inoculated intracardially with 0.2 cc of a 10 per cent. liver suspension. The same volume of a 1 per cent. suspension likewise resulted in the death of all rats, whereas the animals given 0.1 per cent. suspension showed only slight evidence of experimental disease. By routes other than the intracardial a fatal infection in serial passage was not obtained.

Although it is obvious that a still more susceptible animal is needed, the results above indicate that the cotton rat is much more suitable than the guinea pig for the investigation of many problems in typhus fever which urgently await solution.

J. C. SNYDER

C. R. ANDERSON

LABORATORIES OF THE INTERNATIONAL HEALTH DIVISION,
THE ROCKEFELLER FOUNDATION

[1] Gerardo Varela, *Medicina* (Mexico), 13: 171, 1933.
[2] H. R. Cox, *Public Health Reports, U.S.P.H.S.*, 53: 2241, 1938; 55: 110, 1940.