tific studies in their respective fields. The area selected for field study was the Gaspé Peninsula in the northeastern portion of the province of Quebec, Canada. It was my privilege to carry on a part of the geological studies in conjunction with Dr. E. T. Apfel, of the geology staff of Syracuse University, and curator of geology in the Syracuse University Museum of Natural Science.

The talus slopes of the northern coast of the peninsula presented an interesting study. The angle of rest of coarse materials does not usually exceed 35 degrees. However, the slopes along the north coast of the Gaspé Peninsula exceeded this dip generally.

The best-developed slopes were in the section of the northern coast between the villages of Mont St. Pierre and Rivière Madeliene. Through this section, the towering cliffs of the Ordovician limestones, shale and sandstones, attaining altitudes of more than 300 feet, rise abruptly from the highway bordering the St. Lawrence River. The talus slopes at the base of these cliffs have angles of slope from 36 to 40 degrees. The lesser angle was only encountered once, all other slopes ranged in dip from 38 to 40 degrees.

The material comprising the slopes was for the most part made up of angular, elongated calcareous slate fragments. They were sufficiently stable so that the slopes could be walked upon, with but little disturbance of the material comprising them.

At Cap Gros Morue, fifteen miles west of Rivière Madeliene, the slope assumed an angle of repose of 36 degrees. This particular slope was limited to about 20 yards along the road. Immediately adjoining this part, the slope increased to 38 degrees. In both instances the height of the slope was approximately 70 feet. A hundred yards east, the slope displayed had an angle of 40 degrees and a height of 150 feet. This particular slope was exceedingly firm. Walking across its surface, very little material was disturbed, other than that on the immediate surface. The talus consisted in the main of particles of calcareous shale with slate, ranging in size from ½ inch to 5 inches in length with the intermediate sizes, 1 to 3 inches, predominating.

Two hundred yards west of Cap Gros Morue, the slope measured 39 degrees and the same characteristics prevailed as at those noted farther to the east. About 200 yards west of Mont St. Pierre, a talus slope borders the road for 400 yards and rises 175 feet above it. The angle of rest here was 39 degrees. Readings were taken at several points over the surface of the slope and carefully checked.

Other slopes were studied along the face of the cliffs on the northern coast and all were found to have angles of repose of 38 to 39 degrees, including the smaller slopes. The locations of the smaller slopes are not given here, as the most significant portion of the northern coast, in as far as the talus slopes are concerned, has been described.

It seems singular that an area in which so many talus slopes occur should contain so many with an unusually high angle of rest; also the absence of slides in an area of this nature commands attention.

A close examination of the slopes disclosed the fact that each fragment, resting with its long axes parallel to the dip of the slope, was overlapped by the preceding one forming an end drag on each piece. The arrangement was so orderly that, viewed as a whole, it gave the appearance of having been laid by hand. The enechelon arrangement of the fragments and the elongated manner in which the rock weathers apparently accounts for the compactness and rigidity of the slopes.

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FURTHER EVIDENCE ON THE AMAZING LONGEVITY OF BACTERIA

IN 1931[1] I published an account of experiments which demonstrated the existence of living bacteria in anthracite coal from Wales and from Pennsylvania. Shortly thereafter[2] there appeared an article by the distinguished German bacteriologist, R. Lieske, in which results of similar studies by him (antedating mine but unknown to me when my work was in progress) give complete concordance with my results and important supplementary data besides. Lieske and I differ only in regard to the explanation of how the bacteria have survived in the coal for untold ages. He believes that the coal bacteria carry on a weakly vegetative existence there, whereas I believe that they exist in a resting stage in the coal and either do not respire at all or only with extreme slowness. I still believe that my hypothesis is correct. But the purpose of this note is not to discuss hypotheses which I shall treat more adequately elsewhere, but to call attention to a great mass of additional experimental data which I have obtained by another method of attack on the problem of longevity of bacteria. Since it may be some time before my extensive data on these newer studies can be published I give a few of the results herewith.

One of the objections made to my work on anthracite coal and on other ancient rocks is that the small numbers of bacteria which I found in such materials always suggest the question of possible invaders or contaminants. I have, I think, shown this criticism to be invalid, but to strengthen my position and render more plausible my contention respecting the

1 *Jour. Bact.*, 22: 3, September, 1931.
2 *Biochem. Zeitsch.*, 250: 1–6, July, 1932.

longevity of bacterial spores or other resting stages of bacteria I have been carrying on studies of historic and prehistoric materials whose age is reasonably well known and in which large numbers of bacteria might be expected. I started with soils which had been kept in sealed bottles for 25 and 33 years, respectively, and then continued with subsoils which had been in bottles unopened for 65 years. In all these samples living bacteria are very numerous and in great variety and all the soils contained either single-celled green or blue-green algae or both in vigorous condition. I then proceeded to a study of adobe bricks taken from the interior of thick walls in the California missions from structures 112 to 150 years old. All these contained enormous numbers of living bacteria, and the youngest of them also showed single-celled green algae. Following these materials, I turned to some of the Arizona pueblos whose age is definitely known to be no less than 600 years old. From material in the heart of the pueblo walls I isolated many forms of bacteria, and the total numbers, while smaller than those in the mission bricks, are still very high. I proceeded next to examine respectively adobe bricks from pre-Inca pyramids near Lima, Peru, specially collected for me from the interior of the pyramid, and adobe bricks from pre-Aztec pyramids in Mexico, also collected expressly for me under special instructions. The age of the former is estimated by archeologists to be between 1,000 and 1,400 years and that of the latter no less than 800 to 1,000 years. In both of these adobe materials bacteria, while not as plentiful as in fresh soil, are still very numerous and comprise a great variety of forms which grow on "selective" media. Space is too limited in this note to permit of giving the detailed technique employed in these experiments, which will be described elsewhere, but attention is called to the remarkable longevity of both bacteria and of simple algae as they appear, respectively, in these experiments. I may add also that some of the mission walls have been protected from water during all their history, and all my specimens, whether from protected walls or not, are found to be extremely desiccated for the reason that they come from the heart of the wall to which water does not penetrate, as examinations at the end of the rainy season clearly attest.

Many still older materials than those described will be investigated and reported upon later.

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A POSSIBLE CAUSE OF OLD AGE

HEAVY water has a higher boiling point (101.42° C.) than ordinary water. Heavy water also inhibits the growth of seedlings, which seems to indicate that it has an inhibitory effect upon the normal functioning of the protoplasm. As the human body evaporates a large proportion of its water intake, it will in the course of years become enriched with heavy water. This increase in the proportion of heavy water in the body fluids may account for the increasing inhibitory action of the protoplasm during senility.

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REPORTS

RESEARCH IN THE YALE GRADUATE SCHOOL

SEVENTY-FOUR research projects have been undertaken by students already holding the degree of doctor of philosophy or its equivalent, who are enrolled in the Yale Graduate School as research fellows. Nine countries are represented in this group, including England, Germany, Canada, Belgium, China, Czechoslovakia, New Zealand, Norway and the United States. These men and women have been trained for their research at sixty different colleges and universities, and while most of them are working either in the Sterling Memorial Library or the laboratories of the university, some are working in places so remote as the Bishop Museum in Honolulu, the Yale Anthropoid Experiment Station in Orange Park, Fla., the Navajo and Shawnee Indian Reservations and the British Museum.

In addition to the faculty, library and laboratory facilities put at the disposal of research workers, a number of research fellowships to assist this group of scholars have been established. This year forty-one research fellowships with stipends were awarded. In addition, twenty honorary research fellows have been appointed without stipend. Another group of fellows has been sent to work at Yale by educational foundations, including the National Research Council, the Rockefeller Foundation, the American Council of Learned Societies, the Commission for Relief in Belgium, the Commonwealth Fund and the Alumni Association of former German Exchange Fellows.

Fifty-two of the seventy-four fellows are carrying on scientific work, while twenty-two are studying languages, philosophy and the social sciences. Chemistry has the largest group with seventeen working at the Sterling Chemistry Laboratory and five in the lab-