to which $4–5 \times 10^6$ tons of natural crude produced in Roumania, occupied Poland, Austria and Germany have to be added. In other words, the 1.8×10^7 tons of liquid fuel which could be produced from the present sugar-cane production in Hawaii, Puerto Rico, Philippine Islands and Cuba are 80 per cent. higher than Germany produces in her synthetic oil plants, in which certainly more than $2,000,000,000 have been invested. Continental U.S.A. produces now 2.2×10^8 tons of crude oil.

That hydrogenation of coal with the Bergius-I. G. process and of carbon monoxide with the Fischer-Tropsch process is carried out on a large scale in Germany (10,000,000 tons per year) is not perfect proof that these processes under the present conditions is the only way to end the oil shortage for this and other countries. Great Britain has not enlarged her Billingham coal hydrogenation plant, with about 150,000 tons of oil products per year.[9] Hydrogenation of coal and carbon monoxide can not be carried out without large government subsidies (6.65 cents per gallon on home-produced petrol in Great Britain).

Any synthetic method whatsoever must produce liquid and solid fuels at prices higher than the very low present prices of natural oil and bituminous coals in this country. Farish[10] and Williams[11] gave data from which the high price of coal hydrogenation products can be seen (22.6 cents per gallon for gasoline with coal hydrogenation,[10] 24.4 cents per gallon with carbon monoxide hydrogenation from coke,[11] 19.2 cents from bituminous coal,[10] 18.2 cents from subbituminus coal,[11] 18.2 cents[11] and 8.8 cents[10] respectively from natural gas). Direct costs per gallon of gasoline are 15.9 cents for coal hydrogenation[10] and 14.7 cents for carbon monoxide hydrogenation.[10] 6.7 and 4.5 cents per gallon, respectively, have to be spent for 10 per cent. depreciation. The production of liquid and semi-liquid fuels from plant material, especially in tropical and subtropical countries, or where practically valueless wastes result, can be made at rather low prices provided the transportation problem does not offer special difficulties.

This plant conversion process has the great advantage that it does not touch the materials underground. In this and other countries the farmer must produce more raw materials for industrial purposes. In smaller installations, plant material could be converted into the fuel which is necessary for his tractors and for heating his home. This can not be done by the coal hydrogenation which, according to our present knowledge, must be carried out in large and very costly installations.

The plant conversion process puts liquid fuel at the disposition of practically all civilized nations. Any country which is not blessed with natural oil and which has or can develop an adequate agricultural or forest production can now produce an important part of its liquid fuel needs.

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[9] W. A. Bone and G. W. Himus, Coal, Its Constitution and Uses, 1936, p. 556.

[10] W. S. Farish, Committee on Mines and Mining, House of Representatives, July 15, 1942.

[11] J. P. Williams, Subcommittee on War Minerals of the Committee on Public Lands and Surveys, U. S. Senate, August 6, 1943 (Pittsburgh).

OBITUARY

MEMORIAL TO FRANK LEVERETT

ON November 15, 1943, after an illness of only a few weeks, Frank Leverett passed away at his home, 1724 South University Avenue in Ann Arbor, Michigan, at the age of 84 years. Until the time of his last illness he was active in researches dealing with glacial geology, a field in which he had gained a most enviable and world-wide reputation.

Frank Leverett was born at Denmark, Iowa, on March 10, 1859, the son of Ebenezer Turner Leverett and Rowena (Houston) Leverett. He was descended from a line of ancestors that emigrated from Boston, England, to Boston, Massachusetts, in 1663.

Upon completion of his academic training in Denmark Academy, Leverett taught in the public schools during 1878–1879. For three years following, until 1883, he served as instructor in natural sciences at Denmark Academy. It was in this position, while conducting field excursions with his classes, that he first became interested in the study of geology. In the fall of 1883 he entered Colorado College, where he took courses in mineralogy and assaying. In 1884 he enrolled in Iowa State College of Agriculture and Mechanic Arts and was graduated from that institution with a degree of bachelor of science in 1885.

Following his graduation from Iowa State College, Leverett journeyed on foot to Madison, Wisconsin, to confer with T. C. Chamberlain, then president of the university, concerning the possibility of obtaining a job on the U. S. Geological Survey. Being director of the Division of Glacial Geology in the Federal Survey, Chamberlin made an opening for young Leverett and assigned him to a temporary job as field assistant in glacial geology. Inspired by this opportunity to engage in a field of work which seemed to satisfy completely his cravings for scientific adventure, Leverett

gave such a good account of himself that he was continued as an assistant until 1890, when he was appointed to the position of assistant geologist on the Survey. In 1901 he was advanced to geologist and in 1928 to senior geologist, a position which he held until his retirement in 1929.

During his forty-three years of continuous service with the U. S. Geological Survey, Leverett's achievements in the field of glacial studies gained for him world-wide recognition as one of the leading authorities on Pleistocene glaciation. He was an indefatigable investigator and never ceased to take a wholehearted and genuine interest in the problems connected with that field of science.

Leverett spent the year 1908 in Europe, where he became personally acquainted with many of the leading glacialists on the continent. His numerous excursions into the glaciated tracts abroad gave him an opportunity to draw comparisons between the glacial deposits of Europe and those of North America which, through a long period of years, he had covered so thoroughly on foot or by means of horse and buggy.

Frank Leverett was twice married. His first wife was Frances E. Gibson, whom he married in 1887. In 1895, several years after her death, he was married to Dorothy C., daughter of Russell and Dorothea (Schmidt) Park, who survives him. There were no children by either marriage.

For a period of twenty years, from 1909 to 1929, Leverett served as a special lecturer in glacial geology on the staff of the University of Michigan. He was a skilful and resourceful teacher, greatly beloved by his students. He drew freely upon his great wealth of knowledge gained from personal experience and was able to make the subject of glaciation a most attractive study. He took great interest in his students, old and young alike, and never grew tired explaining over and over again perplexing problems that to him were nothing more than simple principles, so well did he know them. Following his retirement from active service with the U. S. Geological Survey, the University of Michigan conferred upon him the honorary degree of doctor of science in 1930.

Leverett was elected a fellow of the Geological Society of America in 1891, the year after its founding. In 1910 he served as the second president of the Michigan Academy of Science, Arts and Letters and subsequently contributed many valuable papers during his long membership in that organization. He was honored with election to membership in the American Philosophical Society in 1924. He was a fellow of the American Association for the Advancement of Science and served as its vice-president during 1928. In 1939 he was elected to membership in the National Academy of Sciences. He was a member also of the Science Academies of Iowa, Wisconsin and Washington (D. C.), the Forestry Association, the Geophysical Union, and served as a corresponding member of the National Geographic Society. He held memberships in the honorary fraternities of Phi Kappa Phi and Sigma Xi.

Frank Leverett was a prolific writer. His bibliography lists some 170 titles in the form of reports, water supply papers, bulletins, monographs, professional papers and miscellaneous papers published in the period between 1889 and 1943. The greater part of these pertain to problems in Pleistocene geology and water resources. Outstanding as a classic is his Monograph 53 (with Frank B. Taylor), "The Pleistocene of Indiana and Michigan and the History of the Great Lakes," published by the U. S. Geological Survey in 1916.

Leverett spent a lifetime doing a big job well. His critical interpretations of natural phenomena and his masterful portrayal in writing of his observations marked him as a truly great scientist. He learned his facts first hand and spared no effort in making certain that he understood the meaning of the features he observed before he translated them into his published writings. He considered his work in the field of glacial geology as merely an open door to a vast multitude of problems that should engage the efforts of glacialists for generations to come.

Leverett's private study in his home in Ann Arbor was an open classroom to an almost endless procession of geologists who sought his expert advice and counsel. He seemed to have a peculiar personal concern for the younger geologists and would spend hours assisting them with their problems. He took special delight in recounting the highlights of his personal travels and experiences.

A great scientist, a masterful teacher, but in all a modest man of remarkable wisdom, Frank Leverett will be remembered by all who knew him for his great love of glacial geology. His works will stand as an enduring monument to a lifetime of purposeful achievement.

STANARD G. BERGQUIST
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DEATHS AND MEMORIALS

JESSE PAWLING, from 1925 to 1935 associate astronomer at the U. S. Naval Observatory in Washington, D. C., died on April 11 at the age of seventy-eight years. Mr. Pawling graduated from Cornell University in 1893 and after several years of graduate work in other universities and teaching physics in Philadelphia, he went to the Naval Observatory in 1905, where for thirty years he worked on positional astronomy.

WILLIAM TITUS HORNE, professor of plant pathol-