The appropriation of $250 for the beginning of an experiment station has, under advice, been carefully husbanded by me after the failure of the appropriations asked of the last legislature, in order to insure the continuation of the home work.

Fortunately the legislature of 1877 gave him $5,000 for two years and the legislature of 1879 gave $5,000 a year for two years, of which he says, in his report for 1880, "it barely enables us to pay running expenses, and farther improvement and increase of scope will be impossible"; for he then had half a dozen field and laboratory assistants to provide for. At the same time, however, that his local patrons and employers were wondering how Hilgard could use $2,500 for expense money, the United States gave him not less than $25,000 to spend in his cotton work.

The stand taken by Hilgard with reference to the dignity and pedagogical value of agricultural science, while so many institutions, now great, were in their formative periods, was recognized as sound throughout this country and beyond. Set forth in his early reports, it exercised a profound influence. The proper relation of agricultural practise to agricultural science, as factors in educational effort; the educational distinction between labor performed for enlightenment and labor prescribed to beget a liking for labor; the place of both the art and science of agriculture in a university of higher learning, when both are handled ably for instructional purpose—these were among his fundamental contentions, upholding them through many controversies, and his victory is seen in their entry into the regular curricula of all of the newer institutions of learning and their pursuit by older institutions established upon other standards of learning before the existence of these educational factors was dreamed of as worthy and capable.

Hilgard's strategic diversion of 1879 to 1883 was one of the brightest and most effective movements of his career. On the basis of his work in Mississippi he was requested by the director of the census of 1880 to take full charge of the cotton investigations for that census and to do something greater for the cotton industry than was ever done before and he was promised funds for inquiry, investigation, laboratory work and whatever else he deemed necessary to get at the fundamental facts and principles connected with cotton growing in the United States. He reviewed the subject as a whole and in divisions, studied each cotton state and finally, after four years of work, produced in two volumes his report upon the cotton industry of the United States, a lasting benefit to all cotton-producing states. This report, in two quarto volumes, was a force in engrafting original research upon the instructional work, established through the educational land-grant law of Morrill, by the enactment of the Hatch law for state experiment stations in all states.

The results of Hilgard's labors are in the warp of California's first half-century of intellectual and industrial life. He was quick to see his opportunities for public service, to recognize his duty therein and he was masterful and tireless in pursuit of it. He was bold in conquest of truth and fearless in his use of it for the interest of mankind, seizing gladly the smallest fact from research and pressing it to the humblest service but always perceiving and enforcing the relations of both the fact and the service to the broadest interests of his states and of his fellow men. Thus all came to know him as richly wise, unswervingly true, and deeply patriotic and humanistic—a man whose thinking was as clear and whose motives were as unselfish as his service of them was forceful and effective.

E. J. Wickson
University of California

THE SCIENTIFIC WORK OF EUGENE WOLDEMAR HILGARD

Eugene W. Hilgard accepted the position of assistant state geologist of Mississippi in 1855, at the age of twenty-two, but was well equipped for scientific investigations of any kind. He had spent his early boyhood days on a farm, giving his spare hours to the reading of standard works on chemistry and botany and in making collections of plants and insects; then in later years had completed his

scientific training at Heidelberg, Zurich and Freiberg, taking for his graduating thesis the candle flame, in which he was the first to define four parts and to give the chemical processes in each. Thus well trained in the natural sciences, especially in physics, chemistry, botany and geology, with a keen mind, quick and accurate in his observations, and with a remarkable memory, he entered upon the work of the survey with enthusiasm, although the field seemed very unpromising from a geologist's standpoint. He traveled over the state with the state geologist, making observations and collecting material for study. The state geologist, however, failed to make a satisfactory report to the legislature and the survey was suspended, Hilgard returning to Washington as chemist in the laboratory of the Smithsonian Institution and lecturer on chemistry in the National Medical College. In 1858 he was appointed state geologist of Mississippi and resumed his detailed investigations of the geology, botany and agriculture of the state.

One of the chief characteristics in Professor Hilgard's nature was the extreme care, accuracy and attention to detail that he gave to everything he undertook. This is strongly shown in the results of the Mississippi survey, which will ever stand as a tribute to his high standing as a geologist.

Mississippi, because of its large proportion of virgin soils, seems to have been especially well adapted for researches in soil character; and in his geological survey of the state, Hilgard was quick to note the sharply outlined differences in the native tree and plant growth on the several types of soil, and especially the differences in behavior and durability of soils under continued cultivation. He therefore determined to make these the subject of special study in order that the farmers themselves might gain some benefit from the survey. Thus were begun those studies of the chemical, physical and other properties of soils that became his life work, and which, reaching out into other states and other countries, have brought to him honor and renown over the entire civilized world. In 1860 was printed his report on the Geology and Agriculture of Mississippi, a volume of 391 pages in which were given in detail his observations on the geological and agricultural features of the state with chemical analyses of many of the soils. The geological map which accompanied the report also presented the soil divisions which closely followed the geologic changes.

During the civil war Hilgard was placed in charge of the buildings and equipment of the University of Mississippi by the governor, and when its faculty was reorganized at the close of the war he was made professor of chemistry, which title was in 1871 changed to that of professor of experimental and agricultural chemistry; but though relinquishing the position of state geologist to others he continued his interest in the further study of the geology of the state, and of the other southern states. In 1867, at the request of the Smithsonian Institution he made an examination of the Mississippi River delta, the rock salt deposit of Petite Anse Island, and the cause of the formation of the mud-lumps in the passes of the river; and later a geological reconnaissance of Louisiana for the New Orleans Academy of Sciences. The results and discussions of these examinations are published in a number of reports and papers.

Professor E. A. Smith, state geologist of Alabama, says of Professor Hilgard's geological work in Mississippi and Louisiana:

> When in 1855 Dr. Hilgard accepted the position of assistant geologist of Mississippi there began the career of the most distinguished worker in Gulf Coastal Plain Geology, and the fame which he won for himself in this "uninteresting" field is known to all geologists. He has laid the foundation on which most subsequent work in the "Mississippi Embayment," as he named it, securely rests, and after the lapse of more than fifty years since the publication of his report in 1860 his work is appreciated and referred to as authoritative not only by the farmers and other citizens of that state, but by the geologists who have succeeded him.
>
> In the excursions down the Mississippi River and through Louisiana the post-Pliocene of the Port Hudson "stump stratum," and by inference

at least its extension from the Sabine River to Mobile Bay were definitely determined, and the Coast Pliocene of the 1860 map was changed to Port Hudson. The results of these expeditions may be summarized as follows:

1. The outlining of the Mississippi Embayment in Louisiana and Mississippi.

2. The outline geological study and mapping of these two states. He was the first to give a clear and definite account of the origin and distribution of the surface formation which he called the Orange Sand, now known as Lafayette. He was the first to give a definite account of the great series of river and estuarine deposits, "the Grand Gulf," representing all geological time between the Vicksburg and the Lafayette.

3. The recognition of the Cretaceous Ridge, or the backbone of Louisiana, and the determination of the Cretaceous age of the rock-salt and sulphur deposits of Calcasieu parish.

4. The study of the exceptional features of the Lower Mississippi delta and of the mud-lumps and the definite correlation of the Port Hudson formation.

Probably no work has done more for the correlation of the scattered accounts of the geology of the southern states than the Cotton Culture Reports of the Tenth Census prepared under the direction of Dr. Hilgard. In these a summary of the physical and geological features of each state is first given. Then follow accounts of the agricultural features and capabilities of the cotton states, such as would be of interest to immigrants and investors, along with special descriptions of each county, with soil maps and many soil analyses; altogether the reports are reliable handbooks of the cotton states as regards general and agricultural information, and deserve to be more widely known than they are.

On coming to California in 1875 as professor of agriculture in the state university, Hilgard entered upon his greatest field of activity; and from the very beginning, when he laid the strong foundation for the college of agriculture and experiment station of the University of California to the later years when he witnessed the immense results of his labor, he displayed the same remarkable energy, indomitable will and perseverance as well as the hearty comradeship and readiness to help that characterized his work in Mississippi and which gained for him hosts of friends and supporters. He was always ready to give freely of that great and varied store of information of which he was possessed.

Among his California activities there stand out most prominently his studies on humid and arid soils, and especially his researches into the cause, occurrence and effect of alkali salts upon vegetation, and the methods to be used in neutralization and reclaiming alkali land. He was the first to enter upon this field of study, the results of which have been extensively quoted and his bulletins published in other countries where alkali lands exist.

His report on cotton production and the soil regions and soil characteristics of the cotton-producing states, made for the Tenth U. S. Census and comprising two large quarto volumes is a highly valuable work; and his book of about 600 pages on "Soils" is also the highest authority on arid and humid soils.

The mind and hand of Hilgard were never idle, and while engaged in solving old problems in relation to soil fertility and plant life he was ever on the alert for new ones. The results of his activity are shown in the hundreds of published articles in the station reports, outside journals, both foreign and domestic, government publications, etc. During the thirty-five years of active service in the University of California he allowed himself but one vacation of a year and that was spent abroad. A few weeks were given to a survey along the northern transcontinental railroad and a few weeks to a visit to his Mississippi geological locations.

While Hilgard was not the first to make a soil survey and chemical analyses of soils he was the first to interpret the results in their relation to soil durability, fertility and crop production. He was the first to maintain that the physical qualities and chemical characters of a soil go hand in hand in determining its cultural value and he maintained that the complex character of a soil demanded an investigation into its chemical, physical, mineral and biological characters if we would understand it fully. His broad and thorough scientific knowledge, his great work on soils and his valuable publications brought him

many honors, among them the degree of LL.D. from the universities of Mississippi, Michigan, Columbia and California; the Liebig gold medal from Munich, and others from the expositions of Paris, Rio de Janeiro and St. Louis, as well as the offer of Assistant Secretary of Agriculture from President Harrison.

Although much reduced in vitality during the last three years of his life as the result of an injury, his interest and desire for service in the cause of agriculture were keen and virile, and his great regret, daily expressed to the last, lay in his inability to further pursue his studies of soil and other problems.

R. H. LOUGHRIDGE
UNIVERSITY OF CALIFORNIA

THE INDUSTRIAL FELLOWSHIPS OF THE MELLON INSTITUTE

SOME of the important recent events in connection with the operation of the practical system of cooperation between science and industry at the Mellon Institute of Industrial Research of the University of Pittsburgh, have been reported during the past year in this journal. I allude especially to the dedication of the permanent building of the institute,[1] the establishment of a school of chemistry at the University of Pittsburgh,[2] and the inauguration of Professor M. A. Rosanoff as head of the department of research in pure chemistry of the Mellon Institute.[3] In addition, there has been occasion to communicate elsewhere accounts of the graduate school of specific industries of the Mellon Institute[4] and a discussion of the principles involved in the administration of endowed industrial research laboratories.[5] However, almost two years have elapsed since the last report was made to SCIENCE[6] on the status of the system of industrial fellowships initiated by the late Dr. Robert Kennedy Duncan at the University of Kansas and later, on September 1, 1911, transferred to the University of Pittsburgh.

The progressive growth in both the number of industrial fellowships in operation and in the amounts subscribed for their maintenance, is shown in the following table.

Academic Year	Number of Fellowships in Operation	Number of Fellows	Amounts Subscribed for the Maintenance of Fellowships
1911–12.....	11	23	$39,700
1912–13.....	16	30	53,500
1913–14..	15	29	59,100
1914–15.....	24	42	74,350

It is of interest to note that when the industrial fellowship system passed out of its experimental stage—when the Mellon Institute moved into its permanent home in February, 1915—twenty-three fellowships were in operation. At the present time (March 1, 1916) there are thirty-six fellowships and two additional ones have recently been arranged for, to begin later in the year. Sixty-three industrial fellows are engaged on the fellowships now in operation. The growth of the institute has about reached the stage where we shall be obliged to decline further industrial investigations for the present, since our laboratories are almost filled up to capacity.

A LIST OF THE INDUSTRIAL FELLOWSHIPS IN OPERATION AT THE MELLON INSTITUTE ON JANUARY 1, 1916

No. 19: Aluminum.—$5,000 a year for two years; $5,000 a year for the third year. Bonus: $10,000. Fellows: Lester A. Pratt, Ph.D. (University of Pittsburgh); Hugh Clark, Ph.D. (University of Pittsburgh); F. D. Shumaker, B.S. (University of Pittsburgh). (June 1, 1913.)

No. 28: Fertilizer.—$2,500 a year for three years. Bonus: $5,000. Fellow: Earl S. Bishop, M.A. (University of Nebraska). (January 5, 1914.)

[1] Hamor, SCIENCE, N. S., 41 (1915), 418. See also Hamor, *J. Ind. Eng. Chem.*, 7, 326; *Met. Chem. Eng.*, 13, 266, and *Eng. Min. J.*, 99, 480.

[2] SCIENCE, N. S., 42 (1915), 491. See also *Met. Chem. Eng.*, 13, 782; *J. Ind. Eng. Chem.*, 7, 1,002, and *Univ. Pgh. Bull.*, 11, No. 23.

[3] Hamor, SCIENCE, N. S., 42 (1915), 636. See also Bogert, *ibid.*, 737.

[4] Bacon, *J. Ind. Eng. Chem.*, 7, 343; *J. Frank. Inst.*, November, 1914, 624.

[5] *J. Soc. Chem. Ind.*, 35 (1916), 18–27.

[6] Duncan, SCIENCE, 39 (1914), 672.