EUGENE WOLDEMAR HILGARD AND HIS CONTRIBUTIONS TO SCIENTIFIC AGRICULTURE AND AGRICULTURAL EDUCATION IN AMERICA

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PREFACE

This thesis is concerned with the examination and illustration of the contributions of Eugene W. Hilgard to the development of scientific agriculture and agricultural education in America. Hilgard was one of a select group of individuals in the last half of the nineteenth century who gave voice and direction to the embryonic programs which have matured into our present agricultural system.

The author wishes to express his appreciation and acknowledge his debt of gratitude to his major thesis adviser, Professor Alexander M. Ospovat, not only for his patient guidance and assistance throughout the study, but also for opening up a new and rewarding field of study in the history of science. Appreciation is also extended to other committee members, in particular, Professor Norbert R. Mahnken, for his perseverance in proof-reading the manuscript and for his valuable comments and suggestions on ways to improve it, and to Dr. Homer L. Knight and Dr. Robert M. Spaulding for their invaluable assistance.

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CHAPTER I

INTRODUCTION

Since about 1840 developments in the science of agriculture have produced a major revolution in that industry. In 1840, Justus Liebig, the great German chemist, put forth his famous work Chemistry Applied to Agriculture. This treatise did much to usher in a new era in the history of agriculture which might be labeled the age of scientific agriculture. Since Liebig, agriculture in America has undergone significant changes based on his principles. Land-grant colleges, established under the Morrill Act, have become centers of training and education for agricultural scientists, managers, and educators. These colleges, in conjunction with their experiment stations, and county, state and federal extension services, form the nucleus of agricultural research and development on a nationwide scale.

As an aid to the further development of scientific agriculture in America, the United States Department of Agriculture was established in 1862. Since then it has grown into a vast and diversified bureau which controls and supervises much of the nation's farming interests. The federal bureau along with state bureas, working in conjunction with the land-grant colleges, provide a vast network of services pertinent to the continued development of scientific agriculture in America. A few of the more important services provided by these organizations include: soil analysis, seed improvement and distribution, insect

and pest control, fertilizer quality control, crop allotment, methods of culture, and irrigation information. All phases of agriculture such as horticulture, agronomy, viticulture, forestry, dairy, etc. have come under their aegis.

The evolution of such a vast and comprehensive scientific agricultural system in the United States is largely indebted to the far-sighted efforts of several chemists of the nineteenth century. These chemists came from the ranks of American scientists who had received their education in European centers of education.[1] They were able to superimpose the theories of Liebig on the agricultural scene in the United States by operating within the framework of the Morrill act and the Hatch act.[2]

The task of persuading Americans, however, to use scientific principles in their agricultural practices proved to be a most difficult one indeed. The major obstacle in the path of progress was the obstinate and recalcitrant nature of the farming population itself. These people were generally suspicious of science and its principles as applied to agriculture, and often held nothing but contempt for men of learning. In the southwestern part of the United States, the farmers' policy was "more cotton, more land, more negroes, and more cotton," and to hell with soil conservation and science![3]

Indeed, progress toward establishing scientific agriculture in

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[1]A. Hunter Dupree, Science in the Federal Government: A History of Policies and Activities to 1940 (Cambridge, Mass., 1957), p. 149.

[2]The Hatch act was passed on March 2, 1887 and provided funding for the college experiment stations.

[3]E. W. Hilgard, "Rational Agriculture," The Southern Ruralist (May 25, 1866).

America during the latter half of the nineteenth century depended largely on a change of opinion among farmers in regard to their attitudes concerning science. Several methods were recognized as providing the means of altering the negative attitudes of the traditional agriculturalists in America. The most obvious and direct means was the attempt to enlighten the farming population as to the merits of scientific agriculture by a thorough dissemination of literature expounding the principles of the new science. Illustrating this type of approach was the rapid growth of agricultural periodicals, magazines and newspapers during the latter half of the nineteenth century. Yet, there were drawbacks to this method for many farmers could not read and of those who were literate only a few were sufficiently educated to comprehend the principles which were being promulgated.

Some of the early agricultural science pioneers believed that advances in the new science alone would do much to illustrate its utility and thus would be welcomed and approved by the rural society of America. Others, however, did not see how isolated research, however successful, could be adopted by farmers who were on the whole unknowledgeable even in the basic principles of the new science. Indeed, only a few realized that if agricultural science was to grow and develop in America it would have to win the confidence and support of the public by serving its vested interests, that is, agricultural science would have to demonstrate its capacity to solve everyday practical problems. Yet, the agricultural science pioneer who realized the correctness of this procedure faced a number of long range problems. For example, how were the principles of agricultural science to be broadly applied to the agricultural scene in America?

Most agriculturalists and educators who were at this time operating within the framework of the Morrill act, saw the solution to this problem in the spreading of a thin veneer of agricultural knowledge among rural society by organizing the colleges of agriculture to educate the masses. Yet, in endeavoring to educate the many, the standards of education had to be lowered to the extent that instruction was confined to the basic fundamentals of plowing, hoeing, and pig feeding. As a result of this theory of education, many of the newly formed agricultural colleges became mere vocational institutes where students received disciplinary training based on uninstructive labor. This program of instruction did little to promote progress in agricultural science, but it was thought to be the correct procedure since it was condoned by society. Consequently, large numbers of students enrolled in this type of college and the schools which favored instruction in uninstructive labor became known as universities based on the "popular plan."

Opposing the so-called "popular plan" of agricultural education were a number of individuals who felt that the basis of agricultural study should be in the scientific and technological areas. Only a few of the more astute scientists and educators favored this plan, and since it was not supported by the public only a few students enrolled in colleges which featured this plan. But despite the small attendance at their colleges, these farsighted and innovative educators continued to believe that their methods were the proper ones which would ultimately bring about constructive change in American agriculture. They knew that the few graduates they turned out would serve as leaders, managers, and educators of the next generation. It would,

then, be through this small elite class of future agriculturalists that the desired transition to scientific agriculture in America would ultimately be realized. Thus, undaunted by the continued low enrollment in their classes and the constant criticism by the public, these educators continued to carry on their programs which finally resulted in transplanting the theories of Liebig on the face of American agriculture.

Foremost in this struggle to superimpose Liebig's theories on American agriculture was Eugene Woldemar Hilgard. Of the early pioneers in this revolutionary movement which took place in the latter part of the nineteenth century, it is, perhaps, Hilgard, more than anyone else, who helped not only to bring about a more favorable climate of opinion regarding the importance of scientific agriculture, but also to bring innovative approaches to agricultural education. In this regard his major contributions to the development of scientific agriculture in America lie in giving voice and direction to the embryonic programs which have matured into today's agricultural system and in preparing a fertile and receptive environment in which these programs could grow.[4]

Whether in his capacity as State Geologist of Mississippi, Professor of Chemistry at the University of Mississippi, or Professor of Agriculture and Director of Experiment Stations at the University of California, Hilgard consistently employed his talents to promote the interests of scientific agriculture. Newspapers, magazines, journals,

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[4]A. C. True, "A History of Agricultural Education in the United States, 1785-1925," U. S. Department of Agriculture, Misc. Pub. No. 36 (Washington, 1929), p. 259.

speeches, and personal letters were the means by which he carried his campaign to the people. State fairs, legislative sessions, conventions, public and private meetings, classrooms and research laboratories were the arenas in which he fought for the interests of scientific agriculture.

But what forces compelled Hilgard to take up the crusade in behalf of scientific agriculture in the first place? His motivation in this matter was based on a philosophy that the continuing strength and prosperity of the nation depended upon a modern agricultural program based on scientific methods. Traditional methods of agriculture, as Hilgard had observed, were "ruinous and exhaustive" to the fertility of the soil. And, according to Hilgard's world view, the depletion of the soil's fertility would precipitate a corresponding loss of population.[5] The problem most urgently facing America was the conservation of its soil's fertility. Yet, in order to stop the conspicuous waste of this vital natural resource, the farmers had to be somehow persuaded to adopt more rational methods of agriculture.[6] Throughout his long career he followed two systematic approaches in order to solve this problem.

Beginning in 1858 and continuing until approximately 1872, he concentrated on a program to enlighten the farming population of the South in the methods of rational agriculture. His program consisted of writing magazine and newspaper articles and special reports on the

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[5]E. W. Hilgard, Address on Progressive Agriculture and Industrial Education (Jackson, Miss., 1874), p. 1.

[6]The use of the terms rational and progressive agriculture is intended to be synonymous with the term scientific agriculture.

subject of rational agriculture. However, by 1872, he realized that his efforts to bring about reform among the masses were quite futile. He traced his failure to the attitudes of the farmers which were apathetic and sometimes even hostile toward the principles of the new science.[7] The farmers felt that the principles of rational agriculture were far too troublesome. This was logical since America at this time was still a land of many frontiers and the pioneer farmers were often too busy clearing new lands or managing what they held to be bothered by new methods of agriculture.

In light of this seemingly incorrigible attitude among the farming populace, Hilgard, as early as 1871, shifted his approach toward building an educational system in the United States where an agricultural elite could be trained. He envisioned an educational system where future leaders, scientists, managers, and teachers could be produced. Individuals graduating from the agricultural colleges were to be well versed not only in the principles of scientific agriculture, but also in the liberal arts. Thus, Hilgard worked to build an agricultural educational system in which the university would serve as a center of progress from which the principles of scientific agriculture could flow outward in a radiating pattern to the very social fabric of American rural society. His role in realizing this dream will be the primary concern of this study.

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[7]A. C. True, "A History of Agricultural Education in the United States, 1785-1925," p. 163.

CHAPTER II

BIOGRAPHICAL SKETCH

Eugene Woldemar Hilgard was born on January 5, 1833 in Zweibrücken, Rhenish Bavaria. He was the youngest of a family of three boys and four girls born to Theodor Erasmus and Margaretha Pauli Hilgard. His father at the time was a jurist holding the position of Chief Justice on the Court of Appeals for the province of Zweibrücken.[1]

Eugene Hilgard came to America in 1836 when his father, who had become disenchanted with the German authorities when they superseded the Code Napoleon with the more conservative laws of the Old Regime, resigned from the Bench and migrated to America. The elder Hilgard settled his family on a farm in the vicinity of Belleville, Illinois. The community of Belleville at that time contained a small but swelling population of distinguished Germans who had fled Germany for various political reasons. Several of the Belleville residents were related to the Hilgards.[2]

Eugene Hilgard remained on the farm until he was sixteen years of age. Yet, the brief time he lived there he put to good use in preparing himself for the role he was to later play in the agricultural

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[1] E. W. Hilgard, Biographical Memoirs, University of California, Berkeley, Archives, The Bancroft Library; hereafter cited as Memoirs. (Pages not consecutively numbered).

[2] Frederick Slate, "Eugene Woldemar Hilgard," U. S. National Academy of Science: Biographical Memoirs, IX (1919), p. 95: See also Henry Villard, Memoirs of Henry Villard (Boston, 1904), p. 4.

revolution which swept America in the last half of the nineteenth century. Under the very competent tutorship of his father,[3] he mastered the rudiments of mathematics and also learned French, Greek, Latin and English. Through his own initiative and self-instruction, however, he mastered the fundamentals of Gmellin's Handbook of Chemistry, Muller-Poullet's Textbook of Physics, and Oken's Natural History. It was, indeed, quite an achievement for someone under the age of sixteen. Yet, as Hilgard only matter-of-factly put it: "The fundamentals of these two sciences and many of their important details, were absorbed without any teaching, [and they] proved later to be of material assistance."[4]

It would be a misapprehension to assume that Hilgard was a unique product of a typical rural community in America. He was unique, but the Belleville community was not the typical rural settlement. It was composed mostly of German immigrant doctors, lawyers, professors and other professional men who had fled Germany in the 1830's for various

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[3]Theodor Erasmus Hilgard (July 7, 1790-January 29, 1873) was a noted lawyer, judge, horticulturist, and writer. He had studied at the universities of Gottingen and Heidelberg, and also at Coblenz and Paris in France. At the age of twenty-two he became advocate at the Superior Court of Trier, and later rose to the Court of Appeals at Zweibrücken. He established a large law practice and was a member of the Landrat of the Rhenish district. For twelve years beginning in 1824 he served as Justice on the Court of Appeals. Gustave Koerner in his Memoirs has described Theodor as such: "a profound and elegant jurist, an excellent mathematician, a classical scholar, familiar with the modern languages, well versed in ancient and modern literature, with a really surprising knowledge of horticulture and vine culture. . .In his dealings with others he was strictly honest and punctual, . . .He was also very exacting . . . very close in money matters. Although his nerves were finely strung he was very passionate although somewhat of an egotist." For more on Theodor see Gustave Koerner, Memoirs of Gustave Koerner, ed. T. J. McCormack (2 vols., Cedar Rapids, 1909), I, pp. 387-88.

[4]Slate, p. 98.

political reasons. It could boast of a fermenting intellectual climate which featured weekly reading circles, drama clubs, and poetry sessions.[5] Its leading citizens even founded a library which was staffed with a wide assortment of German books, the best periodicals in the English and German language, and a collection of Congressional documents.[6] It is not surprising that amid this intellectual activity Hilgard became imbued with the most recent liberal theories concerning government, philosophy, and religion.

The prevailing philosophy of the community was that mankind would experience a great uplifting sometime in the near future. In keeping with this theory of mankind's destiny, his father impressed upon him the necessity of doing utilitarian work for society. According to the elder Hilgard, it was a man's deeds in life and not his relationship to an organized church which determined his worth in society.[7] Hilgard's father further impressed upon him that his own personal value in life would be judged on the basis of his service to mankind.[8] That these principles and theories were eagerly absorbed by the younger Hilgard is evident by his desire to lead the great uplifting of humanity.[9]

Yet, as a boy on an Illinois farm, Hilgard learned things other

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[5]Gustave Koerner, Memoirs of Gustave Koerner, I, p. 458; see also Oswald Garrision Villard, "The 'Latin Peasants' of Belleville, Illinois," Journal of the Illinois State Historical Society, XXXV (1942), pp. 7-20.

[6]Gustave Koerner, I, p. 413.

[7]Hans Jenny, Eugene W. Hilgard and the Birth of Modern Soil Science (Pisa, Italy, 1961), p. 108.

[8]Ibid.

[9]Ibid.

than language, philosophy, and science; he learned also the rudiments of farming and viticulture. From his father and through close observation of nature he learned that soils are formed from the wearing down and weathering of rocks, and that soils are improved by moving them about and mixing different substances with them.[10] He also gained valuable insight into the art of wine making as a result of his father's efforts to refine a facsimile of the fine German wines.[11] Unknown to Hilgard at the time, this seemingly casual exposure to agriculture would later lead him into a vocation in which he would become famous.

However, at the age of sixteen farming did not appeal to him and with science at this time being equated with progress, Hilgard decided to make his mark in this field of endeavor. In 1848, on the advice of the family physician, he left the debilitating, malarial climate of Belleville and made his way to Washington D. C. where he could temporarily live with his oldest brother, Julius,[12] and also attend scientific lectures which were then in progress in the capital city.[13]

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[10]E. J. Wickson, "Addresses at Memorial Services in Honor of Dr. E. W. Hilgard," University of California Chronicle, XVIII (1916), pp. 166-67.

[11]Maynard A. Amerine, "Hilgard and California Viticulture," Hilgardia, XXXIII (1962), pp. 1-2; see also E. W. Hilgard, Memoirs.

[12]Julius Erasmus Hilgard (Jan. 7, 1825-May 8, 1891) was the oldest brother of Eugene W. Hilgard. He is best remembered for his career in the United States Coast Survey where he served as superintendent from 1881 to 1885. He also served as a delegate to the International convention at Paris which was convened in 1872 for the purpose of forming an International Bureau of Weights and Measures. At the Centennial Exposition in 1876 he was appointed as one of the judges on scientific apparatuses. He was a charter member of the National Academy of Science and was president of the American Association for the Advancement of Science in 1875.

[13]E. W. Hilgard, Memoirs.

Hilgard's visit to Washington in the summer of 1848 started for him a long journey which, before ending in 1855, would take him to such cities as Philadelphia, New York, Heidelberg, Zurich, Freiberg, Barcelona, Valencia, Alicante, and Carthagena, and finally back to Washington, D. C. The impetus for this long but fruitful journey originated in the city of Philadelphia where he enrolled in the Franklin Institute in the fall of 1848 to study analytical chemistry.[14]

Armed with the fundamentals of science which he acquired while still on the farm, Hilgard was able to exhibit to his mentors a remarkable and unusual talent for the sciences. His extraordinary ability did not go unnoticed by his professors. John Semple, Professor of Chemistry at the Homeopathic Institute where Hilgard enrolled to complement his studies at the Franklin Institute, promptly enlisted his services as an assistant lecturer.[15] B. D. Booth, Professor of Analytical Chemistry at the Franklin Institute, advised him to continue his studies in Europe.[16]

Hilgard arrived in Heidelberg late in the spring of 1849. Classes were already well underway and it was only after he informed Leopold Gmellin that he had already "waded clean through" the first three volumes of his Handbook of Chemistry that the famed chemist allowed him to enroll in his course at no charge.[17] Political events and revolution in the summer of 1849 closed the university and Hilgard was forced

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[14] E. W. Hilgard, Memoirs.

[15] Slate, pp. 99-100.

[16] Ibid.

[17] E. W. Hilgard, Memoirs.

to continue his studies at the University of Zurich. He remained at Zurich until the fall of 1850. Even at Zurich, Hilgard's scientific acumen impressed his mentors so much that Karl Löwig, Professor of Chemistry, made him his assistant--a position which earned him the title of "vice-professor."[18]

Political conditions in Germany stabilized to the extent that Hilgard could return in 1850 and he subsequently enrolled in the famous Mining Academy at Freiberg, Saxony. At Freiberg he used the school year of 1850-1851 to study the principles of mining engineering and geology. Poor health, induced by the steady inhalation of poisonous gases at a smelter plant, compelled the eager scholar to seek respite in more favorable conditions. His forced departure from Freiberg coincided with the appointment of Robert von Bunsen to the position of Head of the Chemistry Department at Heidelberg University. Thus, in the fall of 1851, Hilgard enrolled once again in the University of Heidelberg where he subsequently took his Doctor of Philosophy degree in chemistry in 1853.[19]

Although Hilgard earned his degree in chemistry, he was not narrow in his approach to science. He had initially studied mineralogy, chemistry, and medicine during his first semester at Heidelberg in the spring of 1849. Yet, at Zurich he broadened his perspective by studying in addition to chemistry, natural science and geology. He diversified even more at Freiberg by taking up the study of mining engineering, metallurgy and geology. At Heidelberg in the fall of

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[18] Ibid.

[19] Slate, p. 104.

1851, he again pursued the study of mineralogy and chemistry, but added physics to his curriculum.[20] It is rather ironic that at this stage in his career he did not hold Liebig and the science of agriculture in high esteem. Although he once entertained the idea of enrolling at Giessen where the noted chemist taught, he dismissed the notion since Löwig was not on friendly terms with Liebig. It is even more interesting that in light of his subsequent career in the science of agriculture, he considered that it would be more beneficial to graduate under the name of the Zurich professor than under Liebig's. Indeed, he even expressed horror at the thought of having to indoctrinate himself in the theories of Liebig.[21]

Nevertheless, even as a college student, Hilgard showed that he possessed a daring and inquiring intellect. In his early research investigations he delved into the physiological effects of arsenic in which he used his own body to test the effects.[22] On one such occasion, while investigating the nature of oxamid compounds, he inadvertently exposed himself to near lethal quantities of hydrocyanic gas.[23] At the Mining Academy of Freiberg he successfully isolated a new double phosphate of iron and potassium and speculated on the possibilities of mining with chemicals and fire. He also conducted

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[20]Ibid., pp. 100-06.

[21]Letter, E. W. Hilgard to Julius E. Hilgard, Feb. 9, 1852, University of California, Berkeley, Archives, E. W. Hilgard Collection, Bancroft Library; hereafter cited as E. W. Hilgard Letter File.

[22]Lester S. Ivins and A. E. Winship, Fifty Famous Farmers (New York, 1924), pp. 255-56.

[23]Slate, p. 103.

experiments on the feasibility of extracting gold with chlorine water.[24]

Hilgard's true test of scientific ability came at Heidelberg University under the direction of Robert von Bunsen. Bunsen assigned him the task of investigating the mechanics of the candle flame. He succeeded in meeting Bunsen's challenge, even earning high praise from his mentor for his outstanding contribution to the knowledge of the then little understood field of fuel combustion. Hilgard was able to penetrate the inner secrets of the candle flame with the aid of glass tubing he personally designed. By adroitly manipulating the glass tubing he discovered that there were four parts to the candle flame rather than the three which were then known. He further showed that in the extreme interior part of the flame nearest to the candlewick, a cone of unburned gas existed in which oxygen was absorbed. He then proved that the unburned layer of gas was enveloped by a luminous layer of burning gas which in turn was further surrounded by a layer of non-luminous burning gas. Finally he proved that the three layers of gas were surrounded on the outside by a fourth layer which was composed of luminous burning gases.[25]

Hilgard's work on the flame of a candle served as the basis for his doctoral dissertation. Toward the end of October, 1853, and after all the requirements for a Doctor of Philosophy in chemistry had been met, he was awarded the degree summa cum laude. This distinction is all the more remarkable in light of the fact that he was only

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[24]E. W. Hilgard Letter File, E. W. Hilgard to Julius E. Hilgard, Feb. 9, 1852.

[25]E. W. Hilgard, Memoirs.

twenty years of age and had had "no apprenticeship at the baccalaureate level."[26] Although he had received perhaps the best science education Europe could then offer, he had also emerged from his European education with a more cosmopolitan outlook on life. An example of this is evident in Zurich where he came under the influence of such writers as Emanual Swedenborg and Arthur Schopenhauer. Swedenborg's The Heavenly Mysteries and Schopenhauer's World as Will and Idea profoundly affected him and were instrumental in turning him toward Catholicism later in life. They also served partly to compel him to attempt to bring science, religion and ethics into a working symbiosis.[27]

After taking his general examinations for the degree of Doctor of Philosophy he was examined by a local physician for a chronic cough and lung complication which had persisted since his Freiberg days. He was given at the most only several months to live. The doctor advised convalescence in a Mediterranean area in order to prolong the inevitable. Although the doctor recommended the island of Elba, Hilgard decided on the city of Malaga, Spain. Once there, he paid little attention to the doctor's prognosis and carried on his work as if unaware of the uncertainty hanging about his future. He quickly completed the final draft of his doctoral dissertation and forward it to Bunsen by February, 1854. He also took up residence in a strictly Spanish section of the city so that he would be forced to learn the language. When he had become sufficiently fluent in the use of Spanish, he set up a small business of assaying minerals and ore. As

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[26]Slate, pp. 104-05.

[27]Jenny, p. 111.

a side line to the assaying business he also delivered instruction in the art of using the blowpipe for mineral analyses.[28]

It was typical of Hilgard that these self-imposed tasks did not satisfy his restless, inquiring nature and he further engaged in activities which included the large scale distillation of the essences of roses and orange flowers for the purpose of manufacturing perfumes. The countryside of Malaga also offered opportunities for carrying out geological and botanical investigations. It also gave him his first experience into the nature of arid lands and irrigation systems.[29]

The constant out-of-doors activity in the hot dry climate of Spain gradually restored his health. With renewed vigor and robust health he commenced a more active social life and soon found himself in the company of the so-called "good families" of Malaga society. It was during these social visits that he met his future wife, the daughter of a retired army colonel by the name of Bello. Hilgard returned to Spain in 1860 to claim his bride, Jesusa, whom he took back with him to Mississippi where he was then employed. She remained with him faithfully until her death in 1896.[30]

Hilgard returned to the United States in the summer of 1855 fully recovered from his lung complications. There was little doubt in his own mind that he would eventually return to America, although his immediate relatives in Heidelberg urged him to remain in Europe and

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[28] E. W. Hilgard, Memoirs.

[29] Ibid.

[30] Hilgard had three children by his wife Jesusa; two daughters, Alice and Louise, and one son, Manuel Eugene, who died tragically in 1889 of typhoid fever.

vie for a professorship in one of the European universities.[31] Although he returned to America with a Doctorate of Philosophy in chemistry, it had not been of particular concern to him that he obtain one. He took the degree only because he thought it would be helpful to him and not because he believed that there was any merit to the degree itself. A letter to his brother Julius makes this point clear: "I do not care a whit for the title, but would it be of essential use in the domains of Uncle Sam?"[32]

Upon his arrival in Washington, D. C. he accepted a position as chemist at the Smithsonian Institute. He considered the position only temporary, hoping soon to find a more prestigious one. Only a short while later in August, 1855, professor F. A. B. Bernard of the University of Mississippi offered him the position of Assistant Geologist for the state of Mississippi. He accepted the offer despite the efforts of his friends and colleagues to dissuade him from taking a position in a region where the popular Paleozoic formation which was then occupying the attention of American geologists was not represented.

Hilgard had initially thought in terms of a professorship in chemistry, but above all, he wanted to become an important and nationally recognized figure in the field of science. Time was of essence[33]

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[31] E. W. Hilgard, Memoirs.

[32] E. W. Hilgard Letter File, E. W. Hilgard to Julius E. Hilgard, February 9, 1852.

[33] E. W. Hilgard Letter File, E. W. Hilgard to Julius E. Hilgard, Aug. 20, 1856: Hilgard expressed concern about staying too long in Mississippi as a geologist for fear of jeopardizing his chances of becoming nationally recognized in chemistry; see also Ibid., June 6, 1856.

and the current route to national recognition, he believed, was through the Agricultural and Geological Surveys which were being organized by various states during this period.[34]

Hilgard started out as an Assistant Geologist in the fall of 1855 under Lewis Harper, who was then acting State Geologist. Hilgard became State Geologist early in 1858 and remained in that capacity until October, 1866, when he resigned to become Professor of Chemistry at the University of Mississippi. In October, 1870, however, he again resumed the position of State Geologist while still holding the professorship of chemistry at the university. He had taken over the added responsibilities of State Geologist only to prevent the post from being filled with an incompetent. Hilgard served in the dual capacity of State Geologist and Professor of Chemistry until he resigned from the faculty in 1872.[35]

Although Hilgard during his later years in Mississippi turned more and more to the study of agricultural science, his early geological work remains a significant part of the modern geology of the Southwest. His most significant accomplishments included the outlining of the Mississippi embayment in Louisiana and Mississippi and the outlining, studying, and mapping of the cretaceous and tertiary formations of those states. He also outlined and mapped the cretaceous ridge or backbone in Louisiana from Lake Bistineau to the chain of the Salt

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[34]E. W. Hilgard, "A Historical Outline of the Geological and Agricultural Survey," Publications of the Mississippi Historical Society, III (1900), p. 207; Mississippi approved legislation entitled "An act to further endow the university, Mississippi," on June 1, 1850. This act led to the establishment of the Geological Agricultural Survey.

[35]Ibid., pp. 212-20.

Islands. He conducted a study of the exceptional features of the lower Mississippi Delta and explained the peculiar formation of mud-lumps and the reason for their origin. He also carried out an investigation of the Port Hudson Clay.[36] His work in regard to the Geological and Agricultural Survey of Mississippi is contained in his Report on the Geology and Agriculture for the State of Mississippi (1860).

Hilgard's geological work in Mississippi would have in itself assured him a prominent place in the history of American science, but greater fame awaited him only after he left Mississippi and embarked upon a new career in California. The circumstances surrounding his departure in 1872 from Mississippi were not pleasant. He left amid a climate of political and racial instability brought about mostly by the defeat of the South at the hands of the North in the Civil War. He resigned, but only after it was obvious that there was no hope of resuming work on the suspended Geological and Agricultural Survey. Moreover, his plan for a modern type agricultural college (more will be said of this later in this study) which had just started had to be abandoned because of a severe cutback in funds. Thus when the machinery was set in motion to separate the college of agriculture from the university, Hilgard, in a sense of hopelessness and despair, turned to the University of Michigan where he had recently been offered the post of Professor of Agriculture.

Yet, even at the University of Michigan, where he remained from 1872 through most of 1874, he found that his ambitions and interests were severely restricted by the unprogressive agriculture which was in

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[36]E. W. Hilgard, Memoirs.

vogue there. He found that he had little opportunity to carry on research in soil science. The absence of any meaningful research and the prevailing inclement weather in Michigan prompted a desire in him to get back, not only to research opportunities, but also to an area which featured a more favorable climate. Fortunately for Hilgard and the science of agriculture, Daniel Gilman, then president of the University of California and later president of Johns Hopkins University in Baltimore, persuaded him to visit the University of California and teach a six weeks course in agriculture. Hilgard agreed with the understanding that should he find conditions favorable in California, the way would be open to secure a permanent position on the faculty. Hilgard was quick to perceive the unlimited opportunities inherent in a new university and a new state. After fulfilling his obligation of teaching six weeks, he permanently joined the faculty at Berkeley in the early spring of 1875.[37]

Thus, at the age of forty-two and with a twenty year career in geology already behind him, he embarked upon a new career in agriculture with all the vigor and enthusiasm of a new college graduate. Before his long tenure as Professor of Agriculture and Director of Experiment Stations would end in 1906, he would transform a fledgling and unstable college of agriculture into a vast system which could exert influence not only over the entire state of California, but also over significant parts of the United States. E. J. Wickson, at the memorial addresses given in honor of Hilgard in 1916, noted that Hilgard's work in California "is in the warp of California's first

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[37]E. W. Hilgard, Memoirs.

half century of intellectual and industrial life. . ."[38] There is strong evidence that Hilgard's work also forms a prominent part of the framework of the American agricultural system which has grown into the vast enterprise it is today. The following chapters will be concerned with examining Hilgard's contributions to this framework.

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[38]E. J. Wickson, "Addresses at the Memorial Services in Honor of Dr. E. W. Hilgard," p. 176.

CHAPTER III

HILGARD'S CRUSADE FOR RATIONAL AGRICULTURE IN MISSISSIPPI

Had it not been for Hilgard's position as Assistant Geologist for the state of Mississippi, scientific agriculture in America might not have gained its most vigorous supporter. It was during his geological explorations that he became painfully aware of the "harmful and ruinous" agricultural methods which existed in the South. It was obvious even from a casual inspection that the prevailing practices had reduced large areas of the once fertile lands of Mississippi and Louisiana to such a state of infertility that farmers were pressed to raise even a respectable crop of "broom corn" or "sledge." It was conditions such as these which obsessed Hilgard with the belief that agricultural reform was the most urgent need in America. He believed that if the United States was to remain a strong and free nation, the farmers had to be taught the importance and necessity of using rational methods of agriculture. Hilgard, at last, had found a mission in life worthy of his boyhood aspiration.

If, on the one hand, his geological reconnaissances of the southern states had provided him with a worthy cause, they also provided him with direction. While carrying out his exploration of Mississippi and Louisiana, he became aware of the intricate relationship existing between chemistry and the physical make-up of various soils. In ob-

serving the unifying features of various rocks, soils, weathering effects, and vegetation, he eventually became convinced that there was a correlation between a soil's suitability for cultivation and its chemical composition. If this relationship existed, as his observations and experiments seemed to suggest, then a soil's quality could be determined by means of multiple chemical analyses. The possibilities inherent in this concept offered a number of opportunities to the science of agriculture. For example, it opened the way for a comprehensive evaluation and identification of new and unfamiliar lands. This would, according to Hilgard's reasoning, eventually create conditions where farmers, rather than having to rely upon blind experimentation to determine the quality of a particular soil, or worse, having to depend upon the word of unethical real estate agents, could determine the best lands by simply consulting a soil chart.

Hilgard's crusade for rational agriculture, then, centered on two major themes: The utility of chemical soil analysis, and the conservation of the nation's soil fertility. Once he became aware of their significance, he took up his crusade in earnest. His crusade received national recognition in the early 1870's when he vigorously defended the utility of chemical soil analysis before the nation's agricultural scientists who were opposed to it.

Although Hilgard had been quick to perceive the utilitarian benefits inherent in the chemical analysis of soils, his enthusiastic endorsement of it was not shared by his contemporaries. Even the

eminent Samuel W. Johnson[1] expressed a dissenting opinion regarding its usefulness and averred that he would rather trust the judgment of a seasoned farmer in the matter of determining a soil's characteristics.[2] Hilgard countered Johnson's opinion with an article entitled "On Soil Analyses and their Utility." He argued that chemical soil analysis was practical, especially in determining the "great abundance" or "very great deficiencies" of one or more of a soil's primary ingredients. He also pointed out that, contrary to public opinion, average determinations of soil samples covering large areas were feasible. By this statement Hilgard inferred that chemical soil analysis could be used successfully to determine the character of new and untried lands. In answer to the critics who were opposed to chemical testing of new or virgin soils, Hilgard posed the question:

> How are we to advance our knowledge of soils, if we abandon as hopeless the determination of their chemical character? Are the proofs that have been brought against the utility of soil analysis really of such a character as to justify so grave an omission--an omission, too, which in many cases cannot hereafter be supplied?[3]

Hilgard in countering Johnson's critical opinion struck one of the first blows for the interests of chemical soil analysis. Although he won Johnson to his point of view in regard to the utility of soil analysis,[4] the complete triumph of this method, which is now the

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[1] S. W. Johnson, Professor of Agriculture at the Sheffield School of Agriculture, Yale, gained prominence at this time on the basis of two books, How Crops Grow and How Crops Feed.

[2] E. W. Hilgard, Memoirs.

[3] E. W. Hilgard, "On Soil Analyses and their Utility," American Journal of Science, CIV (1872), pp. 435-36.

[4] E. W. Hilgard, Memoirs.

mainstay of scientific agriculture and which was the essence of Liebig's rational agriculture, had to wait another thirty years before its utility was finally recognized by the Department of Agriculture.[5]

Hilgard's initial interest in the usefulness of chemical soil analysis was inspired by Dr. David Dale Owen of New Harmony, Indiana. Owen at the time was in charge of both the Kentucky and Alabama surveys. He not only impressed upon Hilgard the usefulness of chemical soil analysis, but pointed out to him the importance of paying close attention to the soils and other pertinent agricultural features. The collection of agricultural data, he pointed out, would politically enhance the continued success of the geological surveys.[6] That Hilgard closely followed Owen's advice is evidenced from the strong preference given to agriculture in his subsequent report entitled Report on the Geology and Agriculture of the State of Mississippi.

The report was compiled under the auspices of the Geological and Agricultural Survey and was first published in 1860, but due to the circumstances of the Civil War, it did not reach the public until 1866. In compiling the report which consisted of 391 pages, Hilgard evenly divided it into a treatment of geology and a treatment of agriculture. He presented the agricultural section in such a manner as to fully indoctrinate the masses in the fundamentals of rational agriculture. Soil, he wrote, "in its most general acceptation, . . . implies the surface stratum of earthy material as far as the roots of

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[5]E. W. Hilgard, "Soil Work in the United States," Science, XIX (1904), pp. 233-34.

[6]E. W. Hilgard, "A Historical Outline of the Geological and Agricultural Survey," pp. 225-26.

the plants reach."[7] Next he showed his readers that the composition of a soil included various compounds and elements such as silicon dioxide, calcium, potassium, nitrogen, iron, phosphorus, and so on.

After giving his readers an introduction into the science of soil, he then proceeded to build his case for educating the farmers in the importance and methods of soil fertility conservation. He explained the nature of plant growth and how plants grew by absorbing various chemicals from the soil. He pointed out that the fertility of a soil is proportional to the amount of nitrogen, calcium, phosphorus and other elements present in the soil. Each year, he noted, crops remove a certain percentage of the elements from the soil and unless they are replaced by fertilizers or manures, the soil will eventually become exhausted of its mineral supply.[8] Since there was only a fixed amount of mineral ingredients in the soil at the beginning and because each successive crop removed a certain percentage of the total, it was vitally important for the continued prosperity of future generations that the present farmers employ the most judicious methods in exhausting the soil of its minerals. Hilgard compared the prevailing methods of agriculture in Mississippi to a businessman who from year to year seems to net large profits, but never returns any of the profit for capital improvement. Such a practice, he noted, was doomed to

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[7] E. W. Hilgard, Report on the Geology and Agriculture of the State of Mississippi (Jackson, Miss., 1860), p. 202.

[8] Hilgard's rather pessimistic philosophy concerning the singular importance of soil fertility rested on the assumption that the exhaustion of the soil, despite all precautions, was inevitable. Although, according to modern scientific knowledge, Hilgard was in error on this point, it is not surprising that he should have held this conviction. The nitrogen fixation cycle had not been discovered at this time, and the huge and nearly inexhaustible super-phosphate deposits had not been uncovered.

failure in the long run. So too, he implied, were the agricultural operations in America unless the farmers turned away from their present practices and began returning to the soil in the form of manures those minerals which had been removed by the crops.[9]

In order to provide the farmers with information in the methods of soil rejuvenation, he gave detailed instruction in the latest methods of replacing the mineral ingredients. Noting that manures were the best source of plant food, he advised that special attention be given to their selection, handling, and application. Since cattle and barnyard livestock represented the most accessible supply of natural manure, he recommended enclosing the cattle during the feeding season so that their manure could be easily recovered and put on the fields. Before spreading it over the fields, he advised the farmers to expose the manure to the elements and allow it to thoroughly decay. This would insure that it reached its maximum concentration of ammonium. In his report Hilgard listed other sources of manures such as the green marls and limestone deposits which were indigeneous to the state. He noted also that soil could be improved by removing soil from the rocky and hilly areas to bottom lands, thus improving the richness of the tillable land with which was not normally put to use.

In Hilgard's view, any system of soil rejuvenation in Mississippi was futile unless the farmers improved their methods of cotton culture. In discharging the responsibilities imposed by the Survey, Hilgard became deeply aware of the harmful practices of the farmers who, after harvesting their cotton, sent it, seed, lint, and hulls to the proces-

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[9] E. W. Hilgard, Report on the Geology and Agriculture of the State of Mississippi, p. 250.

sor. For a mere pittance, Hilgard lamented, the average cotton farmer sold his seeds to the cotton gin where they were squeezed for oil and then discarded into a creek which ultimately carried them out to sea.[10]

Although the average farmer in Mississippi saw nothing wrong in the traditional practice of wasting the seeds and hulls, Hilgard knew from information obtained from chemical analysis that they contained a vast amount of mineral ingredients. The lint on the other hand, which represented the bulk of the profit on the cotton crop, accounted for an almost insignificant amount of minerals taken from the soil. For example, Hilgard showed that the minerals contained in a four hundred pound bale of cotton were equivalent to those drawn from the soil to grow a seven or eight bushel crop of corn. On the other hand, when the seed, hull, and stalk were removed along with the lint, the mineral loss was twice that required for a corresponding crop of corn.[11]

Hilgard in writing the report sought to make the farmers aware of their harmful practices and by so doing convert them to a more rational practice of agriculture. To bring these concepts more vividly to their attention, he described the present generation of agriculturalists as being "rife with complaints about the exhaustion of soils--in a region which, thirty years ago, had but just received the first scratch of the plow-share."[12] Moreover, he noted, the exhaustion of the land in Mississippi would continue unabated under the

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[10] Ibid., pp. 242-45.

[11] Ibid.

[12] Ibid., p. 239.

present methods of agriculture because the production of useful crops could not be maintained on any soil under any system of agriculture unless fertilizer or manure was used to replace the plant food which had been removed by previous crops.

In an attempt to slow the exhaustion of the soil he urged the farmers to save their cottonseed and return it to the fields. In conserving the seed portion of the crop, he noted, a significant amount of the nation's most precious natural resource, soil fertility, could be saved. In closing the agricultural section of his report, Hilgard advised the farmers to practice a "conscientious utilization . . . of human excrement both fluid and solid, together with bones, dung and all other offal, now partly used for these purposes . . ." In recycling the used materials, he continued, "we have beyond a doubt, the only universal prevention of the exhaustion of cultivated lands."[13]

Although Hilgard's report of 1860 was a plea for rational agriculture in America, it is, perhaps, much more than that to the history of scientific agriculture in America. In this unique report, which is a rare blending of the elements of geology, chemistry, and agriculture, Hilgard voiced the need for rational agriculture in America. Yet he not only pointed out why American farmers should adopt the principles of rational agriculture, he also presented methods by which they could implement them. Thus his report represents, in essence, the philosophy of the new generation of agriculturalists which revolutionized agriculture in America during the latter half of the nineteenth century. Therefore Hilgard's report must represent one of the opening chapters

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[13] Ibid., p. 252.

in the history of scientific agriculture in America.

The great popularity which his report received upon its release in 1866 was the result of its emphasis upon agriculture.[14] Indeed, the locations and discovery of the marls and other valuable minerals as well as manures proved to be an instant benefit to the farmers and industrialists of the state. On the other hand, its emphasis on the utility of chemical soil analysis did much to stir up a lively controversy among the more prominent agriculturists and consequently propelled Hilgard into the limelight of Mississippi publicity.[15]

Hilgard put his increased prestige to good use by responding promptly to various requests from editors of agricultural magazines and journals to clarify his position in regard to rational agriculture. On one such occasion he responded to a request from the editors of the Southern Ruralist. In an article entitled "Rational Agriculture" he attacked the prevailing method of cotton culture by questioning the wisdom of a practice which featured the exclusive pursuit of "more cotton--more land, more negroes, and more cotton."[16] Recalling, perhaps, the sad experience which Ireland suffered as a result of her exclusive cultivation of potatoes, Hilgard noted that the planting of one staple crop such as cotton to the exclusion of all others was a "false policy" designed to bring about an "unsound, one-sided development of mental as well as material resources, and a necessary depend-

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[14] E. W. Hilgard, Memoirs.

[15] Ibid.

[16] E. W. Hilgard, "Rational Agriculture," Southern Ruralist (May 25, 1866).

ence on other countries, which must sometime prove disastrous."[17]

Hilgard's recommended solution to the problem was to use a more rational agricultural policy which involved crop rotation and soil fertility conservation. He urged the farmers to return to the soil that part of the crop which is not very profitable at the market, that is, the cottonseed and their hulls. In conjunction with this policy of salvaging the cotton seed, he called for a more efficient and careful handling of the seeds by the management of the cotton-gins after the lint had been removed from them so that the farmers could more easily recover the seeds and promptly return them to their fields.[18]

Although Hilgard's writings on the subject of rational agriculture were warmly received by various groups in the state, few of his proposed principles were adopted by the Mississippi farmers. Consequently, cotton production continued to expand, and cottonseed, hulls and all, continued to be discarded into the streams and transported out to sea. Productivity of the land, of course, continued to decline accordingly. Hilgard observed these events with alarm. The continued assault upon the Mississippi soil by the cotton growers brought back bitter memories of the devastating results of soil exhaustion in Europe. He recalled from his visits to Europe during the 1850's that the once fertile lands of Germany had been reduced over the centuries to such a degree of infertility that large quantities of fertilizer

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[17] Ibid.

[18] Ibid.

were now required to sustain even a marginal level of production.[19]

In order to ward off a similar fate for America, Hilgard deemed it of utmost importance to persuade the farmers to adopt a more rational posture in regard to their farming practices. Otherwise, unless America profited from Europe's mistakes, a similar fate awaited it. Realizing that the future growth, prosperity, and greatness of America was in the balance, he delivered an address to an assembly at Jackson, Mississippi in 1872 in which he attempted to dramatize the important position which agricultural reform must occupy in the future of America.

> In an agricultural commonwealth, the fundamental requirement of continued prosperity is, beyond any possible cavil, that the fertility of the soil must be maintained. . .The result of the exhaustion of the soil is simply depopulation; the inhabitants seeking in emigration, or in conquest, the means of subsistance and comfort denied them by a sterile soil at home.[20]

Because of the high-priority position given to agriculture, Hilgard felt it was not enough for the cotton growers of the state to simply end their conspicuous waste of soil fertility by conserving their cottonseed, they must also take steps towards adopting a universal system of rational agriculture. A universal or perfect system of rational agriculture, according to Hilgard, was one in which all, or nearly all of the mineral ingredients that had been taken from the soil by a particular crop were replaced in one way or another. In an article to the agricultural journal The Rural Carolinian, Hilgard

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[19]E. W. Hilgard, "The Maintenance of Fertility in Soils," The Rural Carolinian, II, No. 2 (1870), p. 66.

[20]E. W. Hilgard, Address on Progressive Agriculture and Industrial Education (Jackson, Miss., 1873), p. 1.

confronted the farmers with the proposal to develop a near perfect system of rational agriculture. He recommended following the example set by the Chinese and Japanese who for centuries had been using the only truly rational methods of agriculture. He noted that these two East Asian countries were able to support over one-third of the earth's population on a limited amount of land. This, he implied, proved the efficacy of their system. He also pointed out that the Oriental farmer achieved his success by always insuring that the minerals which had been removed from the soil by a crop were replaced by an adequate quantity of night-soil[21] which was obtained in exchange for a quantity of produce at the market. In this manner, Hilgard noted, the Oriental farmers achieved a near perfect recycling of the minerals ingredients.[22]

Hilgard stressed also that in order for such a near perfect system of rational agriculture to become fully operational in America, the average farmer would have to reduce the acreage of land he now had under cultivation. In reference to the degree of land reduction, Hilgard alluded to the adoption of ten acre plots as a suitable amount for one farmer with one mule provided that the land was farmed properly according to the principles of rational agriculture. To show that such a plan was not absurd, he pointed to Japan where five acre plots sufficed to sustain even a large size family. This was possible because the soil was maintained in a high state of fertility at all

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[21]Night soil is human excrement which is removed from a cesspool or privy and used as a fertilizer.

[22]E. W. Hilgard, "The Maintenance of Fertility in Soils," p. 65.

times.[23]

Hilgard knew that such a radical change as reverting back to ten-acre farms was too extreme and so he urged the farmers to employ every other available means to recover or save the mineral ingredients which were lost to the soil each year. To facilitate a thorough recovery of the minerals he called for the cities and rural areas to mutually work out a system in which produce could be exchanged for manure:

> They the city dwellers should return to our fields not only the bones of the cattle they have consumed, but the contents of their sewers and privies, in an efficient, cheap and transportable form. So long as this remains undone the grain-producing regions will vainly strive to maintain, unimpaired, the productiveness of their soil.[24]

Hilgard wrote many other articles in behalf of rational agriculture. Journals such as the Southern Planter, Southern Rural Gentleman, Clarion, Southland, and Holly Springs Reporter carried his message to the farmers of the southern states. His object remained consistent throughout the whole of these articles--enlighten the farmers in the importance and methods of conserving soil fertility and to teach them the fundamentals of rational agriculture. Constantly he explored issues such as the application of manures and marls, row cropping, preservation of cottonseed, recovery of natural and mechanical manures, as well as numerous other topics dealing with the subject of rational agriculture.

Despite his consistent efforts, by the early 1870's it was apparent even to Hilgard that his work towards establishing a system of rational

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[23]Ibid., p. 69.

[24]Ibid., p. 71.

agriculture in Mississippi had not been successful. His failure to win the farmers of the South to his point of view was not the result of any deficiency on his part, for his efforts in this matter had been vigorous and courageous. The problem was the farming population itself --it simply ignored or resisted the methods of rational agriculture because they seemed all "too troublesome." Moreover, the dominant philosophy among the farmers was that even if the land was prematurely exhausted by their irrational methods, there were virgin lands to the west to break out.[25]

In 1866 Hilgard resigned as State Geologist to take over the responsibilities of Professor of Chemistry at the University of Mississippi. As it became painfully apparent that his crusading efforts to transform agriculture in Mississippi had not materialized, he began reflecting on the causes of his failure. His reflections led him to believe that change could not be carried out by trying single-handedly to change the opinions of the masses, but rather change must be initiated through educating a new group of leaders who would eventually replace the old. As Hilgard noted of his previous efforts to effect change:

> The publication of my report of 1860, it is true, made the facts accessible; but I mean no disparagement to the older generation, when I avow my conviction, that it is mainly through the young men, and through the medium of direct verbal instruction, and not through printed reports carefully put away on their fathers' shelves, that the results of the Survey, and the logical consequences flowing therefrom as regards agricultural practice, will ever become incorporated into popular consciousness.[26]

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[25] E. W. Hilgard, Memoirs.

[26] E. W. Hilgard, Address on Progressive Agriculture and Industrial Education, p. 24.

It is clear that Hilgard realized that change in the agricultural practices in America had to be carried to society by efforts originating at the university. Thus, in his view, universities, especially those established pursuant to the terms of the Morrill act, should be made to serve as centers of progress. They should, in other words, exist for the primary purpose of educating the future leaders of society and not remain mere handmaidens or tools of society destined only to perpetuate the established order.[27] As Hilgard succinctly put it on one occasion: The university should serve as centers of agricultural progress from which knowledge radiates outward to the masses.[28] Hilgard's views concerning the purpose and role of the university in society, as in the case of his novel ideas on the utility of chemical soil analyses, did not coincide with the popular or established views at that time.

The majority of the educators in the last quarter of the nineteenth century believed that the land-grant colleges should be vocational institutes where a state's farm youth could be trained in the fundamentals of plowing, hoeing, gardening and pig-feeding. The primary purpose of the agricultural colleges, in the opinion of the established educators of the time, was to inculcate into the students the "dignity of labor" concept. This was to be achieved by compelling them to do intensive, uninstructive labor. This, according to their rationale, would prevent the agricultural students from being "educated away

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[27]For more on Hilgard's views concerning education see: E. W. Hilgard, "Progress in Agriculture by Education and Government Aid," Atlantic Monthly (1882), pp. 531-41 and 651-61.

[28]E. W. Hilgard, "Address on Progressive Agriculture and Industrial Education," p. 26.

from the farm." Moreover, the essence of their doctrines was that change should occur only within tradition, that is, minor improvements or modifications in "how to" plow, hoe, or feed pigs were permissible and even desirable, but little attention was to be devoted to the study of "why, where, and when." Complementing these rather limited, but orthodox opinions was the belief that the agricultural colleges should be segregated from the main centers of classical learning, i.e., those which featured the study of the liberal arts. There were two reasons for this conviction: one being that educators were fearful that agricultural students upon coming into contact with liberal arts students would be lured away from the study of agriculture by the attractiveness of a softer career in the city. Secondly, it was believed that the liberal arts student, being of superior learning, would look down upon the agricultural student and his pursuit of undignified manual labor. Hilgard neatly summed up the essence of this point of view among the traditional scholars during this period:

> In their anxiety to protect the agricultural student from possible snobbish sneers, arising from the antiquated ideas that all manual labor is beneath the dignity of educated men, they proposed to make that idea a determining factor in the choice of the location, connection, and organization of the new schools, by withdrawing them as much as possible from contact with the existing centres of high culture. In this dignified seclusion they hoped to convince the pupils, uncontradicted, of the dignity of labor--surrounding them with a dense "agricultural atmosphere," through which no other rays should penetrate.[24]

Problems such as the ones presented above set the stage for the battle which was to be waged in the last quarter of the nineteenth century over agricultural education in the land-grant colleges. Antiquated

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[29] Ibid., p. 535.

but orthodox ideas of the well meaning, but unimaginative administrators as well as educators had to be overcome before any progress could begin in earnest toward establishing a truly progressive system of agricultural education in America. That Hilgard was in the forefront of the struggle to overthrow the old guard and establish a sounder foundation for the future growth of scientific agriculture in America is a tribute to his resourcefulness, courage, fortitude, and genius. His role in this battle will be the subject of the remaining chapters.

CHAPTER IV

HILGARD'S ROLE AT THE CHICAGO CONVENTION OF 1871 AND THE FORMULATION OF HIS VIEWS ON AGRICULTURAL EDUCATION

In 1862 the Congress of the United States passed the Morrill Act which set aside grants of land in each state of the Union (30,000 acres per Congressman) for the establishment of agricultural and mechanical colleges. The act was quite explicit in its wording concerning the nature of education which was to be carried on in the state supported institutions:

> . . .each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college where the leading object shall be without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanics arts, in such manner as the Legislatures of the states may respectively prescribe, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life.[1]

Despite the rather clear meaning of the law, the agricultural and mechanical colleges which were established throughout the United States according to the specifications of the Act, assumed widely varying aims and purposes. Some colleges were organized and oriented toward technical research (Sheffield School at Yale), others such as the University

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[1]The Morrill Act, July 2, 1862, United States Statutes at Large, XII, Section 4, p. 503.

of Michigan directed its instruction towards practical ends. As a result of the divergent direction which the various embryonic institutions were taking, a convention was convened in Chicago, Illinois in 1871 for the purpose of discussing the future development of these institutions. Hilgard described the purpose of the convention as such:

> I went to Chicago as the result of a call issued some time before by a committee of agricultural college men, to discuss the question of agricultural education, which at that time already had begun to be sharply contested between the advocates of the "Michigan plan," also followed by Pennsylvania, and those who, with the Sheffield School, Harvard, and a few others, favored the university grade of agricultural education. I, after a few years' trial of the Michigan plan at the University of Mississippi (which I then represented), contended strongly for the second, with the corollary that in order to interest the farmers, experimental work bearing directly upon each State's practical problems, is the prime need. We had quite a lively time, Michigan battling strongly for the student-labor plan, as the only "practical" one, and which would not "educate the students away from the farm." Gilman (Dr. Daniel C.), then librarian of Yale, and I were the chief fighters on the university side, seconded in a measure by Gregory (President of Illinois University) and the delegates from Wisconsin and Minnesota.[2]

Hilgard went to the convention to gather data in regard to establishing a proper agricultural college at the University of Mississippi. Yet, much to his dismay, the president of the convention started the proceedings by reading a lengthy but irrelevant paper which, rather than addressing itself to the problems of education, focused exclusively upon the subject of pig feeding. At the conclusion of the reading, Hilgard promptly rose to present a point of order to protest the introduction of such an irrelevant paper. He reminded the delegates that the convention had been convened for the purpose of

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[2]Letter, E. W. Hilgard to Dean Davenport (No Date), quoted in A. C. True, "A History of Agricultural Education in the United States, 1785-1925," p. 118.

discussing the education of young men and not of animals.[3] In voicing his protest Hilgard marked himself as a rebel against the old order. Moreover, in challenging the President of the convention, Hilgard was almost alone except for the support given him by Daniel Gilman. Yet, he secured somewhat of a moral victory in that he prevented the presentation of any other papers such as the one on pig feeding.[4] Historically, Hilgard launched the opening volley in the long struggle to assert the principles of progressive agriculture through education. At Chicago, only the lines of that battle had been drawn, but Hilgard had placed himself at the very front of the progressive forces.

After the convention concluded its business, Hilgard promptly returned to Oxford to present his report to the Trustees of the university. He described the two popular plans (Michigan and Sheffield) but suggested that neither of the two opposing systems be adopted by the University of Mississippi. He explained that he was opposed to the Michigan plan because past experience with it in Europe as well as in the United States had proved that it was not well suited to the needs of the present. Hilgard noted that the farmers who sent their sons to the university to get an education in agriculture, usually withdrew them upon finding out that they were subjected to only routine instruction and much manual labor.[5]

Although Hilgard preferred the Sheffield plan to the Michigan plan,

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[3] E. W. Hilgard, Memoirs.

[4] Ibid.

[5] E. W. Hilgard, Report on the Organization of the Department of Agriculture and the Mechanic Arts (Oxford, Miss: August 29, 1871), pp. 1-9.

he told the Trustees that he did not recommend its adoption by the University of Mississippi either. He explained that he was opposed to the plan used by the Sheffield school on the grounds that it did, indeed, tend to educate the student away from the farm.[6] A university should educate teachers and leaders of progress in agriculture. In this regard he proposed a compromise plan in which the students could obtain training in natural science, agriculture, art and literature as well as in the various aspects of practical agriculture. The latter was necessary only to the extent of familiarizing the student with the application of scientific principles to practical problems.[7]

Hilgard succeeded in persuading the Trustees to adopt his compromise school plan and he was awarded the title of Professor of Experimental and Agricultural Chemistry. As an adjunct to his position, M. W. Philips, editor of The Southern Farmer, was made Professor of Practical Agriculture. Philips' appointment was very popular with the farmers of the state who subsequently sent their sons to the university in large numbers. Although Hilgard's university plan got off to a good start, the farmers, however, upon visiting the campus, observed only the practical aspects of the agricultural curriculum. They formed an opinion that too much time was being given to simple farm work which they themselves could teach better than "Old Philips." Thus, due to somewhat of a misunderstanding on the part of the farmers as to what kind of instruction was being carried out at the agricultural college, they systematically withdrew their sons from its

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[6] Ibid.

[7] Ibid.

premises. By the end of the first semester only two of the original fifteen agricultural students remained at the university. The unfortunate exodus of the students in the spring of 1872 precipitated a corresponding move by the state legislature to decrease funding for the college as well as to separate it from the university at Oxford.[8]

Hilgard fought the separation movement by trying to win public opinion to his point of view. He reasoned that if the public were made aware of the supreme importance of scientific agriculture to the future of America it would block the efforts of the legislature to decrease funding for the college and stymy its plans to separate it from the Oxford campus. His foremost effort to win public support for the agricultural college was an address delivered to an assembly at Jackson, Mississippi, entitled "Progressive Agriculture and Industrial Education."

The significance of the address is not in the fact that it altered public opinion because it did not, it does, however, give insight into Hilgard's earliest ideas for promoting scientific agriculture in America. According to Hilgard, the university was to serve as a center for the collection and compilation of the latest and most progressive knowledge concerning agriculture. This knowledge was to be obtained through studies carried on at the university in conjunction with systematic research conducted by various experimental facilities[9] in the state and supplemented with data obtained through the efforts of the

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[8] E. W. Hilgard, Memoirs.

[9] Hilgard was not too clear on this issue. He was thinking, at this time, in terms of experimental farms operated under the direction and control of private societies.

Geological and Agricultural Survey. The university's role was to serve as a co-ordinating center for the incoming data and to digest and edit the information before disseminating it to the agricultural societies which would subsequently distribute it to the farmers. Hilgard placed a high premium on the role the agricultural societies were to play in popularizing scientific agriculture:

> It is in this way, gentlemen, that we propose, by a close, constant and cordial co-operation with the agricultural organizations of the state, to diffuse what knowledge we already possess, both of the principles and facts; to increase that knowledge by experiments and observations furnished by all those interested in progressive agriculture; . . .[10]

Hilgard further stressed the importance of agricultural societies when he noted:

> It is there in the agricultural societies that not only the fathers are brought in direct contact with the progress of the science and art of agriculture; but there also the sons find the opportunity for applying, for their own benefit as well as that of others, the principles and facts they may have received at the Agricultural College; and for continuing their own studies.[11]

It is clear from his remarks that the college of agriculture was to be the central factor in carrying scientific agriculture to rural society. Yet, in his unique address he did more than outline an organizational plan for the propagation of scientific agriculture, he went on to outline a plan of study which he deemed essential for preparing one for graduation from a progressive agricultural college. His plan of instruction for a Bachelor of Arts degree in agriculture included courses in English and English literature, mathematics, botany,

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[10] E. W. Hilgard, Address on Progressive Agriculture and Industrial Education, p. 27.

[11] Ibid., p. 24.

zoology, general physics, general chemistry, agricultural and economic chemistry, mineralogy and geology, meteorology, ethics, political economy and governmental science. General topics in the areas of agriculture and special agriculture included tillage, subsoiling, drainage, preparation of land, seeding, cultivation, harvesting, and storing of crops. Other agricultural courses featured instruction in the culture of several crops, horticulture, truck farming, and stock and dairy farming. Senior level courses consisted of rural engineering and architecture, landscape gardening, rural economy, general policy of culture, and special geology and agriculture of the state.[12]

Striking testimony of Hilgard's farsighted plans for a progressive curriculum as well as his influence on the subsequent development of agricultural education in America[13] are the recommendations for a modern agricultural curriculum put forth in 1895 by the Association of American Agricultural Colleges and Experiment Stations' Standing Committee.[14] That the committee's recommendations compare favorably with those put forth by Hilgard nearly 24 years before is evidenced by their established requirements for a Bachelor of Science degree in agricultural science. Those requirements were:

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[12] Ibid., pp. 28-9.

[13] Hilgard was present at the meeting of the Association of American Agricultural Colleges and Experiment Stations which, in 1895, endeavored to establish a proper university curriculum for agricultural majors.

[14] Committee members were J. H. Connel of Texas, A. C. True of the U. S. Department of Agriculture, T. F. Hunt of Ohio State University, H. T. French of Idaho, and H. H. Wing, of Cornell University; see A. C. True, "Improvement of College Courses in Agriculture," Educational Review, XIX (1900), pp. 169-74.

> Math, Physics, Chemistry, English, Modern Languages, Psychology, Ethics, Political Economy, General History, Constitutional Law, Agriculture, Horticulture, Forestry, Veterinary science,[15] Agricultural Chemistry, Botany, Zoology, Physiology, Geology, Meteorology, and Drawing.[16]

Excepting History, Psychology, and Modern Language, Hilgard's 1873 curriculum contained every one of the above, plus courses in Mineralogy, Engineering, Architecture, and Landscaping.

In order to implement his proposed plan of instruction at the university, Hilgard recommended the establishment of a faculty to include professorships in the following areas: Practical Agriculture, Technology and Mechanic Arts, Civil Engineering, Botany, Zoology, Horticulture, Chemistry, Special Agriculture and Economic Geology. He also called for the hiring of a Superintendent of Farms whose duties were to implement the plan of instruction as set forth by the Professor of Agriculture.[17] The need for a Superintendent of Farms centered around Hilgard's proposal to establish small farms for testing and using new implements and for applying new theories of culture. This also coincided with his plan to establish experimental plots and botanical gardens which were to be fully equipped with green houses and propagating pits.[18]

It is obvious that as early as November, 1872, Hilgard had arrived

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[15] In 1878 Hilgard recommended the introduction of Veterinary Medicine and a position for a Veterinarian. He called also for courses in Forestry and Dairy: see E. W. Hilgard, Letter File, E. W. Hilgard to Benjamin Ide Wheeler, 1878 (no day or month listed).

[16] A. C. True, "Improvement of College Courses in Agriculture," pp. 169-74.

[17] E. W. Hilgard, Report on Organization of the Department of Agriculture and Mechanic Arts, pp. 7-8.

[18] Ibid., p. 22.

at a modern concept of what an agricultural college should be. He was certain that the agricultural college as an integral part of the university structure was to play a leading role in the transformation of American agriculture. He felt quite certain too that the impetus for change had to begin at the university level and then filter downward via the graduating students and agricultural societies and finally into the very fabric of rural society. One point which Hilgard had not fully developed at this time was the organization for the experiment stations. He saw the necessity of establishing a network of experimental units throughout the state for the purpose of investigating various problems in different areas. Yet, just how this was to be carried out was not clear to him at this time. He knew that experimentation could not sustain itself on profits from experiments alone. Therefore, it was unrealistic to believe that the experimental facilities, however well managed, would be self-supporting. In light of the impending cutbacks in the funding of the agricultural college at Oxford which threatened even the maintenance of a modest agricultural curriculum, Hilgard's only recourse was to turn to the agricultural societies as a sponsor for the experimental farms.[19]

Despite Hilgard's progressive projections for incorporating scientific agriculture into the curriculum of the agricultural college and his plans to promote it throughout the state, he failed in his attempt to gain the public backing necessary to prevent the college from being separated from the main university at Oxford. Moreover, he failed to generate any effective support among the legislators who subsequently

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[19]E. W. Hilgard, "Address on Progressive Agriculture and Industrial Education," p. 22.

carried out their intentions to decrease the funding for the college. Yet, Hilgard was to profit from this defeat. He realized that he had started to fight the opponents of progress too late with too little. At any rate, it showed him the value of building up a solid bloc of public and political support. Thus when he arrived in California in the spring of 1875, he immediately commenced a program of building up a reservoir of public and political goodwill from which he could draw upon in time of crisis. It was this reservoir of support, built up in his early years and nourished during his later years at the University of California, which allowed him to carry out his innovative and progressive educational plans which later were instrumental in superimposing the principles of scientific agriculture on the face of American agriculture.

CHAPTER V

PREPARING A FERTILE ENVIRONMENT FOR THE FUTURE GROWTH OF SCIENTIFIC AGRICULTURE IN CALIFORNIA

The University of California was founded on March 23, 1868, as a land-grant college. Instruction was carried on in Oakland until 1873 when it was transferred to its present permanent site at Berkeley. The College of Agriculture was established in South Hall which included rooms for chemical laboratories, lectures, and a library. The Agricultural College also had two propagating houses, one barn, and forty acres of land for experimental purposes. With Hilgard's arrival in the spring of 1875, the University of California had the necessary framework for introducing scientific agriculture into the State.

The pleasant climate of the Berkeley area belied the social and political turmoil which pervaded the university and its college of agriculture. The university's president, Dr. Daniel Gilman, had dismissed the incumbent Professor of Agriculture and replaced him with a little known professor from Michigan. The abrupt departure of the popular "favorite" and his subsequent replacement by a "foreigner" precipitated a statewide newspaper attack against the University and its new Professor of Agriculture. The friction generated by the dismissal had not been unforeseen by Gilman who selected Hilgard more for his reputation of being a stubborn defender of progressive agriculture

than his repute as an administrator or educator.[1] Hilgard himself had been well aware of the impending struggle with the newspapers, Grangers, Regents, and the State Legislature for he expressed reservations about venturing into a veritable "hornets' nest."[2]

The problems confronting Hilgard in California were much the same as the ones he had experienced in Mississippi. The conservative forces were calling for the separation of the college of agriculture from the university and they also wanted practical instruction in lieu of scientific training. Hilgard, of course, was adamantly opposed to the separation of the college of agriculture, and he was also determined to establish a modern curriculum based on the principles of scientific agriculture. Thus upon his arrival in California, Hilgard found himself at odds with powerful and vociferous forces in the state.

Hilgard's first decade in California was characterized by his determination to build public and private support for his progressive, educational programs and at the same time to disarm his opponents by proving the value of scientific agriculture. He did this by attending numerous social gatherings held by the state's farmers and Grange organizations and by directing the research facilities of the college of agriculture so as to solve local and regional agricultural problems.

Hilgard had not forgotten the valuable lessons taught by his recent defeat by the nonprogressive forces in Mississippi. He knew that unless he obtained a significant measure of public, private, and

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[1] E. W. Hilgard, Memoirs; Hilgard had been recommended for the position in California by S. W. Johnson who admired him for his defense of soil analysis.

[2] Ibid.

political backing, he would never be able to satisfactorily implement or maintain progressive agriculture in California. Thus from the very moment of his arrival in the state, he worked to build a reservoir of good-will among its citizenry.

Hilgard, at first and with success, sought to dissipate the hostile attitudes of the farmers by meeting with them personally. He felt that the fears and suspicions instilled in them by the newspapers could be overcome only by personally assuring them that he held no radical plans for the college of agriculture and that he only intended to improve the methods of agriculture so that greater profits could be obtained from farming. In meeting halls and smoke-filled rooms Hilgard met with farmers and Grange members and reassured them he was in California only for the purpose of helping them to improve agriculture. He pointed out, however, that he could accomplish very little unless he had their support. A memorable occasion witnessed by E. J. Wickson, the late Emeritus Professor of Horticulture, of the University of California and friend of Hilgard's, reveals the effectiveness of Hilgard at these meetings:

> The room was not large and was crowded with men of some prominence in farming and hostile to the University because they really believed that the College of Agriculture ought to be snatched from ruinous association with a so-called "classical institution." It was a stormy assembly but when there came a lull the chairman asked Hilgard to speak. He rose alertly, showing them a slim, graceful figure, and when he had folded and pocketed the blue glasses which a long continued eye trouble forced him to wear, they saw a scholarly face illumined with an eagerness, cordiality and brightness of expression which seemed to say to them: I never was in such a delightful place before in my life. Before he could say a word he had them transfixed with surprise and curiosity, and when he began to speak in a low, conversational voice, with an accent which compelled them to listen closely, every man was at attention. He was saying that he was glad to meet them; that no one could do much for farming unless he had personal knowledge and support of farmers; that he had listened with interest to what

> they had been saying and much of it doubtless would be helpful to him; that other things they could talk over and agree upon when they became better acquainted; that he had come to California to try, with their help and support, to know California, from the rocks to the sky, and proposed to use all that he had learned in other lands merely as a help to begin to know California, which he had already perceived was different from any other land in which he had lived and worked. He wished to work from California outward; not to try to fit old theories to a new state. He had always been interested in differences and wanted to see what they were and how they worked in farming. On his father's farm in Illinois he learned that the soil was not all alike and had been told that soil differed when it came from different rocks, when it was moved about in different ways and when other things were mixed with it, and since boyhood he had been studying the rocks, the soils, the plants, to see what was in the soil and in the plant in the hope of matching them up, to get the best crops and the most money in farming--and then followed a charming half-hour with soil formation and movement, tillage, fertilization, etc. etc., without a scientific term, without reference to a chemical formula--all straight farming talk about soils and plants. Finally he said he had come to find out how these things worked in California. He particularly wished to know whether California farmers had anything as hard to handle as the gumbo soil of the Mississippi Valley.
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> It was a master stroke and all so unconsciously delivered. Before he could regain his seat, questions were fired at him from all over the room and he answered them readily and confidently. At least half-a-dozen had soil which they knew was many times worse than gumbo; would he come to the farm and see it? As the meeting closed after half an hour of such friendly and informal conference, a tall giant from the San Joaquin who was a leader in the opposition and who was known to be able to damn the classics all around a thousand acre grain-farm, leaned down and whispered in my ear: "My God, that man knows something!"[3]

Hilgard's frequent appearances at farmer's meeting throughout the state was only one facet of his program to win the confidence and support of the rural population. Another aspect involved his efforts to bring science to bear on practical problems of agriculture and to show farmers that scientific agriculture could be useful to them. His in-

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[3] E. J. Wickson, "Addresses at the Memorial Services in Honor of Dr. E. W. Hilgard," pp. 166-67.

tention was to involve the college of agriculture in the affairs of the agriculturalists of the state, and in so doing make scientific agriculture an indispensable element of rural society. In short, the more Hilgard and scientific agriculture contributed to the welfare and continued prosperity of the state, the more secure the foundation for scientific agriculture.

The main thrust of Hilgard's efforts to bring scientific agriculture directly to rural society was through the experiment station. Early in the spring of 1875 he established experimental plots on the campus lands. These experimental plots ultimately represent the first experiment station in the United States.[4] There are differences of opinion regarding who exactly established the first official station in the United States. A. C. True in his "History of Agricultural Education in America, 1785-1925" credits W. O. Atwater with founding the first station in 1875 at Wesleyan University, Middletown, Connecticut.[5] Yet True also reports that Hilgard organized an experiment station "almost as soon" as he arrived at the University of California in 1875.[6] Since Hilgard arrived in California in the early spring, it is almost certain that he set up his station before October 1, the date on which Atwater established his.[7] Thus, there are strong reasons for believing Hilgard's own contention that he was the first to set up

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[4]Jenny, p. 24.

[5]Alfred C. True, "A History of Agricultural Education in the United States, 1785-1925," pp. 128.

[6]Ibid.

[7]Charles L. Parsons, "Our Agricultural Experiment Stations," The Popular Science Monthly, XXXIX (1891), p. 350.

an experiment station in the United States.[8]

Whatever the case may be, the importance of Hilgard's efforts to establish an experiment station was his firm desire to bring agricultural research closer to the people by applying its principles directly to practical problems. This was consistent with his long held belief that scientific agriculture could grow and prosper only so long as it was made to serve the public interest.[9]

In keeping with this belief Hilgard located a series of strategic experiment stations throughout California. Stations were established in outlying districts which varied according to climate, elevation, rainfall amount, and soil composition. Ultimately six stations were established including one each in the Sacramento Valley, the San Joaquin Valley, the central Sierra Foot-Hills, the south central Coastal Range, the southern California coast, and the southern California Interior Valleys. Several district stations were located in and about the San Francisco Bay area.[10]

As part of Hilgard's master-plan to build up a solid bloc of public support, the experiment stations under his direction were organized to function not only as research centers, but also as ambassadors of good-will between the college of agriculture and the rural people. In order to attract the interest and co-operation of the people the communities in which he desired to establish an experiment station, Hilgard solicited the advice and recommendations of the rural leaders

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[8] E. W. Hilgard, Memoirs.

[9] Ibid.

[10] Charles H. Shinn, "California Experiment Centres I," Garden and Forest, VII (1894), pp. 442-43.

in regard to the exact positioning of the station and its function pertinent to local problems. As insurance to avoid possible conflict of interest within the communities, he established a sound policy of never hiring field hands above the wages set by the community.[11]

Building and maintaining an experiment station network covering the entire state of California presented many problems. Of the many serious problems which Hilgard faced, the one of financing the operation was the most severe. He started the experiment station program in 1875 on a meager two hundred and fifty dollar grant from the University. He managed this sum of money carefully enough to keep the first station alive until federal funds arrived in 1877.[12] But even the government handicapped his work for it placed a limit of three thousand dollars for the construction of the first station building and seven hundred and fifty dollars for all subsequent buildings.[13] However it charged the individual states to furnish all buildings and equipment exclusive of the station building itself.[14] In 1887 the Hatch Act provided fifteen thousand dollars per annum for the funding of the experiment stations which did much to alleviate Hilgard's dependence on the University for money.[15]

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[11] E. W. Hilgard Letter File, E. W. Hilgard to George Hansen, November 20, 1888.

[12] Jenny, p. 24.

[13] Parsons, pp. 348-58.

[14] Ibid.

[15] The Hatch Act was enacted into law on March 2, 1887 and provided for the funding of agricultural research of a scientific nature. The research proposed by law was to be carried out by the Land-grant colleges' experiment stations: See U. S. Statutes at Large, XXIV, p. 400 ff.

The experiment station principle as envisioned by progressive agriculturalists was vindicated nationally by Hilgard's research at the experiment station located in Tulare county. In working on the complex problem of alkali soils[16] which plagued large areas of the western United States, he found that the barren soils could be reclaimed by a process of underdrainage. Prior to Hilgard's arrival in California, alkali soils had been studied only superficially and classified according to whether they were "black" or "white." Little was known or understood of their true origin for it was largely believed that they resulted from excess absorption of salt from the nearby seawater. The "oceanic origin" theory of alkali deposits led to another erroneous belief that the lands by virtue of their origins could not be reclaimed.

Hilgard's research at Tulare shattered these mistaken theories. In blending his rare knowledge of soil science and geology and scientific acumen, he discovered that the sterility of alkali soils was caused by an excess of indigenous salt which had not been leached from the soil because of the arid climate. An artificial leaching process of underdrainage, Hilgard noted, would remove the excess salts and permit profitable farming of these otherwise barren areas. Moreover, the same absence of rainfall which had caused the alkali problem was responsible also for the high concentration of calcareous minerals in the alkali soils. Therefore, these soils were capable of producing abundant crops for many years to come without benefit of using ferti-

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[16]Alkali soils contain an excess of mineral salts or mixture of salts which give them properties of a base and the ability to neutralize acids.

lizers once the soluble and poisonous salts were removed.[17]

The significance of Hilgard's findings was not overlooked at the time. In an article which appeared in 1902 entitled "New Agriculture," W. S. Harwood wrote:

> . . . within the last two years the value of all the experimental work of the two decades has become apparent. Millions of acres of land, once believed to be desert, will now be compelled to yield richly. It has been proven [at Tulare] that regions which have been shunned for a century as among the barrenest spots on the globe are marvellously rich and amenable to agriculture. . . The result of the work not only provides a distinct addition to national wealth, both in lands and crops, amounting to millions of dollars in value but it serves to set still farther ahead among the cycles of the theorists that date when the earth shall have reached its maximum of productiveness.[18]

Although Hilgard's remarkable findings at the Tulare station made a great contribution to the cause of scientific agriculture, it was only part of his continuing effort to establish a solid foundation for agricultural science in the state by making it serve the interests of the people. Another significant contribution was in the area of viticulture. During the 1870's viticulture was emerging as the number one enterprise in the state. Californians were struggling to secure a larger percentage of the wine market which was then chiefly dominated by foreign producers. One of the more acute problems which faced the vineyard owners was the devastating attacks by phyloxera[19] which were destroying the grape industry in California.

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[17] E. W. Hilgard, Memoirs.

[18] W. S. Harwood, "The New Agriculture: Remarkable Results from Experiment Station Work," Scribner's Magazine, XXXI (1902), p. 646.

[19] Phyloxera is a term which denotes any of a number of related plant lice that attack the leaves and roots of certain grape vines.

An especially severe case of phyloxera in the vineyards of Sonoma county prompted the owners to solicit the services of Hilgard and the college of agriculture to determine the extent of the damage and to search for an effective treatment of the disease.[20] Hilgard found that certain grape varieties were resistant to the attacks and further re-research into the matter led to the introduction of the first resistant grape stocks in California.[21]

Hilgard's brief introduction into viticulture as a result of the phyloxera attacks, provided him with an opportunity to further prove the usefulness of agricultural research based on scientific methods. He seized the initiative by procuring a wide variety of grape stocks from the Livermore company of Folsom, California. Hilgard's research into grape stock varieties continued to increase so that by 1884 the viticultural research projects of the college included eighty-four assorted lots. Research information stemming from these investigations did much to eradicate the state-wide prevalence of miscellaneous grape varieties and contributed significantly toward resolving the existing chaos in the wine industry.

In coming to the aid of the winegrowers Hilgard warned against the growing of excessively large crops of grapes which, because of the absence of sufficient manpower and equipment, prevented a timely harvest of grapes when they were at the choicest stage of ripeness. Hilgard pointed out that the unmanageable sizes of the vineyards resulted also in the indiscriminate harvest of moldy and rotten grapes along with the

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[20] E. W. Hilgard, Memoirs.

[21] Maynard A. Amerine, "Hilgard and California Viticulture," p. 1.

choice ones. Complementing the undesirable harvesting techniques were the equally unsatisfactory techniques employed at the wineries. He observed that wine makers on the whole were guilty of improperly filling the fermentation tanks as well as stirring and storing the wines at the improper times. Moreover, according to Hilgard's findings, the defective after treatment of the wines served only to compound the production of an unsavory final product.[22]

Hilgard's efforts to enhance the quality of California wine made the college of agriculture the leading center in the state for viticultural research. In addition to the research performed in regard to the eighty-four lots of grapes, he carried out valuable quality control tests for various winegrowers who submitted their products for determination of acid or sugar content. The delicate nature of and the need for excellence and discrimination when dealing with wine, coupled with the absence of qualified personnel, compelled Hilgard personally to attend to the details of the work pertinent to viticulture and wine making. Moreover, as head of the Department of Agriculture at the university and Director of Experiment Stations, most of the administrative burdens imposed by the increased involvement in viticulture fell directly upon his shoulders. Until he was able to hire Luigi Paparelli in 1888 as Assistant Director in Charge of Viticulture, most of the research, testing, quality control, and report writing was done by Hilgard. The enormity of the task plus the related duties of teaching, managing and administrating the college of

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[22]Maynard A. Amerine, pp. 15-16.

agriculture once prompted Hilgard to declare that "all the additional facilities I have acquired seem only to serve to make it a little less impossible to keep rolling the Sisyphian stone up hill."[23]

In the course of his work for the viticultural interests of the state, Hilgard and the college of agriculture made a number of valuable contributions. Under his supervision the then largest systematic investigation of red wines produced by experimental fermentation was carried out. The results of these studies were published in a 345-page report which appeared in 1892. By conducting the first systematic study of the phyloxera disease, Hilgard was able to write the first scientific report on the nature of that disease in California.[24]

Overall, the combined contributions of the experiment station research and viticultural research did much to wed the interests of the agricultural college to the interests of the farming industry, and, in so doing, placed the college and scientific agriculture on a much sounder basis. Moreover, the effectiveness of Hilgard's masterplan to win public support is evidenced by the fact that his department was considered the most popular one at the university by 1880.[25] He once remarked that the farmers' desire for information concerning agriculture was so great that their requests almost overwhelmed him.[26] By the late 1880's Hilgard could boast that his position at the college

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[23]E. W. Hilgard Letter File, E. W. Hilgard to George Hansen, February 1, 1889.

[24]Maynard A. Amerine, p. 1.

[25]E. W. Hilgard Letter File, E. W. Hilgard to C. E. Hooker, January 1, 1889.

[26]E. W. Hilgard Letter File, E. W. Hilgard to J. E. Hilgard, February 15, 1880.

of agriculture was so secure that no one in the state dared to oppose it.[27]

A true measure of Hilgard's success in providing a fertile environment for the future growth of scientific agriculture in the state of California was his impressive victory over the forces which fought for the separation of the college of agriculture from the main campus at Berkeley. In the late 1870's a movement arose which called for a constitutional revision to clear the way for the separation of the college from the university. Proponents of the "segregation plan" favored severing both the physical and administrative ties between the two institutions. This would permit, according to the "separatists," the use of the funds of the Land-grant lands exclusively for the college of agriculture. Moreover, the "separatists" felt that the agricultural student would do best when not exposed to the corrupting influences of liberal arts students. The "separatists" plan called for the indoctrination of the agricultural students in concepts such as the "dignity of labor."

Hilgard in a desperate effort to defeat the movement gathered what supporting forces he could from among his friends at the capitol in Sacramento, the Golden Gate Grange, and various other sources. Although most of the members of the state's Grange organizations favored separating the two institutions, Hilgard succeeded in persuading J. V. Webster, the Master of the State Grange, not to support the measure.[28] He was also successful in winning to his side the services of J. W.

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[27] E. W. Hilgard, Memoirs.

[28] Ibid.

Wright, another prominent member in the Grange, and two members (Martin and Winans) of the University of California Regents.[29] Hilgard also drummed up support for his "university plan" by taking the issue to the newspapers. In a series of releases which appeared in the San Francisco Daily Evening Bulletin Hilgard blasted the ideology of those who favored the separation of the college of agriculture from the university:

> The minority or opposition view is, that there should be purely an Agricultural College and nothing else, and that this was all that was intended to be secured by the grant of agricultural land, and all that the State was called upon to establish. They do not want a University, but only a special school where agriculture is practically taught. They want also to segregate the Agricultural College from the University and to use the funds from the Federal Land Grant for that department alone.[30]

Hilgard in these releases denied the success claimed for many of the colleges which featured the farm work principle. He cited the failure of such institutions as the agricultural colleges of Michigan, Missouri, and Kansas[31] as proof that the farm school principle was unworkable.

The inroads Hilgard made into the "separatist" forces enabled him to defeat the proposed plan for a constitutional amendment. Moreover, as a tribute to his work at the college of agriculture, the Organic Act of the university was amended to make it unconstitutional

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[29] Ibid.

[30] San Francisco Daily Evening Bulletin, January 22, 1877.

[31] Ibid., October 26, 1877. Hilgard's contention that these colleges were failures rested on the principle of decreased enrollments; a fact borne out by the Report of the Commissioner of Education. Opponents of the "university plan" used the same argument of small enrollments to attest to its failure.

to separate the agricultural college from the university in the future.[32] Further evidence of the degree to which Hilgard had raised the college of agriculture in the brief time he had been there occurred in 1879 when the legislature specifically cited his work as the reason why there should be a special tax accessed for the funding of the university.[33] In that same year, a law was passed which provided for a one-cent tax to be levied on every one hundred dollars of State revenue obtained through the general property tax. The Act stipulated that part of the revenue from the new tax should be earmarked for the funding of the experiment stations.[34] Hilgard's influence in getting the future of the university and its college of agriculture tied to the future growth of the state of California cannot be overrated. Indeed, together with his victory over the "separatists" and the initiation of a new tax for the university, Hilgard had succeeded in building a sound foundation for the future growth of scientific agriculture in California.

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[32] E. W. Hilgard, Memoirs.

[33] Ibid.

[34] E. W. Hilgard Letter File, E. W. Hilgard to Julius E. Hilgard, January 1, 1887.

CHAPTER VI

HILGARD AND PROGRESSIVE AGRICULTURAL EDUCATION IN CALIFORNIA

The main objective of Hilgard's efforts to build up a large bloc of public and political support among Californians was to provide a sound foundation for the future growth of scientific agriculture through progressive agricultural education. The central factor in his scheme for this was the college of agriculture. It was here, in close association with the university, that the future leaders of agriculture were to be trained, that is, the managers, scientists, educators, and national political office-holders. In order to realize this objective, the graduates of the agricultural college were to be well versed in science, agriculture, the classics, economics, politics, law, and modern languages. Products of the college were to be able to compete at all levels with liberal arts graduates. In order to produce well-rounded graduates with backgrounds in science and agriculture, it was necessary to keep the college of agriculture in close proximity with the main university. It was for this reason that Hilgard stubbornly fought the advocates of the "popular plan" of agricultural education and the "separatists."

The decade of the 1880's was a crucial one for the agricultural colleges and progressive agricultural education in general. It was a period when the progressives met head-on with the conservatives over

the issues concerning agricultural education. The progressive forces differed sharply with the conservatives over the type of education to be given in the land-grant institutions. The progressives believed that it should be more in accordance with the scientific and technical demands of the present. The conservatives favored an educational program where the "many" could receive instruction in the practical aspects of farming.

The decade of the 1880's also featured a desperate struggle on the part of both the progressives and the conservatives to vindicate the merits of their respective systems. The progressives rationalized the chronic low enrollments in their colleges by pointing out that they did not purport to educate the masses, but only the future leaders of progressive agriculture. The conservatives, on the other hand, justified their program by pointing to the large enrollments at their institutions, and consequently the colleges which featured the "farm work" principle came to be known as the "popular" ones. Therefore, the conservative educators believed that their educational policies were the correct ones because the public favored them to those of the progressive's. Thus, size of student enrollment became the all-determining factor whether a particular educational program was successful or relevant. Advances in science, industry, and technology, however, compelled corresponding changes in education; yet, the majority of the educators sought only minor modifications within the existing framework of established tradition. Hilgard, as a champion of the progressive forces, called for change in the educational system of America from the lowest grades to the highest. He believed that lower education in America had to be revamped in order to keep pace with the demands of

science and technology.

Hilgard first attacked the philosophy that large student enrollments proved the success and correctness of the policies advocated by "popular" schools. He pointed out that those institutions which stressed manual labor had also suffered a decline in student enrollment:

> After the first flush of enthusiasm, parents as well as sons began to gauge the benefits received under the system which gave half the pupils' time, or more, to manual labor, [or which conveyed] little or nothing new after a few weeks' practice, and was therefore of no educational value. It soon began to be said that the pupils were made to work for the profit of the college, with occasionally the additional intimation that they had to labor to "maintain a lot of professors in idleness," instead of getting an education, and that the parents might as well take them home, and get the benefit of that service themselves.[1]

Hilgard concluded therefore that on the basis of declining student enrollment at the "popular" colleges, and the continued dearth of students at the schools which featured progressive education, something must be wrong somewhere:

> It would then seem that on the whole the people of the United States are not fully satisfied with anything that has thus far been offered them in the shape of agricultural education, and are slow to avail themselves to the benefits of the Morrill act.[2]

Hilgard was certain that the public did not want merely a practical education for their sons, but felt that they desired something more in the way of a college education.[3] Why then, didn't they send them to the schools modeled on the progressive plan? Hilgard placed the

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[1] E. W. Hilgard, "Progress in Agriculture by Education and Government Aid," p. 536.

[2] Ibid., p. 651.

[3] Ibid., p. 541.

blame on the system of elementary instruction in America. The present mode of elementary education, he noted, was inadequate for preparing students for admission to those universities where science and technology were stressed.[4] He noted that rather than preparing the younger students in the rudiments of natural science, the elementary schools focused almost exclusively upon the study of such "abstract" subjects as reading, writing, and arithmetic. The inordinate emphasis upon these subjects left the impression in the younger students that the study of natural science and, consequently, that of agriculture, was less important than the "abstract" ones. But even worse, according to Hilgard, the exclusive study of the "3-R's" served also to repress the growth of the students' perceptive abilities at a time when they were the most acute. "It is a piteous sight," he lamented:

> to see young children, almost babies kept confined to the school-bench for six or eight hours daily, wearily and ineffectually striving to master such abstract ideas as the power of letter and numbers, or to memorize the monstrous inconsistencies of spelling, which in a few years later would be learned in a fraction of time, under the stimulus of a purpose to be achieved in the amplication of knowledge previously acquired, and with as little trouble, because it is then the right thing in the right place.[5]

Hilgard criticized the forced learning habits imposed upon the student by the elementary schools. He felt that this method of teaching was very detrimental to the future development of the child, especially in regard to his development in science. Of elementary teaching techniques, he wrote:

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[4]E. W. Hilgard, "Preparatory Teaching in Agricultural Colleges," United States Department of Agriculture: Office of Experiment Stations, Bulletin No. 49 (1897), pp. 61-2.

[5]E. W. Hilgard, "The Study of Natural Science," The Michigan Teacher, IX, No. 3 (1874), pp. 79-84.

> Text-book teaching is the bane of all instruction in science. Yet this, unfortunately, is all that most of our common and grammar school teachers that have been educated in the normal schools are able to do . . .
> Those of us who attend teachers' institutes cannot but have been struck with the large prevalence of special prescriptions and patent devices for instilling into the child's brain, in the shortest possible time and with the least trouble to the teacher, certain subjects or branches of the course, resulting but too commonly in mere mechanical memorizing, without any proper understanding on the part of the pupil. . .[6]

It is clear that Hilgard opposed the prevailing philosophy and nature of elementary education. He believed that the elementary student was being driven away from a career in science and agriculture by the teaching techniques employed in the school system. Complementing the forced learning practices was the harmful policy of teaching the student the wrong subjects at the improper time. He noted that science instruction usually began only after the student's mind had been greatly blunted or dulled by years of forced learning, and at a time when the student's interest was more attuned to abstract things.[7]

Hilgard sought to bring change in the elementary system of education by calling for the introduction of natural science in the lowest possible grade levels, preferably in kindergarten.[8] He believed that the early exposure to the study of natural science, when the child's perceptive abilities are at their peak, would better prepare him for the later absorption of the exacting details of science which are given at the college level. In a speech delivered before the Michigan State

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[6]E. W. Hilgard, "Preparatory Teaching in Agricultural Colleges," pp. 61-2.

[7]E. W. Hilgard, "The Study of Natural Science," pp. 80.

[8]E. W. Hilgard, "The New Education," The Kindergarten Messenger, VI (1882), pp. 167-69.

Teacher's Association, Hilgard went on record as supporting science education in the elementary schools as a means of relieving the overcrowded curricula of the universities:

> I am impelled to do so by a conviction, long entertained, that instruction in natural science should and is inevitably destined to form part not only of common and preparatory school education, but that a certain fair knowledge of its leading features at least will, before long, be expected of everyone laying claim to the title of an educated man. I think, moreover, that in this direction especially we may expect to find some of the anxiously-sought-for relief for the overcrowded college curriculum.[9]

Hilgard realized that the introduction of natural science into the elementary levels would require added expenditures by the State which would ultimately be taken from the parents' pocketbooks. Yet he noted that the current rate of spending for education (12 to 18 dollars per annum per student) was rather anemic when compared with the importance of preparing one for a lifetime vocation. Hilgard posed this question to the parents:

> Should it not stand next in importance to food and clothing, such as constitutes the necessaries, not the luxuries, of life; and is the price of a new bonnet, or of two months' supply of cigars, all that can be spared through the year for the child's development? Is not this a very low estimate to put upon that which is to mould the child's destiny for weal or woe?[10]

Even if money could be found to finance science instruction in the lower grades, Hilgard realized that the number of qualified science teachers to do this was very small. He further realized that such an educational program would require higher qualification on the part of the teacher, but as he noted, "the sooner it is understood that primary

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[9] E. W. Hilgard, "The Study of Natural Science," p. 79.

[10] E. W. Hilgard, "The New Education," pp. 168.

instruction [will require] such qualification, the sooner it will be possible to bring within the limited time alloted to their education by our impatient American youth such instruction."[11] Hilgard further added that even if qualified teachers should be found, they too faced handicaps in teaching natural science:

> The teacher may be largely governored in his choice, not only by the opportunities naturally afforded by the locality, but also by his own taste, and by what he knows best. A little enthusiasm on the part of the teacher, and an impression that he knows thoroughly what he teaches, are of paramount importance.[12]

Hilgard of course went well-beyond the point of just theorizing about educational changes, he actively worked to have them implemented into the educational system of California. In 1877 he enlisted the services of the San Francisco Golden Gate Chapter of the State Grange to sponsor his views on education. At an Educational Convention which was held in San Francisco, Hilgard induced the chapter's "Committee to Study the Educational System of the State" to present to the delegates his ideas and recommendations for improving the educational system in California. A portion of their report clearly reveals Hilgard's influence:

> There is an opinion prevalent among such educators that, while our schools are doing a great and noble work, they are not accomplishing all that might reasonably be expected of them. If a portion of the time wasted, and worse than wasted, in the attempt to memorize the endless and senseless details of geography and history, the technicalities of grammar, at an age when they cannot be understood, and long examples in mental arithmetic which, with their complicated solution, must be given with closed book, and in precise, logical terms, could be given to some studies that would interest children [natural science], develop their perceptive powers, accustom them to the correct use of language, and be

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[11] E. W. Hilgard, "The Study of Natural Science," p. 84.

[12] Ibid., pp. 82-3.

> of real practical value to them in after life, more satisfactory results than are now attained would be exhibited at the close of the child's school life.[13]

In its final report the committee brought forward many of the Hilgardian grievances concerning the state of elementary education and reiterated Hilgard's opinion that the schools were instrumental in leading the students away from careers in agriculture. The committee also noted that the periods of time alloted to the preparation of the student's lifetime vocation were too brief. Lastly, the committee held up for special attention the apparent lack of facilities for teaching agriculture and industrial arts in the Common schools.[14]

The committee's recommendation also showed Hilgard's influence. It called for the hiring of elementary teachers who were to be "versed in the principles of natural science, and imbued with respect for industrial calling,[15] and [who had] interest in rural affairs."[16] The committee also called for longer periods of time for the education of students enrolled in the vocational areas; they recommended the introduction of natural science into the elementary curriculum, and insertion of industrial arts training into the Normal schools. They also pointed out the need for a more unified approach to education among the Common and Normal schools and the State University.[17]

The committee's proposals brought forth a storm of protest from

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[13] "Rangers on Education," San Francisco Daily Evening Bulletin, May 12, 1877.

[14] Ibid.

[15] Itallics theirs.

[16] "Rangers on Education."

[17] Ibid.

concerned Californians. The newspapers in the state shared in the protest and branded the report radical for suggesting strong state control of education. Since the committee had put forth Hilgard's own ideas, he was morally compelled to defend its report. In subsequent newspaper releases Hilgard endeavored to allay the fears of the public. He pointed out that the committee's ideas were not as radical as they had been made out to be nor had they called for strong state control of all education. He assured them that the committee did not suggest that all the defects common to public education were to be remedied by state action. He admitted, however, that the committee felt that abstract studies were too strongly pursued in the schools at the expense of natural science, and therefore its members believed that education in the lower schools had not kept pace with the demands of higher education. In order to better clarify the committee's position, Hilgard summed up the main points of its report:

> The entire problem is one whose solution time must of necessity be a large ingredient, not to be replaced by any amount of hasty legislation. But what is possible is, to put that problem, as well as the possible modes of solving it, clearly before the public mind, so that we may work in the right direction; not hastily overturning anything before we have something better to put in its place. And this is quite clear--before we can have anything taught, we must have the teachers qualified to do the teaching. No legislative fiat can accomplish this; they must first be educated, with a view to giving such instruction. The sooner that process is commenced the better. This function necessarily devolves upon the University and the Normal school, and the recommendations made with regard to these I consider as of the most immediate importance, because it is there that the change must be inaugurated, and from there spread to the Common schools.[18]

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[18] E. W. Hilgard, "The New Education," San Francisco Daily Evening Bulletin, May 18, 1877.

It is usually a truism that the ideas of innovative individuals and reformers are far too radical-sounding to be seriously considered for implementation into an existing system. Hilgard's proposals concerning elementary education reform suffered the same fate. However, the farsightedness of his proposal to introduce science education into the lower grades as a panacea for the over-burdened college curricula was vindicated by the need to convene the representatives of the agricultural colleges in 1897 for the purpose of discussing the propriety of beginning preparatory instruction in the sciences for the incoming students. The problem confronting agricultural colleges was that many of the students upon first entering college were unable to meet the science requirements of the universities. Ironically for Hilgard, over twenty years after he had first made his recommendations concerning science instruction in the elementary schools, he found himself a member of a convention convened for the purpose of rectifying, at the college level, the deficiencies in science instruction caused by the lower schools.

Hilgard read a paper at the convention in which he argued against the popular proposal to initiate preparatory science instruction in the colleges. He opposed the plan because the college curricula were already "overcrowded" and also because it would be a violation of both the "letter and spirit" of the Morrill act. He opposed it also because he felt it would jeopardize the chances of getting science instruction into the lower grades. Hilgard went on to state his case against installing preparatory science instruction in the colleges:

> The question confronting the agricultural colleges, then, is whether they shall aid in the struggle of the science for a place in preparatory instruction, or by including the elements of the sciences in their own curricula, bid for

> numbers rather than for a high grade of scientific and technical instruction, and shall to that extent weaken the other schools in the struggle for the rights of scientific teaching in the lower grades. Also, whether in so doing they are not violating at least the intention, if not the letter of the law, by scattering their means upon that which should properly be done in the other schools.[19]

Hilgard felt that the plan to include preparatory science teaching into the college curricula was a violation of the terms of the Morrill act because it suggested the education of the masses and thus harked back to the "popular plan" or "farm school" approach to agricultural education. History, according to Hilgard, had proven the unsoundness of the farm school plan and in light of recent happenings, he questioned:

> This raises the vexed and oft-discussed question whether the agricultural colleges should, or were designed to, educate the mass of farmers' sons, or whether, on the contrary, they were intended to educate, chiefly, at least, the agricultural experts and leaders of progress. I think that the drift of the development of the colleges in the older States, as well as the consensus of opinion among the older members of this Association, points toward the latter view as the one that is ultimately to prevail.[20]

Hilgard's single purpose in working for the introduction of science instruction into the elementary schools was to enhance the quality of education given at the college of agriculture. He believed that if the incoming students were well-grounded in the principles of science, then the great amount of time which was being used to teach the rudiments of science could be used instead by the college to give more detailed instruction in agricultural science. Yet, Hilgard's efforts to improve the quality of education at the college of agriculture did not end with his campaign to get science introduced into

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[19] E. W. Hilgard, "Preparatory Teaching in Agricultural Colleges," pp. 61-2.

[20] Ibid.

the elementary schools. He looked beyond this and went beyond the state of California by turning his attention to bringing the Department of Agriculture and the agricultural colleges into closer harmony.

Hilgard rightly felt that the development of scientific agriculture and the work of the agricultural colleges and experiment stations throughout the United States could be greatly enhanced if the Department of Agriculture would take the responsibility for co-ordinating all agricultural research information. Much of the research work which had been accomplished by the nation's colleges and experiment stations had remained unknown to stations in other states. This caused an unnecessary waste of the station's time and energy by duplicating research work that had already been done. Hilgard called on the Department of Agriculture to increase its involvement in the affairs of the colleges by serving as a central agency for the collection, processing, and dissemination of agricultural research information. In an article for the Atlantic Monthly magazine Hilgard suggested a more progressive role which the department could play:

> It would thus naturally and legitimately become the leading centre of agricultural information and progress, gathering up all the disconnected threads, now scattered from the Atlantic to the Pacific, into a radiating net-work, conveying back and forth messages of mutual information and encouragement, by deed as well as by words.[21]

In conjunction with his proposal for bringing the Department of Agriculture into closer harmony with the affairs of the agricultural colleges, he urged the department to prepare an annual report which would list the progress made in research by each of the agricultural

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[21] E. W. Hilgard, "Progress in Agriculture by Education and Government Aid," p. 661.

colleges and their experiment stations.[22]

Hilgard had other more comprehensive schemes for the national government to perform on behalf of the agricultural colleges. In a continuing effort to further improve their efficacy, especially those lying west of the Mississippi river, he worked for the establishment of an agricultural survey of all lands west of that river. He believed that a national agricultural survey, complete with soil analysis and land classification, would greatly benefit agricultural research and add to the effectiveness of the experiment stations program by providing them with "full, authentic, and impartial" information concerning the soils of the newer states. Hilgard did not see how the experiment stations could competently discharge their duties of furnishing accurate agricultural advice within these areas without a complete knowledge of their soil features. He further believed that in order for the experiment stations to properly discharge the duties imposed by law, they must have an understanding of the soil features which could only be supplied by an agricultural survey of the territories in question. For this reason he proposed that the agricultural survey be made part of the National Geological Survey.[23]

In a letter, which is typical of Hilgard's effort to promote the agricultural survey, he solicits the services of Congressman W. W. Morrow by pointing out the need for such a survey:

> Permit me to call your earnest attention to a subject which interests profoundly not only the people of this state, but the entire population, present and prospective, of all

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[22] Ibid., p. 658.

[23] E. W. Hilgard Letter File, E. W. Hilgard to W. W. Morrow, October 20, 1887.

> that portion of the United States lying west of the Mississippi river; and that I think should receive the attention and early action of Congress at the coming session. I refer to the need of an "agricultural survey" of the region as a complement and legitimate part of the "geological survey" now in progress.[24]

The interest Hilgard created concerning the need for a national agricultural survey prompted Congress to call him to Washington to give his views on the subject.[25] The culmination of his campaign to build support for a national agricultural survey was manifested in an amendment which was attached to the Sundry Appropriations Bill and introduced by Morrow of San Francisco. The amendment provided for the funding of an agricultural survey for the purpose of classifying all public lands west of the Mississippi river.[26] The amendment was acted upon in June of 1889 but it failed to receive the requisite number of votes by only a slim margin.[27]

Despite the failure of the measure to receive the necessary number of votes, Hilgard had not waited or depended upon the federal government to provide this type of information for the state of California. Very early in his career as Professor of Agriculture, he had realized the importance to agricultural education of knowing the details of the state's agricultural features. In 1879, as a result of an investigation of the asphalt potential of the state which he conducted for the Northern Pacific railroad, he was able to make a rapid but partial

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[24] Ibid.

[25] E. W. Hilgard Letter File, E. W. Hilgard to Arthur Rodgers, spring, 1892.

[26] Jenny, p. 41.

[27] Ibid.

survey of the agricultural and geological features of the southern half of the state.[28]

In the early years of the 1880's he was able to make a similar survey of the north half of the state. This gave the college of agriculture its first comprehensive knowledge of the agricultural and geological features of the entire area of the state. As in the case of the survey of the southern half of the state, Hilgard surveyed the northern part without benefit of state or university funds. The survey of northern California was an outgrowth of work done in regard to a cotton report which Hilgard carried out for the Tenth Census of the United States (1880). Hilgard received the offer to do the cotton report from General Francis A. Walker, who was at that time Superintendent of the Tenth Census. Walker selected Hilgard on the basis of the excellent work he did in regard to the Geological and Agricultural Survey of the state of Mississippi. His appointment of Hilgard to this important task is all the more remarkable in light of the fact that California at that time was not a member of the cotton states and was distantly separated from them. Yet Walker desired Hilgard's services because he "wanted something more in the way of a cotton report than just dry columns of figures."[29]

Hilgard accepted Walker's offer because the $25,000 that went with it would do a great deal to sustain California's embryonic and financially starved experiment station system.[30] He also agreed to

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[28]E. W. Hilgard, Memoirs; the state's asphalt deposits are confined mostly to its southern half.

[29]Jenny, p. 27.

[30]E. W. Hilgard Letter File, E. W. Hilgard to Julius E. Hilgard, September 7, 1879.

do it because the nature of the report offered an excellent opportunity to further the cause of scientific agriculture by including in it a physiographic and agricultural survey of the northern half of the state.[31]

Hilgard achieved a great deal more with the cotton report than he had at first thought possible. Although the final report was published in quarto which thereby limited its wide distribution in the United States, its contents did much to support Hilgard's advocacy of the utility of chemical soil analysis. The report, which consisted of two volumes and a total of 1,772 pages, embodied a comprehensive account of the soil surface and geological features of the cotton states,[32] and clearly illustrated the relationship between the chemico-physico makeup of soil and its suitability for agriculture. Overall, Hilgard's cotton report represents one of the first thorough, comprehensive, and exceptional studies of the relationship existing among geology, soil science, and agriculture.[33] Upon its release to the public in 1883, it brought California national recognition and lifted the college of agriculture at the University of California into the front rank of those institutions favoring progressive or scientific agriculture.[34]

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[31]E. W. Hilgard Letter File, E. W. Hilgard to Arthur Rodgers, Spring, 1892.

[32]The States and territories included in Hilgard's cotton report were: Alabama, Arkansas, Arizona, California, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, South Carolina, Tennessee, Texas, Virginia, Utah, and the Indian Territory.

[33]Eugene A. Smith, "Memorial of Eugene Woldemar Hilgard," Geological Society Bulletin of America, XXVIII (1917), p. 47.

[34]E. J. Wickson, "Addresses at Memorial Services in Honor of Dr. E. W. Hilgard, University of California, January 30, 1916," p. 175.

General Walker was extremely pleased with Hilgard's work and paid him a signal tribute to his achievement when he wrote in the introductory letter of the cotton report:

> In setting on foot the proposed investigation into the cultivation of cotton the Census Office was peculiarly fortunate in securing the services, as chief special agent, of Professor Eugene W. Hilgard, now of the University of California, but for many years a professor in the University of Mississippi, and the head of the geological and agricultural survey of that state. Besides rare powers of mind and high scientific attainments, coupled with the advantages derived from long and careful study of the subject matter of the investigation, Professor Hilgard possessed the commanding qualification of being the author of that method of soil investigation which, after protracted debate, has been fully established to the approval of the agricultural chemists of the United States.[35]

The cotton report made easterners aware for the first time of Hilgard's unique abilities, not only of his knowledge of soil science, geology, and agriculture, but also of his ability to organize, edit, and digest vast amounts of information pulled from widely divergent sources. Thus, it is not surprising that the increased prestige and added reputation which he received as a result of the report brought forth several offers for commissionerships in national offices. In 1881 he was urged by several prominent persons representing the eastern part of the United States to offer his name for consideration for the position of Commissioner of Agriculture.[36] In 1885 he was considered for a commissionership in the Department of Interior, but lost out to N. J. Colman of Missouri.[37] And in March, 1889, he received an outright

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[35]United States Department of the Interior, Census Office Tenth Census, 1880: Report on Cotton Production in the United States, V and VI (Washington, D. C., 1884), V, p. 11.

[36]Jenny, p. 26.

[37]Ibid.

offer to succeed to the post of Assistant Secretary of Agriculture which had been vacated by the resignation of Edwin Willits.[38] A combination of local interests, increased salary at the university, and poor health contributed to his decision not to accept the offers.

Hilgard's private efforts to survey the agricultural and geological features of the state of California and his one-man crusade for a government survey of the lands west of the Mississippi river reveal the great importance he attached to having information of this type. The urgency he placed upon acquiring such information was in keeping with his views of the functions of an experiment station. They were not only to function as semi-autonomous research units but also serve as coordinating links between the rural community and the college of agriculture. This vital link between the farmers and agricultural experts was to be strengthened by the experiment station's ability to provide accurate and useful information to rural society concerning progressive agricultural practices. Without knowledge of the soil features, the experiment stations would be severely handicapped in providing this service to the community. Hilgard makes this point abundantly clear when he pointed out the functions of the experiment stations:

> If it is not one of the essential and primary objects of agricultural experiment-stations to render to the agricultural population the scientific aid which they so sorely need when brought face to face with new and untried conditions and factors in a new country, in order to afford them relief from the slow tentative process of blind experimentation by which the solution of practical questions is commonly approached, then, indeed, the raison d'etre of such establishments will be seriously questioned in all but the older states, where the otium cum dignitate of purely scientific investigations can

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[38] E. W. Hilgard, Memoirs.

> be indulged in without leaving undone things that ought first to be done.[39]

Although Hilgard saw the functions of the experiment stations as providing both scientific research information and practical agricultural information, many influential and powerful voices in the country were calling for separation of the two functions. They wanted the experiment stations to concern themselves with merely the practical investigations while the theoretical and scientific were to be confined to the College of Agriculture.[40] Hilgard once again took up the pen in defense of an experiment station system based on modern scientific methods featuring more emphasis on the theoretical than on the empirical. In a letter to the editor of Science he argued against dividing the functions of the experiment stations:

> I think it would be a grave mistake to segregate the two branches of the work, whether in space or time, and most especially to intrust the solution of practical problems to persons of inferior qualifications, as is too commonly done, to the detriment of the cause of science, and to the disgust of those engaged in pushing it in the face of the difficulties it naturally encounters in a new country. There is a limit to the usefulness of differentiation, when each of the segregated branches is thereby trimmed down to narrowness, and want of proper co-ordination with the other. In our widely varied domain, each location affords peculiar advantages for the prosecution of some branch of both pure and applied agricultural science; and those in charge of the several stations should know, or carefully consider, in which direction their greatest usefulness (in the widest sense of the word) lies.[41]

Hilgard had previously taken steps to set the experiment stations in California on a more progressive path. Under his direction the

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[39] E. W. Hilgard, "The Functions of Experiment-Stations," Science, V (1885), p. 23.

[40] "Editorial Comments," Science, IV (1884), p. 509.

[41] E. W. Hilgard, "The Functions of Experiment-Stations," p. 23.

stations served as semi-autonomous units in which scientific agricultural information was conveyed back and forth between the agricultural college. Administratively, control started at the university and flowed downward through the college of agriculture and ultimately downward to the experiment station. The stations, as functional units of the university, but under the direction of Hilgard at the college of agriculture, were assigned the complex role of being a "reference bureau, information center, and a laboratory."[42]

The nature and scope of the work performed by the experiment stations are revealed in the contents of their quarterly bulletins. According to law, the stations in the United States were required to submit quarterly bulletins but these bulletins on the whole did not bring a great deal of credit to their authors.[43] While most stations were engaged in useful but rather unscientific endeavors such as methods of pig-feeding, gardening, and plowing, Hilgard's stations were busy investigating the nature of phyloxera, soil mechanics, plant physiology, pasteurization of wines, and other complex chemical phenomena. The quality of the California bulletins reflects the great emphasis Hilgard placed upon communicating the results of this work. It is obvious from a cursory inspection of a cross-section of station bulletins which appeared in the 1880's that those of California were superior in quality and content to the vast majority. Hilgard was one of the very few who took the pains to bind the reports into an annual volume. It is not surprising that the bulletins issued under Hilgard served as models for

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[42]E. W. Hilgard Letter File, E. W. Hilgard to W. W. Morrow, October 20, 1887.

[43]Parsons, "Our Agricultural Experiment Stations," pp. 353-54.

other stations in the United States.[44] Overall, the progressive standards which he established for the California experiment stations were borrowed by other institutions and used as a prototype for their station programs.[45] Hilgard's system in essence, was a prime model for others in regard to providing men, means and organization.[46]

In keeping with his progressive experiment station program, Hilgard established an equally progressive agricultural curriculum for the college. During his early years at the university he personally instituted courses in botany, economic botany, agricultural operations and implements, chemistry of plants and their products, chemistry and physics of soils, maintenance of soil fertility and the chemistry and physics of good housekeeping (a precusor of modern home economics).[47] By the 1890's he had expanded the curriculum to fifty-four courses dealing in some manner with agricultural science.[48] Although in the 1870's Hilgard had to do most of the teaching himself, by 1884 he had relegated most of the teaching duties to assistants which allowed him to turn his attention more toward experiment station work.[49]

In 1900 Hilgard made what was his last editorial attempt to influence the course of agricultural education in America. In an article

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[44]E. W. Hilgard Letter File, E. W. Hilgard to Charles L. Ingersol, President of the State Agricultural College, Fort Collins, Colorado, February 25, 1889.

[45]E. J. Wickson, "Addresses at the Memorial Services in Honor of Dr. E. W. Hilgard," p. 175.

[46]Ibid.

[47]Jenny, p. 83.

[48]Ibid.

[49]E. W. Hilgard Letter File, E. W. Hilgard to A. C. Richardson, July 28, 1884.

in Science he discussed the merits of making Greek and Latin a requirement for a Bachelor of Arts degree. He believed that the two languages should be made part of the college curricula in order to instill a "broadness of general culture" in the graduate. He dismissed the popular opinion that availability of translated works in Greek and Latin negated the need for the study of the two languages. He noted that not more than one percent of the students bothered to read the translated works and thus, on the whole, the students graduating from the colleges remained "blissfully ignorant of the fact that the Greeks and Romans did anything which an enlightened modern scientist is bound to respect."[50]

Hilgard felt that the narrowness of general culture imposed by the absence of Greek and Latin in the college curricula was a most serious evil. He believed that the student of science held the impression that "modern time and its brilliant scientific and industrial achievements, is really all that is worth considering."[51] Hilgard pointed out the dilemma which faced the modern science graduate:

> Frequently even the history of his own special science is wholly unfamiliar to him, as may be but too frequently observed in the case of those who have graduated on the basis of "organic" chemistry, and pride themselves upon their ability to produce new compounds by the score, with the exact structure-formulae in black-and-white, but who barely remember, in a general way, such names as Lavoisier, Davy, and Berzelius, much less what their science owes to these men.[52]

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[50] E. W. Hilgard, "The Study of Greek and Latin vs. Modern Languages," Science, XI (1900), p. 953.

[51] Ibid.

[52] Ibid., p. 954.

This paragraph clearly shows that Hilgard foresaw the need for the history of science as a necessary and vital supplement to science. Unfortunately, he did not live to see the development of a whole new field of concentration in the history of science which emerged later in the twentieth century.

Hilgard concluded his arguments on behalf of Greek and Latin as part of the science curriculum by recommending that those students taking a bachelor's degree should possess a broader education through the study of the two languages while those "who are content with narrow lines should also be content to receive only a corresponding degree."[53]

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[53] Ibid.

CHAPTER VII

SUMMARY AND CONCLUSION

The scientific talents Hilgard acquired in European universities and later introduced into his work upon his return to the United States were instrumental in permitting him to exert a profound influence on the development of agricultural science in America. He was one of the first to uphold the principle of chemical soil analyses and was "the first to interpret the results of the analyses in their relation to plant life and productiveness."[1] His period of lonely perseverance in institutionalizing the utility of chemical soil analysis has earned him the titles of "founder"[2] and "nestor"[3] of agricultural science in America.

Although his crusade to establish rational agriculture in Mississippi appeared to be a failure in his own eyes, it most assuredly contributed to the state's later acceptance of the new science by alerting the farmers and plantation owners to the dangers inherent in their traditional methods of agriculture. Who can say that the seeds of doubt which he sowed in the 1860's with his many writings on ration-

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[1]Lester S. Ivins and A. E. Winship.

[2]Theodore Huebener, The Germans in America (Philadelphia, 1962), pp. 124-25.

[3]Albert Bernhardt Faust, The German Element in the United States (2 Vols., Boston, 1909), II, p. 52.

al agriculture did not later bear fruit by speeding that time when the principles of agricultural science were finally recognized throughout the state?

It was in California, however, that he made his greatest impact on the development of scientific agriculture. The achievement he wrought through the sheer force of his indefatigable personality which stands out the most is the preparation of a fertile environment for the continued growth of the college of agriculture. Possibly, never has one person done so much for the cause of scientific agriculture in America as did Hilgard in establishing this edifice to scientific agriculture in California. Almost single-handedly he transformed the fledgling and anemic College of Agriculture at Berkeley into a monolithic giant which today spans the breadth and width of the state. The greatness of the man and his achievement can only be roughly comprehended in light of the subsequent growth of the college itself. In the late 1870's and throughout the 1880's the average enrollment in the college of agriculture varied between five and ten students.[4] By 1921, sixteen years following Hilgard's retirement, the enrollment in the college included 611 regular students, 450 branch students, 5,625 students in correspondence courses, and 1,302 students at the University Farm at Davis. The college staff, including the personnel at Davis, increased to 120 professors and instructors and fifty-seven extension service agents. Land for research purposes under the aegis of the college amounted to 27,577 acres with research projects located near the vicinity of Riverside, Fresno, Porterville,

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[4]Robert Hill Loughridge, "Writings About Hilgard," Manuscript, University of California, Berkeley, Archives, The Bancroft Library.

Meloland, Mountain View, Shingle, Petaluma, Chico, and Santa Monica, and in the counties of Los Angeles, Tulare and Butte. Expenditures for the year ending June 30, 1920, totalled $884,513 of which only 165,722 came from federal sources.[5] By 1968 the university field experiment stations throughout the state numbered ten and the land area for agricultural research purposes at the Davis farm had increased to 3,700 acres. Projected student enrollment for 1975 is listed at 18,500 students![6]

Hilgard realized his dream of transforming California agriculture through progressive agricultural education. There was no luck involved in this remarkable achievement for he had followed sound approaches in preparing an environment for its future growth. In attending farmers' meetings in the state, he was going directly to the people to promote ways to involve them in the affairs of the college. He spoke their language to convince them of the merits of agricultural science. By relying on sound community organizational techniques, he won many sponsors for his progressive programs. This was all the more remarkable because at this time science had become so specialized and complex that it had been far removed from the public's comprehension.[7] This only compounded the average person's distrust of men of science and made it all the more difficult to justify scientific work in terms of social value.[8]

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[5]E. J. Wickson, Rural California (New York, 1923), pp. 355-57.

[6]Albert G. Pickerell and May Dornin, The University of California: A Pictorial History (Berkeley, 1968), p. 159.

[7]George H. Daniels, American Science in the Age of Jackson (New York, 1968), p. 41.

[8]Ibid., p. 48.

In keeping with his long held belief that the continued growth of scientific agriculture depended upon its utility to society, Hilgard led the nation in establishing a network of experiment stations in California. Their purpose, in part, was to bend science to serve the practical needs of the communities where they were located. At the college he initiated and expanded research into the vital areas of viticulture and winemaking. As a result of this pioneering work, together with his remarkable discoveries concerning alkalai soils, the validity of agricultural research was upheld not only in the state of California, but throughout the nation as well. His masterful success in California stems in part from the fact that "he raised to a higher plane the value of research as an aid to scientific development and [thus made it] easier to get funds necessary to aid in research work."[9]

Hilgard pursued excellence in agricultural education. He was ahead of his time in outlining and projecting a model curriculum for agricultural studies. Upon his arrival at the University of California he instituted a plan of study which was expanded to fifty-four courses by the 1890's. He realized, however, that a plan of study in agricultural science was incomplete without a knowledge of the soil features of the state, so in keeping with his resourceful nature, he single-handedly provided the college with this vital information by conducting a comprehensive survey of the state's agricultural features.

The success of the college of agriculture is largely indebted to Hilgard's perseverance in upholding the principle of agricultural education based on the "university plan." He led the progressive forces

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[9]Lester S. Ivins and A. E. Winship, p. 259.

in their struggle against the "farm school" advocates who called for perfunctory training of the "many" in the techniques of plowing and hoeing. His leadership in making the "university plan" a success assured the future rise of a new generation of agriculturalists who were well versed in the principles, objectives, and aims of agricultural science. His victory over the "separatist movement" of 1879 saved the college from degenerating into a third-rate farm school and instead tied its future to the growth of the university.

Throughout his long tenure as Professor of Agriculture and Director of Experiment Stations, Hilgard strove to make the college and its related facilities the leading center for agricultural research. He organized the experiment stations to function as training centers, collection data agencies, and laboratories. Research work conducted by them was oriented toward the theoretical but always in such a way as to complement the practical nature of agriculture. Hilgard defended the principle of theoretical research as a supplement to empirical investigation and his support of this dual function of the experiment stations served to set the proper example for other stations in the United States.

Hilgard was one of the original leaders in the movement to unite all the resources of the nation behind agricultural education and its research programs. In calling for reform of the lower schools and introduction of science into their curricula, he was endeavoring to bring the state's educational system more in line with the aims of agricultural education. On the other hand, his proposed plan to make the Department of Agriculture a co-ordinating center for agricultural research, and his campaign to obtain a national agricultural survey of

all the lands west of the Mississippi river, reveal his intention to bring the resources of the nation to bear on agricultural research.

There are the intangibles which cannot be easily determined by an examination of this type into Hilgard's many contributions. Indeed, he was the pillar of progressive agriculture in the west, and the example he set must have provided timely guidance and support for others who were facing similar problems in other parts of the country. His success in making the principle of progressive agricultural education a reality, plus his timely writings on the subject, also provided much needed inspiration for those individuals who favored the new science but were unsure of their methods.

There is also the might-have-been side to the story. Could Hilgard have done more for the cause of scientific agriculture? The question seems rather absurd when asked in light of his already tremendous contributions, but it is interesting to wonder whether or not he made a mistake in not accepting the post of Assistant Secretary of Agriculture in 1889. By this time he had already accomplished all that he had set out to do--the crucial battles of the 1870's and 1880's in in California had already been fought and won. No other crises appeared in the 1890's which warranted his special talent; thus the last fifteen years of his career were spent presiding over a sprawling empire and brooding about the apparent misguidance of the Department of Agriculture. Indeed, no one can fault Hilgard for not going to Washington in 1889, but a man of his quality could have been put to good use in solving some of the problems and developing leadership within the Department.

It has been noted that Hilgard was "not only the founder but the

architect and builder of scientific achievement for agriculture in California and was one of the small group of men who were really original and influential in conceiving and determining institutional effort for agricultural advancement in the United States."[10] In the final analysis, his career must represent a splendid triumph for the man and his ideas over the forces opposing change and progress.

Hilgard was retired from the university in 1905, concluding an illustrious thirty year career as Professor of Agriculture and Director of Experiment Stations. Yet even in retirement he put his knowledge of soils into book form in a volume which was published in 1906 and entitled Soils, Their Formation, Properties, Composition, and Relation to Climate and Plant Growth in the Humid and Arid Regions. He also wrote another book in collaboration with W. J. V. Osterhout entitled Agriculture for Schools of the Pacific Slope.

Hilgard received many honors and awards for his distinguished service for the cause of science. On the basis of his research into the nature of climate and soils he was given the "Award of Very Great Distinction" by the Royal Academy of Science in Munich, Germany. In 1894 he was the recipient of the "Liebig Medal" for his outstanding contributions to agricultural science and he received the rare honor of honoris causa interum collalum from Heidelberg University for fifty years of distinction in science by an alumnus. In the United States he was honored with numerous honorary doctor's degrees, in particular, from the University of Mississippi and Columbia University. In 1923 the University of California's journal for agricultural research was

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[10] E. J. Wickson, Rural California, p. 33.

changed to Hilgardia and one of the agricultural buildings on the Berkeley campus now bears his name. Los Angeles and Berkeley as well as other cities in the state have avenues named after him. Perhaps the most appropriate honor which symbolically personifies his great achievement is the 13,357 foot high mountain in the Sierra Nevada which carries the name, Mt. Hilgard. It stands among three other towering mountains: Mt. Darwin, Mt. Lyell, and the Agassiz Needle.[11]

Hilgard lived to be eighty-three years of age. He died on January 8, 1916 following a long illness with pneumonia. Yet, the name of Hilgard will live on as long as there exists the thirst for knowledge and truth through science for Hilgard did not belong only to California or the United States, but to that institution which knows no boundary or nationality, the realm of science.

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[11] Jenny, p. 124.

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