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SCIENCE FOR THE FARMER: THE DEVELOPMENT OF THE MINNESTOA AGRICULTURAL EXPERIMENT STATION, 1868-1910

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Midwestern farmers in the later half of the nineteenth century faced a series of problems in livestock and crop production which the average farmer could not -- for lack of time, money, skills, and other resources -- solve. At best, the average farmer could experiment with different types of feed, seed, crops, or livestock. But, trial and error experiments by an untrained and unorganized multitude of farmers offered few practical solutions. The average farmer, faced with such difficulties, had several options: he could experiment on his own or as part of a group (e.g. the State Horticultural Society); he could find experts who would devote themselves to solving farm problems; or he could make do with what he had.

For farmers as a group, the second alternative made the best use of scarce skills, funds, and time; and it was this alternative which, encouraged by the Morrill Act of 1862 and the Hatch Act of 1887, was offered by the colleges of agriculture. The University of Minnesota College of Agriculture and Agricultural Experiment Station provide an excellent case study of the attempt through federal and state cooperation to bring the science of the day to bear on the problems facing farmers.

INSTITUTIONAL FOUNDATIONS

The University of Minnesota, although legally created in 1851, did not form a College of Agriculture with its own experimental farm until 1869. The University's College of Agriculture was the second attempt to provide

formal agricultural training in the State. In 1858 the legislature authorized but did not fund an Agricultural College at Glencoe.[1]

The early years of the College of Agriculture bore considerable resemblance to the early years of the University: few students, a rapid turn-over in faculty, distrust (at the best) by the farmers, and neglect by the legislature. To the surprise of almost no one, the first two (assistant) professors of agriculture departed after brief tenures. (D. A. Robertson, 1869-1870; D. P. Strange, 1872-1874.) The third professor of agriculture, Charles Y. Lacy, remained for six years (1874-1880).[2]

Under Lacy, there had been some students, but apathy and a belief that the training had little usefulness in farming worked to deprive him of them almost as fast as he recruited. His efforts were devoted largely to the comparative trials of various seeds (sent by the United States Department of Agriculture), crops, shrubs, and trees. Even though the Regents were willing to pay him to do research while he waited for students, Lacy gave up and in 1880 left the University. During the Lacy years, while the Regents

> awaited a new inspiration that might breathe life into the College of Agriculture,.../ they / soothed their consciences by taking over an experiment begun by the State Horticultural Society. They assumed responsibility for the fruit farm at Lake Minnetonka and sponsored the experiments of Peter Gideon.[3]

In January of 1881, the Regents appointed Edwin D. Porter Professor of Agriculture. Porter began his tenure at the University with a concerted effort to meet with all of the "recognized agricultural organizations in the state", and with the legislators and the "responsible men" to determine their views on the role of the College of Agriculture in the service of the State. This public relations tour gave Porter the opportunity to discover and allay many of the fears farmers had towards "intellectuals" from the University "ivory tower". By the time Porter retired in 1889, there is evidence that farmers viewed the College of Agriculture, its faculty, and its new Experiment Station more favorably.[4]

Under the new Professor of Agriculture, the "capacity of the farm in the production of the entire range of farm crops and garden produce /particularly of Minnesota/" was tested, and the comparative trials of potatoes, corn, and amber cane were expanded. The trial experiments convinced Porter that (as Lacy had earlier claimed) the University's land was unsuited for an experimental farm. The farm, with poor soil, bisected by railroad tracks, and near a large and growing population center, was a poor place to raise livestock or grow plants.[5]

Porter made two contributions to the future growth and prestige of the College and (later) the Experiment Station: first, he systematized the distribution of knowledge through the practice of visiting and lecturing to farmers' clubs and a formal "Farmers' Lecture Course"; and second, he convinced the Regents to acquire more suitable land for a farm in St. Anthony Park (then northwest of St. Paul). The Farmers' Lecture Courses developed into the Farmers' Institutes and (later) into the Agricultural Extension

Division. Over two hundred people attended the first series of lectures in 1882 -- seven times the number Porter had hoped for. His selection of the new farm was equally well received by the leading farm organizations, especially by the State Horticultural Society and the Grange. At the time of its establishment as the University Farm (in 1882), the land had been continuously cultivated for over twenty-five years, yet its productivity was much higher than that of the old farm.[6]

INSTITUTIONAL DEVELOPMENT

In 1885, the State legislature directed the Board of Regents to establish an agricultural experiment station. The Regents immediately designated the University Farm as the new experiment station and the College of Agriculture faculty its staff. The station was to conduct original research or verify other work done on the physiology and morbidity of plants and animals, to determine remedies for the various disease and insect problems, to determine the chemical composition and stages of growth of plants, to analyze the soils and waters of the state, to develop plants, trees and shrubs adapted to the soil and climate conditions of the state, and to conduct other related research.[7]

Objectives:

The objectives of the University Farm were three: first, to provide a laboratory (school) for training future farmers in practical agricultural techniques; second, to provide employment to aid students in financing their educations; and third, to provide a place to conduct the research work proper to an experiment station. While the practical training furnished in the preparatory School and the College of Agriculture could

have been detrimental to the research orientation necessitated by the work of the Experiment Station (since the educational faculties comprised the research staff), the result of this union of functions in the same people was turned to advantage over time. The School and the College became the transmission agents for the experiment station as the students acted as private extension agents to their parents and neighbors. This personal contact helped promote acceptance of the work done at University Farm.[8]

The fact that Minnesota established an Experiment Station two years before the Hatch Act of 1887, which provided federal funding, was an indication of the strength of state support for agricultural improvement. Farmers as individuals or as members of agricultural organizations supported the School and the College of Agriculture and the Experiment Station, and influenced the course of their development. In fact, the organized farmers in large measure determined what problems the institutions would examine.

Individual farmers, for example, initiated some flax wilt research in 1889 by appealing to Governor Merriam for assistance in solving a pressing problem. At the request of the Governor, the Regents appointed Otto Lugger, the Station Entomologist, to investigate the causes of flax wilt -- thought to be a soil deficiency of some kind. Dr. Lugger was already well known to the farmers of Minnesota for his expertise in combatting crop-destroying insects. As Kommedahl and others point out, Lugger reached the wrong conclusions about the causes of the wilt, but in creating an interest in the flax wilt problem, he made a considerable contribution to the ultimate solution. Other examples of farmers and farm organizations influencing activities of the Station abound.[9]

Organizational Structure:

Under the Porter organization, the older College of Agriculture was joined by the new Experiment Station. To coordinate these two units, a Department of Agriculture (similar to an Institute) was created. In the early years, the Dean of the Department was also Dean of the College and Director of the Experiment Station. By 1895/1900, the position of Dean of the College of Agriculture was separated from the position of Dean of the Department. Under the Department was the School of Agriculture (established in 1886-87).

Within the College and the Experiment Station, there were various divisions (elsewhere known as departments). The first divisions were (1888): Agriculture; Agricultural Chemistry; Entomology and Botany; Horticulture; and the Veterinary Divisions. Dairy Husbandry (1891) and Animal Husbandry (1892) were created out of the Division of Agriculture, which was renamed the Division of Agronomy and Farm Management (1896). In 1908, the Division of Entomology and Botany was renamed Botany and Plant Pathology; and the Division of Agricultural Engineering was created. In 1909, the College of Forestry was created out of the Division of Horticulture and Forestry. The Farmers' Lecture Courses (1882) had become the Farmers' Institutes in 1885-86, and in 1910, the Division of Agricultural Extension. Most of these reorganizations and new divisions reflected changes within the Experiment Station and (to a lesser degree) the College of Agriculture. In 1887-88, Porter, as director of the Station, proposed a plan of structural reorganization to fit the Station to the requirements of the Hatch Act and its newly increased role.

With the approval of the Regents, authority was vested in the Director of the Station (who was also the Dean of the Department of Agriculture). The Board of Regents Agricultural Committee (which included the Director, ex officio) was to exercise general supervision. Under the Director came the Corps of Experimentation, composed of the Division Heads. The staff of the Station and the faculty of the College of Agriculture were identical.[10]

Porter resigned in 1889, and was succeeded by Nelson W. McLain who soon found the staff challenging his authority as he interpreted his duty and powers. Professor David N. Harper travelled to the Red River Valley to investigate wheat raising without McLain's approval. The Director, at the next staff meeting, made clear his opinion that he was the one responsible for all lines of work and was the one to authorize research selection and travel. Harper objected to this method of determining what work was to be done, and in explicit reference to the Regents' rules of 26 April 1888, stated that such authority was properly that of the Station Corps of Experimentation. The resulting loss of authority of the Director, and the decline of respect shown him by the staff led to McLain's departure before the end of his second year. His successor, Clinton D. Smith, served almost eighteen months before he too departed, in large measure because of conflicts with the staff.[11]

Between 1889 and 1893, decision making and authority rested not in the legally responsible director but in the staff as a group. In an attempt to impose a central control and direction on factious staff, Regent William Liggett was appointed Chairman of the Experiment Station Staff in December, 1893. Because of his unquestioned authority (as

Regent-Chairman) and because of his diplomatic skills which the staff continually tested, Liggett was able to re-establish the authority and dignity of the office of Director by December, 1896, when he was made Director of the Station. The staff voiced no unhappiness at the return to the directorship method of administration. Serving through July, 1907, Liggett made possible the maintenance of a central authority in the Station. Combining the position of Director with that of the Dean of the Department and the College of Agriculture reinforced the power and prestige of the office. This joining of the positions with a Vice or Assistant Director to administer the Station under the Dean and Director's supervision continued for over fifty years until Dean Harold Macy's appointment, when H. J. Sloan was appointed Director of the Agricultural Experiment Station (1954).[12]

Branch Stations:

The Minnesota Agricultural Experiment Station established its first branch in 1893 (the "Coteau Farm") on land owned by O. C. Gregg, superintendent of the Farmers' Institute, at Lynd in the southwestern part of the state. This farm was abandoned in 1903. In 1896, the Station acquired land near Grand Rapids in the northeast and near Crookston in the northwest for use experimental farms or sub-stations. In 1907, the Fruit Breeding Farm at Zumbra Heights near Lake Minnetonka was established. In the 1907-10 period, a forest experiment station was established near Cloquet, to support the work of the School of Forestry, headed by S. B. Green, professor of horticulture and forestry. In 1910, the U. S. Indian School and farm at Morris was transferred to the University and organized as the West Central Branch Station. In addition to the branch stations and University Farm,

there were experimental fields of two to forty acres in size leased throughout the state by various Station divisions.[13]

The various branch stations tested the suitability of climate and soil for various crops and tested the effects of land drainage schemes and fertilizers on productivity. The staffs of the branch stations conducted fruit breeding and animal feeding trials (paralleling Haecker's work), produced certified potato seed, tested and promoted windbreaks and other forest management techniques and tree uses, and conducted studies of swine inbreeding, cattle breeding, and dairy, sheep, and poultry husbandry.[14]

Branch stations often initiated work at the suggestion of local farmers or in response to needs which the staff perceived even though the bulk of the farmers had not. The very location of the branches gave them a limited regional focus and thus offered opportunities for a close rapport with their constituents and theoretical employers. The superintendents of the branch stations participated in and often led local farmers' organizations. An effective interchange of ideas and criticisms was established between the branches and their neighboring constituents.[15] In the early years while the branch staffs were small, there were advantages of working directly with the larger, more diversified central station staff to bring an interdivisional approach to problems, although coordination of interdivisional and branch-central station work imposed strains upon the Station's administration.[16]

Staff

The staff of the Station in 1888 and in successive years consisted of: a) administrators; b) principle researchers; c) technical, clerical and other support workers; and d) research assistants. Although in the

early years, the administrators of the college and station were the same people, this coincidence of functions did not last and station (i.e. research) administrators lost their connection to instructional administration in the college.

The principle researchers of the Station were also the teaching faculty of the College and (to a considerable degree before 1900) the School of Agriculture. (As the most recent directors have noted, the staff of the Station are those College faculty members who are at the time doing research.) The double function did not cease, and had the advantage of keeping many of the teachers abreast of research results that could be applied to teaching. Students might have relayed that knowledge to their farming parents and neighbors -- acting as unpaid agricultural extension agents. The faculty-principle investigators in turn benefited from exposure to students who might raise questions of immediate concern to them or their parents as farmers or report back previous research suggestions. This mutual interchange of questions, ideas, and results was, according to Andrew Boss and other contemporaries, especially common in the School of Agriculture.[17]

Responsibility for the selection of research topics was a chain function, with the faculty-staff suggesting, the division heads recommending, and the director approving. In the early years, as well as later, suggestions or requests have come from farmers, farm organizations, cooperatives, and various industrial organizations and business firms, but since the faculty-staff were an increasingly important source of research suggestions, the numbers, qualifications (and interests) of the staff were of some importance.

In 1888, there were two members of the Division of Agriculture (including the director, Porter), the other divisions having one member each. Only two Ph.D.s were on the staff, although Porter soon resigned leaving one Ph.D. -- Lugger. By 1909, there were two Ph.D.s, H. J. Franklin and E. M. Freeman, who left in 1910, again leaving only one Ph.D. The 1888 staff had two holders of the M.A. degree, the number increased to three (1892-1901), then to four, five, six, and then seven -- clearly the master's degree was "a crown of many jewels," the normal end of formal training for the staff. By 1911, there were thirty-two holders of the Bachelor's degree, seven M.A.s, one Ph.D., three doctors of veterinary medicine, and ten who had no formal degree and no formal collegiate training. It is interesting to note that the two most distinguished members of this group did not hold degrees: Andrew Boss (Professor of Agriculture, later Vice Director of the Station) and T. L. Haecker (Professor of Dairy and Animal Husbandry) who became widely known for his feeding standards.[18]

The station support staff of technical, clerical, and other regular and temporary workers quite naturally increased in size, skills, and status over the years. From the very beginning, some students served as assistants, and this practice increased in frequency as more students needed financial support and the need of the Station for unskilled or semi-skilled workers rose.

RESEARCH TYPES AND METHODS

Strongly influenced by farmers and farm organizations in its development, the Experiment Station, from the beginning was problem oriented

in its work. However, to draw a distinction in terms of (pure) basic research, applied research, and developmental research, the tendency over time was to move towards more basic research. The trend accelerated as the staff and station organization matured, and the staff role in the service of the agricultural community and the University became more clearly defined.[19]

Research Types:

In 1888, with a staff of six researchers, most work was of two types -- either the collection, adaptation, rephrasing and distribution of work done elsewhere, or developmental research. By 1910, with a staff of over fifty researchers, the reporting of work done by others was a very minor portion of the overall output of the station. Some basic research, a large amount of applied research, and a fair amount of developmental work was done. The trend is not clearly evident before 1920, but basic and applied research were becoming more important in several divisions, at the expense of developmental work. On the whole, the station was becoming more interested in basic and applied research.[20]

An example of this trend in the Division of Animal Husbandry is Haecker's work on feeding standards for dairy cows. His experiments in animal nutrition -- in the production of milk -- were essentially basic in nature. The resulting feeding standard used for over forty years was clearly applied research. The testing of this standard was developmental. One man and his assistants did work involving all three research types.[21]

A similar development occurred in the Division of Agricultural Biochemistry, where research was first applied-developmental, but by 1910,

such work was most frequently basic-applied in nature. Applied research in dairy chemistry and animal nutrition occurred more often after 1895. Agronomy and plant genetics was another case of basic-applied research. Out of this work came such varieties as Minnesota No. 163 and No. 169 Wheat, Minnesota No. 13 Corn, and numerous other wheat, oat, barley, flax, and corn varieties.[22]

The work of the Agronomy and Farm Management Division in farm management and costs of production (later transferred to the Division of Agricultural Economics) was of a developmental nature. Work that the Division of Agricultural Engineering later was to consider its own, but which was then distributed over a number of interested divisions, was also developmental.

Research Methods and Subjects:

The methods of research also changed, reflecting the changing research type. Crop trials and other field experiments were supplanted by breeding experiments. Animal morbidity-mortality investigations moved from the farmer's barn to the Station barns and laboratories, and animal nutrition moved from comparing different feed mixtures to making chemical analyses of nutritional needs and the composition of meats and milk, and measuring the effect of diet composition on product composition and value.

The research conducted by the experiment station staff, regardless of the type or method of research utilized, had several objectives: producing higher yields, understanding morbidity-mortality, reducing costs, promoting efficiency, and improving facilities. Nutritional feeding standards for animals and plants, and human nutritional needs were also important research subjects.

From 1868 the experimental farm was used for comparative testing of seeds to find the varieties best suited to Minnesota, with the objective of improving yields. Attempts to prevent yield reducing morbidities of otherwise suitable crop varieties led to insect life cycle, habit and extinction studies, as well as to disease and remedy investigations. In the course of the crop investigations, the staff began to collect cost data -- though experimental plots were too small for a valid study without field surveys by route-men in various areas of the state. In the 1880's, the staff studied plant mineral needs and chemical deficiencies, and chemical compositions and nutritional values (for both animals and humans) of the various crops. Uses of crops -- e.g. productivity in milling cereals -- also became an early field of investigation, not a surprising occurrence, given the large milling industry in nearby Minneapolis.[23]

In the early years of the University Farm, the staff also studied animals. Haecker's investigation of nutritional requirements and effects of various feeding standards for dairy cattle were extended gradually to sheep, poultry, and other farm animals. The effects of insects and diseases (some insect-borne) were other early subjects of investigation, and led to studies of animal morbidity and mortality and searches for remedies. There were some studies of the impact of ventilation in stock barns on livestock health (e.g. contagious abortion tuberculosis in cattle), of milk production costs, and later, of slaughter animal production costs.

Although studies of nutrition, disease, and production costs had limited impact at first, they led eventually to the development of home economics and food science and nutrition departments after 1910, the

development of the Bureau of Agricultural Economics in 1912, and the cooperation between the Division of Veterinary Science and the School of (human) Medicine after World War I.[24]

By the 1890's, the increasingly varied nature of research questions, researcher expertise, and of outside factors such as climate and soil conditions in the state meant that no one person could successfully master all aspects of a problem, nor could one experimental farm location give satisfactory results for the whole state. As a result, the University established branches of the experiment station in other parts of the state and promoted team research efforts and inter-disciplinary work. Because divisional and discipline boundaries were drawn very loosely or not at all in the first branch stations, men with a variety of training often worked jointly on projects. The project or group approach to problems was formalized in the experiment station by W. M. Hays in the late 1890's.[25]

SUMMARY AND IMPLICATIONS

By 1910, the Experiment Station existed within a political context. The legislature, urged on by the better farmers and farm organizations, created it and provided a large amount of funding for the operation of the branch stations and for certain designated projects. The farmers assumed, on the basis of twenty-five years of experience, that the Station would help them solve the various problems which beset them. They and their organizations frequently suggested research problems and benefited from much of its work.

The Station was part of the larger federal-state agricultural research network and acquired information of use to Minnesota farmers from stations

in other states and from the various agencies of the United States Department of Agriculture. In turn, the Minnesota Agricultural Experiment Station passed on inquiries and results of its own work to the other members of the research network. In 1910, this exchange process was becoming increasingly significant as a source of answers to common problems facing farmers in several states. Through various cooperative projects initiated before the turn of the century, the Station helped to provide solutions to these common problems, and in turn received information of use to its constituents.

The Minnesota Experiment Station was also a part of the Department of Agriculture in the University of Minnesota. Within the Department, the Colleges of Agriculture and Forestry provided academic training in agricultural subjects, and their faculties provided the Station with its research staff. The School of Agriculture at University Farm, serving as a preparatory school for the College, was a useful means of disseminating information to parents and neighbors. By the turn of the century, various divisions in the Department had extension agents on their staffs. These agents, working closely with the Farmers' Institutes, reinforced the disseminatory efforts of the research staff and the students. By 1910, the need for a formal extension effort had been realized, and in that year the Division of Agricultural Extension was established to provide such an agency.

In the early development of the Minnesota Station, two important features stand out which would appear to be important for the success of agricultural research in developing nations at the present. First,

the staff of the Minnesota Station strongly identified with the farmers of the State and, particularly in the period under examination, made personal efforts to learn of farm problems and to show farmers ways of solving those problems. (In the line of duty, many a professor at Minnesota came back to St. Anthony Park caked in mud from the fields, e.g. Lugger and Boss.) It would appear that interaction with the students also contributed to the close association between the station and farmers. Students brought pressing problems to the classroom and to the attention of the Station staff that might otherwise have gone unrecognized or ignored. Similarly, students upon returning to the farm carried solutions to these problems which they demonstrated to their families and neighbors.

Second, the gradual shift to a science-based institution made possible a more in-depth analysis of problems and the production of new techniques and inputs that were much more productive than the old. The Minnesota Experiment Station appears to have achieved a balance between practical problem solving and scientific inquiry.

The combination of staff identification with farm people (most of the staff came from farm or rural families), interaction with students, and utilization of scientific methods enabled the Minnesota Agricultural Experiment Station to gain acceptance among farmers while producing new inputs or techniques which increased farm output and reduced production costs.

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[1] James Gray, The University of Minnesota, 1851-1951 (Minneapolis, the University of Minnesota Press, 1951), pp. 13-35,55ff; University of Minnesota, Board of Regents, Ninth Annual Report..., 1868, p. 9 (hereafter, Regents); Andrew Boss, Minnesota Agricultural Experiment Station, 1885-1935, Bulletin 319 (St. Paul, Minnesota Agricultural Experiment Station, May, 1935), pp. 5-8; W. S. Chowen, "A Brief History of the Part Taken by the Patrons of Husbandry in the Establishing of the Experimental Farm and Farm School...", and C. P. Bull, "An Unbalanced Credit for the Development and Establishment of the Central School of Agriculture, University of Minnesota", Supplement 7, Example 3b, ALI.1 #1 and Supplement 10, Example 6, ALI.1 #2, University of Minnesota Archives, Minneapolis; Agricultural College /Glencoe/, Board of Regents, First Annual Report..., 1867, passim.

[2] Regents, 1868, p. 10; Regents, 1869, p. 8; Regents, 1871, pp. 6-7; Regents, 1872, pp. 10, 35; Regents, 1874, pp. 8-10; Regents, 1881-1882, pp. 7-8; "Directors of the Station" (typescript list), Agricultural Experiment Station Info File, University of Minnesota Archives; Bill W. Kennedy, "The Land-Grant Movement and Its Influence on Scientific Agriculture in Minnesota," The Minnesota Academy of Science Proceedings, 30:1 (1962), p. 93.

[3] Gray, University of Minnesota, p. 59; Regents, 1881-1882, pp. 7-8; "Directors of the Station", Info File, University of Minnesota Archives; Kennedy, "Land-Grant Movement," pp. 92-97.

[4] University of Minnesota, Department of Agriculture, Biennial Report, 1881-1882 (reprinted in Agricultural Experiment Station, Biennial Report, 1885-1886, pp. 113-114).

[5] University of Minnesota, Department of Agriculture, Biennial Report, 1881-1882 (reprinted in Agricultural Experiment Station, Biennial Report, 1885-1886, pp. 116-127); Regents, 1881-1882, pp. 12-14, 90-95.

[6] Regents, 1878, p. 9; Regents, 1881-1882, pp. 12-13; Regents, 1883-1884, pp. 12-14; University of Minnesota, Department of Agriculture, Biennial Report, 1881-1882 (reprinted in Agricultural Experiment Station, Biennial Report, 1885-1886, pp. 116-127).

[7] University of Minnesota, Agricultural Experiment Station, Biennial Report, 1886, p. 133 (hereafter, Station, Biennial...).

[8] Station, Biennial, 1886, pp. 128-129; Regents, 1885-1886, pp. 27-28; Regents, 1887-1888, p. 7; C. P. Bull, "History of the School of Agriculture" (typescript), Example 11b, ALI.1 #15, University of Minnesota. School of Agriculture. Papers. 1885-1947, University of Minnesota Archives; Andrew Boss, "Achievements of the Minnesota Experiment Station," Agricultural Research Through Fifty Years, 1885-1935, Bulletin 328 (St. Paul, Minnesota Agricultural Experiment Station, May, 1936), typescript in the Agricultural Experiment Station Info File, University of Minnesota Archives; Kennedy, "Land-Grant Movement," pp. 93-95.

[9] Station, Biennial, 1887-1888, and subsequent years, passim; University of Minnesota, Agricultural Experiment Station, Annual Report, 1896, pp. viii, xiv (hereafter, Station, Annual...); T. Kommedahl, J. J. Christensen, and R. A. Fredericksen, A Half Century of Research in Minnesota on Flax Wilt Caused by Fusarium Oxysporium, Technical Bulletin 273 (St. Paul, Agricultural Experiment Station, 1970), pp. 7-8; Corps of Experimentation, "Minutes of the Experiment Station Corps, 1885-1909," vol. I (unpaged), 30 January 1892, p. 10, ALI.1 vol. 42, and Corps of Experimentation, "Minutes of the Experiment Station Corps, 1885-1909," vol II, 17 December 1888, p. 10, ALI.1 vol. 43, University of Minnesota. School of Agriculture. Papers. 1885-1947, University of Minnesota Archives.

[10] Regents, 26 April 1888 (reprinted in Station, Biennial, 1887-1888, pp. 58-61); Station, Annual, 1890, p. 10.

[11] Station, Annual, 1890, p. 10; Corps of Experimentation, "Minutes of the Experiment Station Corps, 1885-1909, vol. II, 22 October 1889, p. 43, ALI.1 vol. 43, University of Minnesota. School of Agriculture. Papers, 1885-1947, University of Minnesota Archives.

[12] Conversations with Deans H. J. Sloan and H. Macy, 28 November 1972; and with Dr. W. Hueg, Director of the Minnesota Agricultural Experiment Station, 11 January 1973;"Faculty Letter, Apring 1964/65, College of Agriculture, Forestry and Home Economics, Appendix A, Comments by Director Sloan and Dr. Hueg Summarizing Experiment Station Activities," Agricultural Experiment Station Info File, University of Minnesota Archives.

[13] Station, Annual, 1895, p. iii; Boss, Minnesota Agricultural Experiment Station, 1885-1935, p. 12.

[14]Boss, Minnesota Agricultural Experiment Station, 1885-1935, pp. 70-78.

[15]Boss, Minnesota Agricultural Experiment Station, 1885-1935, pp. 11-13, 70-78; Station, Annual, 1896, p. vii; Station, Annual, 1909, p. xxiii.

[16]Station, Annual, 1890, p. 10; Corps of Experimentation, "Minutes of the Experiment Station Corps, 1885-1909," vol. II, 22 October 1889, p. 43, ALI.1 vol. 43, University of Minnesota. School of Agriculture. Papers. 1885-1947, University of Minnesota Archives; Hays and his colleagues at Minnesota, at the U.S.D.A., and at the North and South Dakota Experiment Stations began cooperative work before 1900; Station, Annual, 1900, p. vii; Station, Annual, 1902, pp. vii-viii.

[17]Conversations with Deans Sloan and Macy, 28 November 1972; and with W. Hueg, Director, Minnesota Agricultural Experiment Station, 11 January 1973; and with the members of the Consultative Committee (Deans Sloan and Macy; Dr. Hueg; Professor W. Sundquist, Head, Department of Agricultural and Applied Economics; Professors W. Peterson, V. Ruttan, and W. Fishel, Department of Agricultural and Applied Economics; and Professor R. Loehr, Department of History, all University of Minnesota; Station, Annual, 1890, p. 10.

[18]Station, Biennial, 1885-1886, p. 5; Station, Biennial, 1887-1888, p. 7; Station, Annual, 1911, pp. iii-iv.

[19]To define by example may be the most appropriate method. Basic (fundamental) research is the work on how genes combine. Applied research uses this knowledge of genes to develop breeding techniques. Developmental research applies these breeding techniques to the production and maintenance of new strains of plants or animals. Using all bulletins or bulletin sections (sample for 1888-1910 is 265), the average research type can be derived. For 1888-1892, n=80, average research type = 7.4 (1=basic, 6=applied, 9=developmental research), and for 1906-1910, n=28, average research type = 5.8. The movement towards basic-applied research is noticeable.

[20]Analysis of all station bulletins and technical bulletins (including bulletins with more than one subject) was done. Some of the results are noted in footnote 19. The average research type tends to fluctuate, and there is evidence that there were two groups of people -- by preference for research type -- on the station staff, one group prefering applied-developmental research, the other prefering basic research. The net result of this interaction is to move the average research type for station bulletin reports towards basic-applied research. This is a reflection of a stronger movement in the station staff's work. Station bulletins are intended for popular reference and are not likely to report basic research in depth.

[21]Boss, Minnesota Agricultural Experiment Station, 1885-1935, pp. 34-40; Boss, "Achievements," Bulletin 328, p. 6; Kennedy, "Land-Grant Movement," p. 94 notes the advocacy of "long-range benefits were set up, beginning in about 1910," based on earlier basic work at Minnesota and at other stations.

[22]Boss, Minnesota Agricultural Experiment Station, 1885-1935, pp. 14-19, 24ff; Bulletins 1 (1888) through 146 (1910), passim.

[23]Station, Biennial, 1885-1886, passim; Boss, Minnesota Agricultural Experiment Station, 1885-1935, pp. 8-10, 14-34; University of Minnesota, Agricultural Experiment Station, The Minnesota Agricultural Experiment Station (St. Paul, University Farm, 1925), (unpaged) pp. 7, ("In all such work the Station has the close cooperation of the Minnesot a Crop Improvement Association.").11, 17, 23-25.

[24]University of Minnesota, Agricultural Experiment Station, The Minnesota Agricultural Experiment Station, pp. 17, 21-29.

[25]W. M. Hays developed the "organized attack"on inter-disciplinary problems facing the Station, based on the project system which included a "statement of the part each /scientist/ was to take in the venture and outlining the course of procedure to be followed," Boss, "Achievements /of the Minnesota Agricultural Experiment Station/," pp. 9-10 (typescript), Agricultural Experiment Station Info File, University of Minnesota Archives.