Uplifting American Agriculture: Experiment Station Scientists and the Office of Experiment Stations in the Early Years After the Hatch Act

LOU FERLEGER

Alfred C. True, Director of the Office of Experiment Stations (OES) in its formative years, once remarked that it was the intent of the OES to be supportive, sympathetic, and helpful in order to assist and bolster agricultural research at American experiment stations. Conflicts arose between the stations and the OES, of course, despite good intentions. These conflicts involved more than bureaucratic hassles or professional disagreements on the merits of specific lines of agricultural research. True’s vision of uplifting American agriculture centered on stimulating station scientists to pursue research investigations that were fundamentally abstract in character. He considered investigations that utilized scientific principles critical to achieving progress in agriculture, even if the investigations appeared superficially unrelated to the immediate needs of farmers. He believed that despite differential soil, climate, and crop mixes, experiment station scientists could organize their work efforts in common areas emphasizing original research. Throughout his illustrious career he encouraged experiment stations to adopt his philosophy on advancing agriculture; that is, uplifting agriculture meant reorienting research work away from responding to local agriculture problems to focusing on improving the scientific foundations of agriculture. In other words, if American

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agriculture were to prosper, experiment stations needed to solve the mysteries abounding in agricultural science.

This paper explores the extent to which the OES was successful in influencing experiment station research. The pattern of agricultural research at the experiment stations is also described. The various ways the OES viewed the stations’ work is examined by analyzing their public statements on the nature of the research being carried out. The argument of this paper is that the OES was quite successful—much more than they realized—in reorienting agricultural research at the experiment stations by 1910. While many valuable studies have emphasized the disputes, problems, and disagreements that marked the OES relationship with some experiment stations or the United States Department of Agriculture (USDA), few have connected these issues with the change in the overall pattern of agricultural research at American experiment stations. Another issue examined in this paper is that notwithstanding the OES success at altering the nature of experiment stations investigations, this did not necessarily mean that they were reaching more ordinary American farmers. Simply put, while the OES was successful at changing the attitudes of station scientists regarding their work, they did not fare as well with farmers.

The Hatch Act of 1887 stated that agricultural experiment stations should “aid in acquiring and diffusing among the people of the United States useful and practical information . . . under the direction of the college or colleges or agricultural department of colleges . . . [and] That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments.” The Act further authorized the Secretary of Agriculture “to secure, as far as practicable, uniformity of methods and results in the work of said stations . . . [and] to indicate from time to time such lines of inquiry as to him shall seem most important . . . to furnish such advice and assistance as will best promote the purpose of this act.” To oversee the provisions of this Act, which included giving each station $15,000 annually in addition to whatever additional funds were provided by the states or through fees, the USDA in 1888 established the OES. Six years later Congress passed legislation that allowed the USDA to determine if station expenditures were in accord with the provisions of the Hatch Act. The Association of American Agricultural Colleges and Experiment Stations (AACES) passed a resolution supporting the USDA’s “measure of supervision . . .” of their expenditures. 2

7 Experiment Stations

The Hatch Act implied that experiment stations serve or be accountable to several constituencies, i.e., farmers, land-grant colleges, and the OES. The Act itself was somewhat confusing and subject to wide interpretation.\(^3\) The OES believed that the introductory clause of the Hatch Act had misled people. That is, the suggestion that the stations would “aid in acquiring and diffusing among the people of the United States useful and practical information.” In addition, because experiment stations were located in land-grant colleges, the allocation of station resources was subject to oversight not only by the OES but by college officials. Many of these agricultural colleges had their own troubles, some of which centered on insufficient state funding and farmer disillusionment with the colleges’ programs and policies. Thus, from the onset of the Hatch Act the stations were under intense pressures, and as these various pressures lessened or intensified, the character of their research changed. Individual histories of experiment stations reek with bureaucratic and political horror stories that contributed to inhibiting research agendas.

Experiment station scientists relied on books and agricultural magazines for information on the advances in agricultural science. More importantly, they relied on the Experiment Station Record, the official publication of the OES that regularly printed abstracts of experiments or reports conducted worldwide, including the details of American and foreign stations experiments.

The Record provided two kinds of information for scientists. First, the content (albeit in an abbreviated form) and category of each bulletin was reported in the Record (sometimes the results of experiments were summarized in annual reports). These abstracts allowed American experiment station personnel to familiarize themselves with the specific details of completed experiments worldwide. Second, OES officials wrote editorials on the pattern of domestic and foreign agricultural research. In this regard the OES staff often solicited articles (or summarized major findings) from domestic and foreign investigations of particular interest to the OES. Usually these articles were accompanied by an editorial commenting on the significance of the results. These editorials represented OES views—positively and negatively—on the trajectory of agricultural science carried out by American and foreign investigators.\(^4\)

Completed experiments—indeed of the success or failure of the experiment—were typically recorded in the Record as they were released.

4. True assumed directorship of the OES after volume 4 of the Record. It was not possible to positively determine who wrote the editorials in the Record. However, it appears to have been True and occasionally E.W. Allen. Wayne Rasmussen agrees with my assessment that True probably wrote the editorials. See ESR 4 (1892–92):1; Rasmussen, private correspondence.
for public dissemination. By volume four of the *Record*, the OES had categorized the experiments into various areas with each section containing abstracts describing or highlighting details of the experiment. These published abstracts provided scientists with a snapshot of final results of agricultural inquiries and contributed to the professional standing of the investigator(s). These bulletins, then, provided a crude index for scientists of progress in experiments involving such areas as corn in Iowa, cotton in Georgia, dairy farming in New York, irrigation in Utah, allowing them to correlate their inquiries with others similarly engaged.5

The pattern of agricultural research carried out at the experiment stations is displayed in Table 1. This table describes the percent of experiments per category per region between 1892–1909. The numbers in Table 1 indicate the extent to which each region accounted for specific categories of agricultural research that were abstracted in the *Record*. The percent figure refers to the total number of abstracts cited per category per region in the *Record* divided by the total number of abstracts cited per category in the United States. For example, the North conducted 569 experiments out of 1,289 nationwide or 44.1 percent of the Soil and Fertilizers (category 4) experiments carried out over the years. In terms of the absolute number of experiments carried out, the northern stations dominated the nation. This region accounted for 35 percent or more of all experiments in 8 categories. More importantly, northern stations totalled over 40 percent in 6 categories. In only four categories did they fail to be ranked 1st or 2nd. The Midwest and West led in research work in two categories (the former in field crops and botany, the higher ranking in category 2 because the Midwest completed one more experiment than the North; the latter in forestry and irrigation), and the South ranked first only

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5. David B. Danbom, “The Agricultural Experiment Station and Professionalism: Scientists Goals for Agriculture, 1887–1910,” *Agricultural History* 60 (Spring 1986): 246–55. The length of abstracts in the *Record* varied considerably. Some were short, others quite long. I could not determine the decision rule used to specify the length of an abstract. Since different OES personnel over the years were responsible for summarizing the research results, uniformity in the write ups of the research does not appear to have been a central concern. It was clear, however, that when an experiment or set of experiments were completed that appealed to the field expert, the abstract was more detailed and comprehensive. The writers of abstracts and the managing of the *Record* also underwent several changes over the years. Starting with volume six the *Record* was organized by topics—abstracting station publications, Department of Agriculture and foreign investigations by category of experimental science to make it more readable and accessible to scientists. In volume 11 Dr. E.W. Allen assessed editorial management of the *Record*. The *Record* also stated in this volume that “the abstracts were in brevior [sic] type than was formerly the case, . . . and also to omit many of the details which were formerly included. This calls for closer discrimination on the part of the abstracters, . . . it will make it more strictly a record of progress in agricultural.” See *ESR* 6 (1894–95):1; *ESR* 7 (1895–96):262; *ESR* 11 (1899–1900):2, 1101.
### Table 1. Distribution of United States Experiment Station Experiments, by Region, 1892–1909 (percentage)

<table>
<thead>
<tr>
<th>Articles Classified</th>
<th>U.S.</th>
<th>North</th>
<th>Mid-West</th>
<th>West</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Chemistry</td>
<td>100.0</td>
<td>41.7</td>
<td>23.5</td>
<td>11.3</td>
<td>23.5</td>
</tr>
<tr>
<td>2) Agricultural Botany</td>
<td>100.0</td>
<td>28.1</td>
<td>28.8</td>
<td>20.6</td>
<td>22.5</td>
</tr>
<tr>
<td>3) Meteorology</td>
<td>100.0</td>
<td>45.8</td>
<td>18.0</td>
<td>13.8</td>
<td>22.4</td>
</tr>
<tr>
<td>4) Soil and Fertilizers</td>
<td>100.0</td>
<td>44.1</td>
<td>18.5</td>
<td>13.7</td>
<td>23.7</td>
</tr>
<tr>
<td>5) Field Crops</td>
<td>100.0</td>
<td>21.3</td>
<td>30.7</td>
<td>18.2</td>
<td>29.9</td>
</tr>
<tr>
<td>6) Horticulture</td>
<td>100.0</td>
<td>35.3</td>
<td>23.0</td>
<td>18.9</td>
<td>22.8</td>
</tr>
<tr>
<td>7) Forestry</td>
<td>100.0</td>
<td>27.2</td>
<td>28.9</td>
<td>30.7</td>
<td>13.2</td>
</tr>
<tr>
<td>8) Diseases of plants</td>
<td>100.0</td>
<td>43.4</td>
<td>26.5</td>
<td>14.8</td>
<td>15.3</td>
</tr>
<tr>
<td>9) Entomology and zoology</td>
<td>100.0</td>
<td>36.1</td>
<td>21.0</td>
<td>16.7</td>
<td>26.2</td>
</tr>
<tr>
<td>10) Foods/Animal Production</td>
<td>100.0*</td>
<td>40.7</td>
<td>29.4</td>
<td>14.8</td>
<td>15.0</td>
</tr>
<tr>
<td>11) Veterinary science/med.</td>
<td>100.0</td>
<td>23.9</td>
<td>26.5</td>
<td>12.3</td>
<td>37.3</td>
</tr>
<tr>
<td>12) Dairy farming/Techn.</td>
<td>100.0</td>
<td>42.8</td>
<td>36.5</td>
<td>7.8</td>
<td>12.9</td>
</tr>
<tr>
<td>13) Agricultural/Rural Engin.</td>
<td>100.0</td>
<td>10.8</td>
<td>29.4</td>
<td>46.9</td>
<td>12.9</td>
</tr>
</tbody>
</table>


*Note: The articles classified refer to abstracts of experiment station bulletins and annual reports cited in the Experiment Station Record, excluding those from Alaska, Hawaii, and Puerto Rico. Some bulletins covered experiments in more than one category. For example, bulletin 77 of the South Dakota Experiment Station reported on experiments in “Macaroni Wheat in South Dakota.” These experiments were reported in volume 16 of the Record in two categories: Field Crops (5) and Foods/Animal Production (10). Table 1 reflects citations of bulletins including those experiments that were reported in multiple categories. If the experiment station carried out several different kinds of experiments and they were listed separately, they are recorded above individually. Some stations reported their experiments when they published their annual reports. For example, the 1907 Annual Report of the Pennsylvania Experiment Station cited in the Record listed station experiments or tests in categories 3, 6, and 12. The breakdown above reports abstracts not by the number of bulletins or reports issued per station but by the number of times an abstract referring to the bulletin or report is cited in the Record. To list and count only bulletins and reports would seriously understate the range of experiments carried out in several areas and summarized in one bulletin or report. See True, A History of Agricultural Experimentation and Research in the United States, 163–64.*

*Does not equal 100 percent because of rounding off.

in veterinary science. The data reinforces a well-known fact—that northern stations led the nation in experimental agricultural science.

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6. Between 1892–1909, spanning volumes 4–21, northern stations led the nation in the total numbers of abstracts cited with the Midwest ranking second, the South third and the newer states of the West trailing in citations. More precisely, the North had almost double the number of abstracts than the West and one thousand or more abstracts than either the Midwest or South. Over the years some categories were combined. For example, Category 5 was two separate categories until volume 17 of the Record. Separate reports listed Fertilizer experiments and Air, Water and Soil experiments. After volume 17 Water experiments were included under Meteorology. Soil experiments were no longer listed but, as stated above, included with fertilizers. Some aspects of previous categories disappeared or were no longer listed separately. This appears to be what happened to Air studies. For a full listing of previous and changed categories see volume 16 and 17 of the Experiment Station Record. The list of abstracts of experiments in table 1 reflects the combined categories recorded after volume 17.
Table 2. Distribution of Experiment Station Experiments With Regions and the U.S., 1892–1909 (percentage)

<table>
<thead>
<tr>
<th>Articles Classified:</th>
<th>U.S.</th>
<th>North</th>
<th>Mid-West</th>
<th>West</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Chemistry</td>
<td>2.3</td>
<td>2.7</td>
<td>2.1</td>
<td>1.6</td>
<td>2.4</td>
</tr>
<tr>
<td>2) Agricultural Botany</td>
<td>1.5</td>
<td>1.2</td>
<td>1.6</td>
<td>1.9</td>
<td>1.5</td>
</tr>
<tr>
<td>3) Meteorology</td>
<td>4.2</td>
<td>5.4</td>
<td>2.9</td>
<td>3.6</td>
<td>4.2</td>
</tr>
<tr>
<td>4) Soil and Fertilizers</td>
<td>11.9</td>
<td>14.8</td>
<td>8.4</td>
<td>10.2</td>
<td>12.7</td>
</tr>
<tr>
<td>5) Field Crops</td>
<td>17.4</td>
<td>10.4</td>
<td>20.4</td>
<td>19.7</td>
<td>23.3</td>
</tr>
<tr>
<td>6) Horticulture</td>
<td>13.1</td>
<td>13.0</td>
<td>11.5</td>
<td>15.5</td>
<td>13.5</td>
</tr>
<tr>
<td>7) Forestry</td>
<td>1.1</td>
<td>0.8</td>
<td>1.2</td>
<td>2.0</td>
<td>0.6</td>
</tr>
<tr>
<td>8) Diseases of plants</td>
<td>8.6</td>
<td>10.4</td>
<td>8.7</td>
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<td>5.9</td>
</tr>
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<td>10) Foods/Animal Production</td>
<td>14.7</td>
<td>16.8</td>
<td>16.5</td>
<td>13.5</td>
<td>9.9</td>
</tr>
<tr>
<td>11) Veterinary science/med.</td>
<td>4.4</td>
<td>2.9</td>
<td>4.4</td>
<td>3.4</td>
<td>7.3</td>
</tr>
<tr>
<td>12) Dairy farming/Techn.</td>
<td>8.3</td>
<td>10.0</td>
<td>11.6</td>
<td>4.1</td>
<td>4.8</td>
</tr>
<tr>
<td>13) Agricultural/Rural Engin.</td>
<td>1.8</td>
<td>0.6</td>
<td>2.0</td>
<td>5.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Total:*</td>
<td>100*</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100*</td>
</tr>
</tbody>
</table>

*Does not equal 100% because of rounding off.

A somewhat different picture emerges by examining the distribution of experiments within regions. The percent figure in Table 2 refers to the total number of abstracts cited per category in the Record divided by the total abstracts cited irrespective of category per region over the years. For example, the North had 103 abstracts listed under Chemistry (2) out of a total of 3840 thousand experiments noted in the Record that originated in Northern stations. The data in Table 2 suggest that there were differences regionally in the kinds of experiments stations carried out. Every region had at least one or two categories that stood out—implying that scientists within these regions devoted more attention to these areas than others. This was even the case when the number of experiments cited is small. Not all of these differences within regions, however, were statistically significant. Nor does the data indicate whether or not there were sharp quality differences in the nature of the experiments carried out regionally or nationally. For example, several states within these regions produced fewer and more insightful bulletins on the merits of soil and fertilizer tests than other stations. Other states carried out twice or three times as many experiments but with inconsistent and inconclusive results. It was not possible to determine an appropriate decision rule to rank the bulletins in terms of the quality of the investigation. In sum, Table 2 describes the regional pattern of experiment station research that the OES was editori-
ally commenting on in its attempts to influence the pattern of agricultural research.

Some of the results displayed in Table 2 are not surprising. For example, in three of the four regions field crop experiments dominate all other types of experiments (only in the North was this not the case). In the West and South the two top research areas were field crops and horticulture, in the Midwest field crops and foods and animal production, while the North tended to concentrate on soil and fertilizer tests as well as foods and animal production. Seven categories account for between 82.2 and 86.4 percent all experiments across all regions. These were soil and fertilizer, field crops, horticulture, diseases of plants, entomology (zoology accounted for an insignificant proportion of experiments), foods and animal production, and dairy farming (few experiments focused on technology). Since stations had differential sources of funds at their disposal, it is noteworthy that regions concentrated their major research efforts on a similar set of investigations.7

OES staff were critical of many aspects of experiment station work, including inquiries in these seven categories. Under the Hatch Act, the OES was to evaluate station work regularly in order to judge whether or not stations met its standards for experiment work. These standards are not easily discernible since the OES did not spell them out in an editorial, but it appears that the OES had its own definition of a "model" station. Several characteristics of this model seem evident. First, a model station would make a clear distinction between research and instructional work. Second, the character of research investigations would utilize verifiable scientific principles. Third, the stations would not be purveyors of general information on agriculture—instead they would be autonomous, science-serving institutions, emphasizing, for example, why diversified crop mixes were preferable to having farmers only rely upon one or two crops.8 Finally, since the stations were located in land-grant colleges, the station directors would attempt to discourage administrators from disrupting research work either because of bureaucratic difficulties or inappropriate political interference.

7. It is possible to regroup the data in several other ways. One way is to examine the number of categories in which a region is dominant. This ranking does not imply that if a region has 0.2 percent higher citations that this is a statistically significant difference or that higher ranking means more citations per category nationwide. The rankings do reflect, however crudely, the relative importance of particular areas of research over others. If we combine the number of times a region is ranked either first or second, the North, South, and Midwest had rankings of 1st or 2nd seven or eight times, while the West only had similar rankings five times. This reinforces the previous finding that the regions had multiple areas of research and were not narrowly confined in their experiments.

The European stations, known for their high quality investigations and educational programs, were the most concrete example of what the OES may have desired in its "model" station, particularly the German stations. The character and quality of investigations abroad were so frequently invoked as counter examples to American stations that one could imagine the OES requesting a transplant or a clone from a European station to an American station. Europeans had done important studies in, among many areas, analyzing feed stuffs, dairying, seed investigation and control, systematic variety tests, as well as long-term detailed field studies in a few lines of inquiry that emphasized cooperative work in the field and laboratory.9

Of all the issues raised by the OES, two stand out. First, that station scientists were not carrying out enough original research in agriculture. The OES argued that station research should be original in that it push at the boundaries of agricultural science. Second, that the stations could not satisfy all farmer demands. They criticized state bulletins that were for universal consumption if all they did was present well-known farm practices for popular audiences. In this connection the OES lamented that many station scientists had a heavy work load of instructional duties at the land-grant colleges. This work might serve the college well but not agricultural science.

In the 1890s the OES urged stations to "make a wise selection of the few [questions] which ought to engage the serious attention of any one station. There is a danger that in yielding to a local demand for the testing of new crops or the improvement of old ones the real interests of even that locality may be sacrificed." One apparent consequence was that "field experiments seem [to be] so barren of useful results." This happened, argued the OES, because these experiments were not done jointly with other scientific studies, such as vegetable physiology. The best results in the field would include some joining of chemical and physical inquiries—what the OES called the "union of scientific work." The stations could accomplish this by specializing in one line of work around which all other activities within the station could be grouped. Then, "Concentration and combination of effort will give vigor and effectiveness to these institutions for the uplifting of agriculture."10

The problem, however, was that stations were not heeding OES advice


as they expanded the scope of their work in the 1890s. The OES was particularly dismayed by the character of station variety investigations of wheat and corn. Tests that only covered a few years on limited plats were criticized because these tests were not sufficiently long enough to determine if the variety could adapt to local conditions. Unlike most American tests, they argued, German variety tests lasted 5 consecutive years on a large number of farms. Attempting to influence variety research, they cited with considerable praise a bulletin from the Illinois Station that had recently completed variety tests of corn over eight years on many plats similar to the German testing methods. An editorial commended those who understood the need to conduct experimental inquiries in a “strictly scientific manner.” By the turn of the century the OES editorials identified those stations that extended the time span of their variety tests: Minnesota’s wheat tests, West Virginia’s timothy, Louisiana’s sugar-cane, and Delaware’s sorghum, and upland and sea-island cotton throughout the South. These stations received praise for their emphasis on selection and improved breeding in agricultural plants over an extended time horizon.

11. It is against this background that E.W. Allen, the Assistant Director of the OES, wrote a paper in the 1890s on dairy work at the experiment stations that he intended to present at the eighth annual meeting of the AAACES. A crowded agenda at the conference prohibited him from presenting it there. Instead, the paper appeared in the 8th volume of the Record with a footnote noting that “Inasmuch as it contains reasonable criticisms of the work of our stations in dairying, together with pertinent suggestions regarding the further development of investigations in this line, its publication by the Department is deemed advisable.” In his article Allen analyzes those stations who have recently taken up dairying work, in particular he mentions southern experiment stations. While commending some, he was quite critical of those whose “... chief object is to illustrate the ordinary operations of dairy and creamery management, and to develop the industry in State.” On the one hand, promoting dairy work could lead to commercial success for farmers by upgrading their products for the market. On the other hand, if the stations persisted in this line of work in dairying, these “... conditions are opposed to experimental work, and often render such work well-nigh impracticable.” Simply put, if any experimental inquiries in dairying were to occur, it would be incidental, with little if any far reaching conclusions. Allen’s article raised these issues diplomatically. Nonetheless, he was concerned that without original research in dairying (similar to the European studies he cited) that involved other branches of experiment work, scientists would not be utilizing their resources efficiently. Acknowledging that stations were pursuing various kinds of dairy work, he cautioned them “... to remember that the operations of experimenting, even along the most practical lines, are essentially different in details from those followed by the farmer, and require close supervision and attention to the minor details.” See ESR 8 (1896–97):359–67, my emphasis.

12. ESR 7 (1895–96):174, 903–05; ESR 11 (1899–1900):202–03. Irrigation studies in the West and nationwide were criticized in the 1890s and 1900s for concentrating only some of their efforts on these problems. An editorial on the West in the 1890s argued that the region needed to spend more energy and funds expeditiously, and along the lines of research espoused by the OES. These comments in the 1890s spurred experiments carried out by Western states in the 1900s.  Support for these experiments was accompanied by complaints that these stations should no longer focus on the kinds of crops that can be grown using irrigated techniques—these should be left to farmers—but instead focus on “the most difficult problems which require the aid of science for solution.” Lastly, the OES in the 1890s urged stations to carry out more complex, intricate soil investigations. They hoped more stations would connect soil investigations with field crop tests.
Popular bulletins came under harsh criticism in the 1890s. For example, veterinary studies were criticized because “... a considerable proportion of these are largely popular bulletins representing little if any investigation.” The OES acknowledged that some of the subjects covered warranted dissemination by experiment stations, but after these experiments had been completed and demonstrated the stations should leave the preparation and distribution of various antitoxins and serums to private enterprise. If state funds were given to stations to prepare these materials or pamphlets, the station should hire assistants to do this work, not station scientists. Instead researchers should examine problems in the common contagious diseases of stock, disinfection, or conduct experiments with certain substances used as fodder. A later commentary commended the joint work of the Missouri, Texas, and some southern stations in combating Texas fever. The OES considered this kind of veterinarian research to be of the highest order. To them, it illustrated the critical importance of expending energy and resources on original research.\(^\text{13}\)

According to the OES, the lack of focus in station work continued to negatively influence station work in the late 1890s. An OES review of the work done at the experiment stations in 1897 stressed “... that only about one-half of our station publications contain accounts of investigations regularly conducted by the stations with a view to extending the boundaries of our knowledge regarding the science and practice of agriculture.” The OES regarded these numbers as troubling. They requested that all station personnel carefully monitor their operations to reverse this trend of devoting resources to work of comparatively little value. They blamed these problems on too many stations engaging in superficial experiments generated by demands from farmers for advice to solve immediate problems (or in the case of some stations, too much time spent on “demonstration” work). They ended their review with a harsh assessment of field and fertilizer experiments: “Certainly the comparatively meager results which have come from a vast number of field experiments of certain classes with crops and fertilizers should lead to the most careful consideration of the methods of such work. The continued large use of funds in this direction can hardly be justified unless it is possible to improve the methods of our investigations so as to give us greater confidence in the results.” Their concerns were supported by a leading experiment station scientist’s analy-
sis of all bulletins published in 1898 and 1899. Dr. W. H. Jordan, of the New York State Station, presented a paper at the 14th annual meeting of the AAACES that indicated "that 41 percent of the pages... 'had no other purpose than the diffusion of existing knowledge,' and that the preparation of this class of bulletins 'appears to be materially increasing, when it ought to be decreasing.'

The OES objected to station scientists spending too much time either in responding to farmers' requests or assuming too many duties at land-grant colleges. The OES, when discussing farmers, stated that they thought "intelligent farmers" would be familiar with experiment station work. It is evident in their editorials over the years that they assumed that this class of farmers would avail themselves of the latest research from the world of agricultural science. Thus it is not surprising that they were criticizing farmers in the mid-1890s for relying too heavily on station scientists for general information. While this may have been expected in the past, argued the OES, if a farmer presently "...neglects to consider the important facts and principles set forth in the publications of this Department and of the experiment stations, he ought to blame nobody but himself when his more progressive neighbor outstrips him in the struggle for progress." The OES did not deny the importance of educational work that station scientists participated in; they did, however, consider the time expended disproportionate given their expectation that scientists should be pursuing original research. Furthermore, the continual emphasis on educational work depleted a station's resources, reoriented the station's work in areas not originally contemplated by the Hatch Act, while making the station merely a "...bureau of information or education..." While the goal of experiment stations remained to disseminate "practical" informa-

14. ESR 6 (1894–95):760; ESR 7 (1895–96):261; ESR 9(1897–98):601–04; ESR 12 (1900–01):409–10. OES officials were very troubled by the vast amount of station time allocated to analyzing fertilizers, work the OES felt did not lead to scientific breakthroughs. Editorials in the Record railed against the incompleteness and shoddiness of fertilizer experiments, though occasionally one station (usually unnamed) would be commended for its brilliant work in all phases of fertilizer studies. One editorial said, "The results of field experiments with fertilizers are so liable to misinterpretation that the necessity for the careful statement and explanation of such experiments is increasingly evident..." Most objectionable was the fact that "...unscrupulous manufacturers of fertilizers seize upon unguarded or incidental statements in stations publications and use them for advertising purposes to the injury of the general public and to the disadvantage of the stations." They cautioned stations not to publish "...any information which, though it may be of temporary advantage to farmers, can be construed as an advertisement of private interests." Some experiment station scientists viewed matters differently. At the 12th AAACES meeting one investigator argued that "...in those States where the purchase of fertilizers is an important factor in farm expenditures the stations should aid the farmer in the intelligent purchase and application of fertilizers...this [was] the attitude assumed by most of the experiment stations, and that the position needed no defense." See ESR 4 (1892–93):625; ESR 6 (1894–95):256; ESR 7 (1895–96):633–634; ESR 10 (1898–99):710; ESR 11 (1899–1900):804.
tion, “...this information is to be obtained by conducting original researches and verifying experiments.”

Responding to many personal queries from farmers may also have contributed to the dissemination of poorly prepared bulletins. Some stations, the OES argued, were publishing bulletins that were confusing, misleading, that used technical terms unnecessarily, that did not provide a key for abbreviations, that presented tables and text inconsistently, and that reeked of careless proof-reading. They again reminded scientists of these problems at the end of the nineteenth century by quoting a scientist of “long standing” as supporting the publication of popular bulletins who hoped farmers would “‘write to the station on every problem that they meet,’ these letters to be answered ‘promptly and as fully as possible,’ and where feasible published in weekly press bulletins.” The OES seriously questioned whether such activities were within the purview of the station. They answered their own question by affirming that a small number of hours per week appeared reasonable; any more, dubious.

15. *ESR* 7 (1895–96):435–37; *ESR* 9 (1897–98):301–02. The OES repeatedly criticized stations for allowing their scientists to be burdened with heavy commitments to farmer institutes and instructional duties, in classroom courses where the complexities of agriculture were not fully explored, because these activities detracted from their scientific inquiries. Some leading figures in the experiment station movement disagreed with the OES on these issues. For example, at the 7th AAACES meeting, W.A.Henry, the director of the Wisconsin Experiment Station, remarked in his presidential address that “I believe that our station workers have in many cases accomplished more good for the cause of advanced agriculture through their efforts at instruction than through all they may have discovered.” At a later AAACES meeting a paper was presented suggesting that when both instructional and investigatory activities were combined the latter suffered. In the ensuing discussion scientists from New York, Ohio, Georgia, Florida, and Colorado disagreed with various aspects of the report. In defense of combining education and investigation, I.P. Roberts of New York said: “My experience leads me to the conclusion that the principal object of the experiment station is to diffuse knowledge of improved methods, and secondarily to carry on the work of investigation simultaneously. “Such views, of course, were precisely what prompted the OES to write editorials condemning these practices. See *ESR* 5 (1893–94):275; *ESR* 8 (1896–97):445; *ESR* 9 (1897–98):301–02; 303–04; *ESR* 11 (1899–1900):402–04, 803.

16. *ESR* 8 (1896–97):177–78; *ESR* 9 (1897–98):301–02; *ESR* 11 (1899–1900):401–03. At the AAACES conventions in the 1890s and 1900s there were long discussions on improving the uniformity of station nomenclature. One suggestion was to present one bulletin in simple, nontechnical language, listing facts and recommendations in accessible terms to farmers. Then another bulletin could be prepared especially for scientists that could delineate the scientific processes utilized underpinning the results. At the sixth AAACES convention Nebraska scientist C.L. Ingersoll stated that “Bulletins should be so simple that the most ignorant farmer can get some good from them. Graphic illustrations should be used... results of experiments should be briefly summarized. Full data should not be given in bulletins intended for the farmer.” It is noteworthy that the OES did not want the stations bulletins to include advertisements for products. True stated that “‘The real objection... to advertisements in station publications lies against the recommending of miscellaneous manufactured articles used by farmers which have not been the subject of experimental or investigation by stations in any true sense.’” See *ESR* 4 (1892–93):401; *ESR* 6 (1894–95):261; *ESR* 7 (1895–96):173; *ESR* 9 (1897–98):307–08, 311–12; *ESR* 16 (1904–05):529–30, 841–42; *ESR* 17 (1905–06):212–13; *ESR* 19 (1907–08):805–07.
The thrust of the criticisms by the OES concerning station experiments in the 1890s centered on soil, fertilizer, and field crop investigations. Other areas were mentioned, but the above ones received considerable comment during the decade. In order to determine the extent to which the pattern of agricultural science at the stations changed, Table 3 breaks down the experiments in Table 2 into two periods. The total number of abstracts grew by over 10 percent from the 1890s (Period A) to the 1900s (Period B). Every region except one increased the number of abstracts cited by the Record over the two periods. In the North, where the number declined, the drop is small, only 3.6 percent.

Table 3 suggests that some regions changed their research priorities over these periods. For the total United States, regions cut back on experiments in field crops, horticulture, soil and fertilizers and diseases of plants. Declines in the first two categories were greater than the slight drop in the last two. Entomology, foods and animal production, and dairy farming grew over the years. Different regions accounted for the changing pattern of research. Field crops and soil and fertilizer experiments declined in the North, the West, and the South. Horticulture tests in all regions dropped, though considerably less so in the South. In the above three categories only the Midwest did not deemphasize these areas in lieu of others. In diseases of plants, every region carried out fewer experiments except the South, where such experiments increased. Entomology experiments expanded in the North, West, and South, foods and animal production grew nationwide, as did dairy research (except in the North). In both the West and South the experiment stations reoriented their research work: the South expanded experiments in diseases of plants, entomology, foods and animal production, and dairying, while the West widened its experiments in veterinary science and botany as well as entomology, foods and animal production, and dairy farming.

More importantly, it is apparent from Table 3 that the OES's specific criticism of soil, fertilizer, and field crop experiments influenced station work in the 1900s. In the West and South experiments in these categories in the 1890s declined from 35.5 and 39.8 percent to 26.8 and 32.4 percent respectively in the 1900s. OES officials appear to recognize that their exhortations of the 1890s have worked when they emphatically state in 1900 that "The wisdom of Congress in making the Hatch fund a research fund is every year becoming more apparent. This Department is therefore dis-

17. By 1900 approximately 90 percent of the stations employed entomologists. This, no doubt, contributed to the increase in experiments in this category. See ESR 12 (1900–01):406; ESR 13 (1901–02):102; True, A History of Agricultural Experimentation and Research in the United States, 137.
posed to more strongly insist on a strict interpretation of this act in this direction . . . to devote the Hatch fund to investigations in agriculture. . . .”\(^\text{18}\)

Throughout the 1900s the OES continued to be vigilant on the use of Hatch funds for noninvestigatory station work. Though less strident than in the 1890s, they still lamented that some station workers were taking on too many noninvestigatory duties, particularly inspection work, routine analyses, and instructional activities. The tone of the complaints, however, focused more on the individual attributes of the scientists. In their words: “Many men attribute their failure to achieve success as investigators to their environment, when the trouble is really in themselves. Complaints about lack of time and funds and opportunities count for very little when they come from men who are evidently spreading the scope of their opera-


### Table 3.

<table>
<thead>
<tr>
<th>Articles Classified</th>
<th>U.S.</th>
<th>North</th>
<th>Mid-West</th>
<th>West</th>
<th>South</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(a)</td>
<td>(b)</td>
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<td>(b)</td>
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<td>1) Chem.</td>
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<td>2.3</td>
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<td>2.9</td>
<td>1.9</td>
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<td>2) Botany</td>
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<td>1.4</td>
<td>1.4</td>
<td>1.0</td>
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<tr>
<td>3) Met.</td>
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<td>3.8</td>
<td>5.0</td>
<td>5.8</td>
<td>3.6</td>
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<tr>
<td>4) Fert.</td>
<td>12.5</td>
<td>11.4</td>
<td>15.3</td>
<td>14.3</td>
<td>8.4</td>
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<tr>
<td>5) Crops</td>
<td>19.0</td>
<td>15.9</td>
<td>11.1</td>
<td>9.7</td>
<td>21.1</td>
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<td>6) Hort.</td>
<td>14.3</td>
<td>12.1</td>
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<td>7) For.</td>
<td>0.8</td>
<td>1.3</td>
<td>0.3</td>
<td>1.4</td>
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<tr>
<td>8) Dis.</td>
<td>9.1</td>
<td>8.1</td>
<td>11.7</td>
<td>9.2</td>
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<tr>
<td>9) Ent.</td>
<td>9.7</td>
<td>11.9</td>
<td>9.2</td>
<td>12.9</td>
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<tr>
<td>10) Foods</td>
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<td>16.1</td>
<td>15.6</td>
<td>18.0</td>
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<tr>
<td>11) Vet.</td>
<td>4.0</td>
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<tr>
<td>12) Dairy</td>
<td>7.3</td>
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<td>13) Engin.</td>
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<td>1.8</td>
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<td>0.5</td>
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<td><strong>Total:</strong></td>
<td>100*</td>
<td>100*</td>
<td>100*</td>
<td>100*</td>
<td>100*</td>
</tr>
</tbody>
</table>

*Source:* See Table 1. Volumes 4-11 are designated by a and 12-21 by b.

*Note:* Within regions, several states dominate the number of experiments in period a and b. For example, in the South, North Carolina accounted for 48.5 percent of the abstracts cited in Meteorology (category 3) in volumes 4-11. In the North, Massachusetts accounted for 44.4 percent of Agricultural Botany abstracts in volumes 12-21 and 52.6 of Meteorology in period a and 45 percent in period b. Delaware accounted for 41.3 percent of Veterinary science/medicine in volumes 4-11 in the North. In the Mid-West, Wisconsin accounted for 43.9 percent of Agricultural/Rural Engineering over the whole period; 52 percent in period a and 37.5 percent in b. In the West, Utah accounted for 46.7 percent of Foods/Animal Production and 43.9 of Agricultural/Rural Engineering in period a. Finally, California accounted 49.4 percent of Soil and Fertilizers, 56.4 percent of Horticulture, and 43.8 percent of Forestry abstracts in period a.

* Does not equal 100 percent because of rounding off.
lations beyond a reasonable limit, or who can not produce well-conceived
and carefully thought out plans of research." OES officials recognized that
there were situations where circumstances inhibited station work. Yet they
wanted station scientists to make every effort to minimize any potential
obstacle to fundamental research investigations. In this regard they ap-
plauded the work of the Wisconsin station, encouraging stations to emu-
late their high quality investigations. 19

Criticism of research work continued throughout the 1900s. But it was
neither as severe or common as it had been in the 1890s. Station veterinari-
ans were criticized for spending too much time on nonresearch tasks, ani-
mal production investigators were taken to task for too few and narrowly
defined feeding experiments with horses, and station bulletins were criti-
cized for merely reporting data without systematically analyzing it, in-
cluding publishing the results of inadequate experiments (by which the OES
meant not original investigations) in fertilizers and soils, diseases of plants,
and feeding work. 20 Other aspects of station work also received comment.
As in the 1890s, the OES believed that stations were not operating at peak
efficiency in their investigations in the 1900s because of poor management
of station resources and personnel. They wanted stations to (1) reduce the
triple-duty of station scientists who had to service land-grant colleges in-
structionally, provide general agricultural information to farmers, plus
carry on original investigations; (2) improve farmer education—e.g., col-
lege and extension work, but especially farmers’ institutes, which the OES
thought "should be made the means of uplifting the people morally and
socially,"; (3) increase cooperative experiments between the USDA, OES
and stations; and (4) raise nonfederal government funding of station equip-
ment and buildings. 21

When the Congress passed the Adams Act in 1906 the OES immediately
reminded the stations that the act "differs from the Hatch Act in the more

the 1900s the OES increasingly blamed station personnel for the station’s difficulties in promot-
ing original investigations. For example, the OES commented on a recent meeting of the Ameri-
can Association for the Advancement of Science that focused on the key attributes of research.
They noted "one point quite prominently emphasized by nearly all was the prime importance of
the man. This single factor overshadows all others in research—the theme, the equipment, the
surroundings, and other material resources . . . Men with well-developed investigating instincts
are the great prerequisite. . . . The position of the man of science who devotes himself to
research is not assured as it is in Europe." See ESR 14 (1902–03):517–18.


restricted application of the funds. It provides specially for the fundamen-
tal investigations of original character which the work of the past few
years has brought out such a glaring need of.” The OES cautioned stations
that Adams funds called for judicious selection of research areas and
investigators. While some stations might interpret the Hatch Act as allow-
ing for the allocation of funds for some noninvestigatory work, the use of
Adams funds required consultation with the OES and thus they could
assure that the projects focused on fundamental research.22

The problem of retaining and hiring station scientists accelerated with
the passage of the Adams Act. In the early 1900s the OES became acutely
aware that the stations were having problems securing qualified personnel
for station work. They suggested that “Agricultural research calls for very
special qualifications in the way of native ability and scientific acumen.”
Their view in 1906, after the passage of the Adams Act, was that station
personnel were of three classes: (1) disseminators of general information to
farmers; (2) experimenters who conduct elementary trials and experi-
ments, where the collection of scientific data is incidental to the experi-
ment; and (3) “A third group of men always have in mind, even in what are
apparently simple experiments, a recognition of the principles which are
operative and which serve to explain results.” Of all of the classes, the OES
noted that the last group remained small. Why? The OES believed “This
scarcity is to a large degree a result of the ideals and tendencies which have
dominated station work in the past. The practical phase—the immediately
practical phase—has been constantly in the foreground.” Thus some sta-
tion workers had been ill-prepared for original research. Inadequate ad-
vanced training and low salaries contributed to this tendency.23

By 1907, turnover at the stations grew dramatically. The OES noted that
in this year every station but three lost from one to eight scientists over the
year, while in 1908 many more also left. Although those departing were
typically assistant grade personnel, the OES noted that in 1907/08 at least
one-third were heads of departments or responsible for specific categories
of experiments. Most did not leave station work, instead they moved to
new stations. Some stations managed to hire high-quality replacements,
yet these changes still caused disruption in existing lines of research that
detracted from a station’s ability to sustain research projects. The OES
believed the prime motivation for such high turnover rates was “[t]he

22. ESR 17 (1905–06): 728–30, 929–33; True, A History of Agricultural Experimentation and
Research funded under the Adams Act also received some sharp commentaries, particularly in
plant breeding, the fastest growing category of experiments. See ESR 18 (1906–07): 602–04,

inequality of conditions at different institutions. . ." They regretted these conditions and urged states to improve conditions for investigators.\textsuperscript{24}

By the end of the first decade of the twentieth-century, agricultural scientists at American experiment stations had carried out thousands of field and laboratory experiments examining almost every aspect of agriculture.\textsuperscript{25} Many of these scientists had successfully integrated their research agendas with scientists nationwide under the tutelage of the OES. Station personnel still had to respond to requests from farmers and land-grant colleges to assist them in their endeavors. Yet the quality of the bulletins and reports with regard to emphasizing original investigations is far greater in the 1900s compared to the 1890s.\textsuperscript{26} The OES had successfully influenced stations across all the regions to improve their research procedures and the selection of research projects. As a result, while regions maintained identifiable areas of inquiry over the whole period, substantial change did occur regionally.

On the question of reaching farmers with the results of these investigations, the OES did not achieve the same notable success. In their defense they thought that the best way to improve farm practices was to increase the stock of knowledge in agriculture. They presumed that "intelligent" farmers would avail themselves of their work. They appealed to this class of farmers, the rural elite, who would, if properly motivated, modernize farm practices. Yet as the OES accomplished its goal of increasing the output of high-quality research investigations at the experiment stations, the overwhelming majority of ordinary farmers did not look to the bulletins as critical sources of information on improved farm practices.

More precisely, improving the quality of agricultural research at the experiment stations did not lead very often to farmers acquiring practical information from experiment stations on agriculture. The conclusions of a 1913 study investigating farm practices across the nation, excluding the West, indicated that only 43.3 percent of the 4000 farmers polled received


\textsuperscript{25} True's assessment of the experiment station investigations over the years is in \textit{A History of Agricultural Experimentation}, 142–63. See also Alfred C. True and V.A. Clark, \textit{The Agricultural Experiment Stations in the United States} (Washington: GPO, 1900); Alfred C. True, \textit{A History of Agricultural Education in the United States, 1785–1925} (New York: Arno Press, 1969.)

\textsuperscript{26} This assertion is based on my reading of the bulletins and reports between the two periods. The key characteristic that distinguishes most of the bulletins between the periods is that 1900s bulletins appear to be written strictly for specialists, i.e., other station scientists engaged in similar work and not for farmers. See also Earle D. Ross, \textit{Democracy's College: The Land Grant Movement in the Formative Stage} (Ames: The Iowa State College Press, 1942), 141–42; Kerr, \textit{The Legacy} 42–44. Some stations recognized this and issued another series of bulletins under the heading of "popular bulletins." See, for example, any of the popular editions of bulletins issued by the New York State Experiment Station.
bullets, of which 84.2 percent read them and only 48.2 percent "practiced some ideas obtained from them." These numbers only tell part of the story. As Scott points out, other data in the study indicates that "44 percent thought that experience was still the only valuable teacher. A mere 6 percent reported that they found station literature to be useful, and an even smaller percentage claimed that they learned much at farmers' institutes." Southern stations made important contributions to agricultural science, yet "[w]hile there was a growing body of scientific data and information available on improved agricultural practices from the 1880s onward, most of it was not getting to the masses of southern farmers." 27 As a result, few ordinary farmers nationwide relied on bulletins to change their farming practices, particularly tenants and sharecroppers, who relied instead on their own experiences, habits, and traditions.

The OES recognized, somewhat belatedly, that they were not reaching farmers nationwide. They did not believe that the root cause of this problem was the character of the investigations. Instead they thought the problem was in devising a more efficient method of influencing farmer practices, other than relying on the printed word. They believed that farmers' institutes could alleviate this problem. Early exposure to progressive practices was also encouraged. 28 However, as the 1913 study pointed out, farmers did not benefit greatly by attending institutes. This may partly explain why so many did attend institutes yet did not change their farming practices.

The OES, USDA, and the experiment stations did contribute to upgrading the foundations of agricultural science in the twenty years after the Hatch Act. These experiments, however, did not lead to rapid productivity advances in agriculture. Mechanization, except in the South, accounted for the principal gains in yields per acre. Research on farm implements was carried out in the field crop and rural engineering categories but at quite low levels. 29 Attempts to enlighten farmers on the merits of modern practices expanded in the twentieth century, led by the agricultural extension service.

Those stations that responded well to the OES urgings or criticisms

were more likely to be well-endowed stations that could afford to invest heavily in fundamental research because of abundant resources. This does not mean that stations that had a low level of resources overlooked the OES recommendations. Their record of research accomplishments may have differed but they still made contributions to agricultural science. Virtually every station, however, had a difficult time reaching ordinary farmers. Uplifting agriculture translated into increasing the stock of knowledge in agricultural science that contributed further on in the twentieth century to productivity advances in agriculture. The OES and experiment stations accomplishments were to put agricultural science on the national agenda. Unfortunately, these important efforts to improve farm practices remained far removed from the everyday experiences of the bulk of the nations farmers. Reaching them would have to await another day.