ing information as to the relative standing of fraternity men, reasons for any deficiencies which might exist and possible advantages to offset such deficiencies. Replies were received from the universities of Illinois, Iowa, Michigan, Wisconsin and Minnesota. Although there was naturally considerable variety of opinion, on the whole the replies were favorable to the fraternities, assuming that the latter were normal and were properly governed.

The grade of scholarship was generally admitted to be somewhat lower, but on the other hand it was conceded by most of the writers that fraternity men took a more active part in student affairs.

The accompanying table shows the conditions existing at Purdue and at Wisconsin in 1911 and it is possible that the relative values would be much the same to-day.

Fraternity Men in Student Activities, 1911–1912

Activities	Purdue			Wisconsin		
	Total	Frat.	% Frat.	Total	Frat.	% Frat.
Athletics—varsity	38	15	39.5	83	39	47
Publications (editors)	24	7	29.2	95	56	59
Music and drama	18	9	50.	89	62	69.7
Class officers	15	7	46.6	48	24	50
Honorary societies	46	8	17.4	42	7	16.7
Totals	141	46	32.6 av.	357	188	52.7 av.
Per cent of students in university			23.9			27.3

It will be noted that in all branches of activity but one the percentages of fraternity membership are higher than the percentage of total membership in the university.

In honorary societies, the fraternity membership is less.

On the whole, the fraternity man is one who is content with average rank and is ambitious for athletic, social or political rather than scholastic honors. He is a good fellow, and probably when he graduates knows more of college life and customs than his barbarian brother.

Men in fraternities and out are much the same intrinsically, and what difference there may be is due rather to environment than to character or ability.

C. H. Benjamin
Purdue University

How can we advance the scientific character of the work done in the American agricultural experiment stations?

With the provision of the new Smith-Lever Fund for extension and demonstration in agriculture, with the increase in the already great number of farm advisers, with a thousand agencies for spreading information among the farmers, the experiment stations ought to be able at last to find and to occupy their proper field.

That field is research, the scientific investigation of questions connected directly or indirectly with agriculture. The demand for men capable of such work has always been greater than the supply of trained and able men. How shall we call men, and women, to this high service in increased numbers? And how retain them? These are the vital problems which confront the experiment stations; there are ways in which the great universities may aid the smaller ones in solving these problems.

Without going into the history of the experiment stations it is sufficient to point out that in the beginning their purpose was not clear even in the minds of most of the early workers: they were popular information bureaus in part, until they ran short of information. There has been a great deal of repetition and of compilation in their work: and, in looking over the earlier bulletins, we find little streaks of high-grade ore, pure investigation, the work of men in advance of their time, for the most part not appreciated, and misunderstood.

The mills of the gods grind slowly; now, out of those bulletins published in those earlier years, only the ones which were original in thought and method have survived; the rest served their temporary purpose and were forgotten.

To-day we are beginning to appreciate the value of investigation. In every state university, in every meeting of the Association of

American Agricultural Colleges and Experiment Stations we hear the insistent cry for more research, for more men capable of the scientific investigation of problems.

Where are we to find men, how are we to train men who have a natural aptitude for research? Under all the conditions prevailing in our state universities, their peculiar type of organization and government, how are we to create and to maintain an atmosphere in which genuinely free minds of high endowments and proven ability may work and grow, following research problems through years to their legitimate conclusions? In short, how are we to bring the experiment stations up to the level of the world's best work and thought in science?

The problem is a large one, it touches most vitally and most fundamentally the whole organization of the state university. It is a problem to be studied with the utmost earnestness: are there not ways in which the older universities with established standing may help the newer ones toward a solution?

Few educated men are in any true sense fitted for research and investigation. Much depends upon the training of the man; far more upon the natural gifts and endowments of his mind. It is so easy to endow a college with money: it is so hard to endow it with brains! Men of intelligence, men of rare natural gifts, may be attracted to an experiment station if conditions in the state university to which it is attached are favorable to a man's best development of his best self.

And what, then, are the favoring conditions which make possible in a university a high type of research? A careful canvass of the faculty of one of the larger and older institutions brought out the following opinions.

1. Non-interference with the time, the plans, and the work of the research man. This is a negative condition. Why should it be just the one thought of first of all? I think it is because it is the one condition hardest of all to obtain and hardest to maintain in the American state university.

Changes in boards of control and in administrative heads, changes in buildings and equipment brought about by rapid and poorly coordinated growth, pressure for results from researches which can bear fruit only after prolonged development and in the course of time, a lack of popular appreciation of the outstanding value of laborious, unselfish investigation, that itching for publicity which afflicts many estimable colleges, combinations of teaching or extension or other duties ill-mated with research, vexatious and disturbing financial systems—all these things and many others break into the time and thought of men engaged on research problems, oftentimes to the ruin of well-planned work.

Under such conditions many a piece of research, well-conceived and promising, has dwindled like a tree planted in a cellar, until it has died at last and borne no fruit.

Sometimes, too, the pressure for immediate results has led to shallow, popular work, or to a jumping at conclusions akin to quackery. Sometimes legislatures have been led to make great appropriations to such work because of its popular and flashy character; and their money has been wasted, their confidence impaired. Even in hurried America there is no way in which we can force the tree of knowledge to bear fruit before its season.

2. Another important set of conditions allied to the first is that supplied by the type of supervision and direction in vogue. In any research institution the only form of administration or direction which can be successful is the type implied in the word leadership. Above all other things, research, scientific investigation, is a product of the individual mind, or of a group of minds working on related aspects of the same subject. Research is original, original in method and means and in the end sought. If it is not original, then it is not research. No man can tell in advance what are to be his methods and what his results. If he can tell, then his work is not investigation at all; but demonstration, a retracing of the path found by other minds.

The whole trend of thought in college and station work in America indicates that the greatest responsibility of the leaders in administration, their duty and their pleasure,

must be to attract and to hold strong, independent minds, free in thought and fearless in character: and then, wholly subordinating the machinery of administration to the ends sought, to lead those minds into the best and highest and most original service of which they are capable. Good administration, like good literary style, sinks itself and loses itself in the things said and done, and in the work and thought.

In its relation to the whole university as a division or department of the larger whole it it evident that genuine research in the experiment station can progress only where the atmosphere of the university is just, thoughtful, conservative; and in accord with the best traditions of university life and thought.

I have spoken of two fundamental conditions, non-interference and leadership, which within the state universities will favor research of a high character. There are other favoring conditions which the universities of high development may establish from without for the benefit of the research spirit in the experiment stations. Let us discuss now two means by which they may exercise a profound influence for good. (1) Why may not the great universities regard the experiment stations as graduate schools? That is what they soon come to mean to the men who do research work in them under happy auspices. When the atmosphere of the university is favorable to research: when men are recognized and honored by their colleagues and by the administration because of the high character of the research papers which they have published, then the experiment station becomes a school, a higher university for the members of its staff. In many a university the young man working for his doctor's degree in regular course is not enough alone: he is not forced to draw heavily enough upon his own mental resources: to an extent hardly recognized, he may actually develop not his own ideas and lines of thought, but those of the teacher whose mind overshadows him. A research problem in an experiment station is a better test of what the man really knows and can do toward the development of that new knowledge which is advancement. In the experiment station the research worker must build his own road into the unknown.

I hope the time may come when the larger and older universities will be glad to place students of exceptional power and maturity and promise in the experiment stations to work upon special problems allied to agriculture in preparation for the doctor's degree. The station should furnish books, laboratory, equipment, money enough to enable the aspiring research student to live in relative comfort. But above all it should supply an atmosphere which would welcome and stimulate, and encourage the keenest thought and the bravest effort. Upon the completion of the work to a definite stage, it should be published as the station's contribution to knowledge in that field and as the thesis of the candidate for the doctorate. The completion of successful work giving evience of genuine ability would almost inevitably lead to the employment of the man somewhere in experiment station work. Thus the stations would enrich themselves by adding to their workers young men of demonstrated ability, of high ambition and marked promise, and of preparation under the most favorable conditions. (2) Yet another way in which colleges of high grade and established reputation may do much toward advancing the scientific character of the work done by the experiment stations is by conferring the doctor's degree on men now in station work whose bulletins form a genuine contribution to knowledge.

It is the writer's firm belief that no single agency and no combination of agencies will or can do so much for the elevation of the scientific work of the experiment stations as the interest and the cooperation of the older colleges with established reputations and fine traditions. The stations will strive then by every means in their power to make themselves worthy of such distinguished recognition and support. The treatment of accredited institutions as graduate schools and the prompt recognition of research work by the conferring of the doctor's degree will exert a continual and powerful influence for good upon

the character of the work done in the experiment stations.

SAMUEL BRADFORD DOTEN,
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October 19, 1914

SPECIAL ARTICLES

A DEVICE FOR PROJECTING A SMALL SPOT OF LIGHT SUITABLE FOR EXPLORING PHOTOSENSITIVE AREAS [1]

IN experimental work on light reactions the question of the precise location and extent of the photosensitive areas frequently presents itself. If the organism under observation happens to be small, or if minute sensitive elements are scattered in various parts of the integument, the problem has its difficulties. One of the obvious methods of attack is to explore the animal with a spot of light. To be of practical value for this sort of work the light spot must be small, clearly defined, and without halo, and it should be possible to direct it with the utmost ease and precision. Various devices have been employed for this purpose, none of which has proved entirely satisfactory. The use of a "pinhole" aperture does not give a sharply defined spot of light at a convenient working distance. An elaborate system of collecting and focusing lenses is expensive and is very likely to be cumbersome to handle. After trying various schemes, I found that by inserting a small tungsten bulb into a microscope in place of the ocular and projecting the rays through the objective, a spot of light could be produced which fulfilled the requirements admirably.[2]

The accompanying figure shows the details of the apparatus. A piece of brass tubing, *P*, is turned to fit into the draw-tube of the microscope in place of the ocular, a collar being left on it to prevent it from sliding in too far. Into the upper end of this tube is fitted a wooden plug, *X*, bored to take a small screw

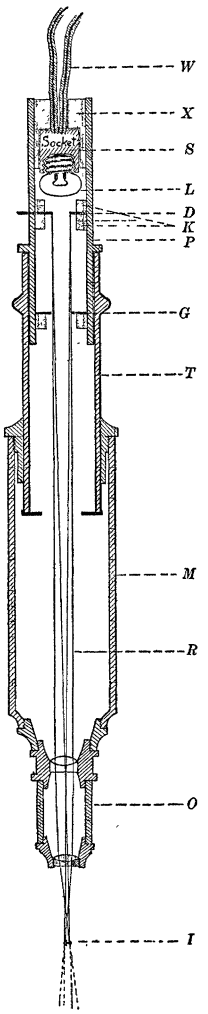

FIG. 1. A Device for Projecting a Small Spot of Light Suitable for Exploring Photosensitive Areas. *W*, wires from batteries to light; *X*, wooden plug fitted into the tube *P*, and bored to receive socket; *S*, screw socket for light; *L*, 2½-volt tungsten "flash-light" bulb; *D*, metal diaphragm with small circular aperture; *K*, cork collars holding diaphragm in place; *G*, diaphragm to cut out reflection from inside of tube, *P*; *P*, brass tube fitting into microscope in place of the ocular; *T*, draw-tube of microscope; *M*, barrel of microscope; *E*, construction lines indicating formation of the image, *I*; *O*, ocular; *I*, inverted and reduced image of aperture in diaphragm, *D*.

[1] From the Museum of Comparative Zoology, Harvard University, and the Anatomical Laboratory of the School of Medicine, Western Reserve University.

[2] The idea of utilizing the lenses of a microscope was suggested by Dr. Clark of the Physics department of Harvard University.