

The president should be fully aware of all graduate and research work carried on by his institution. Both are expensive and neither should be undertaken without carefully counting the cost or without approval by the trustees. A little done with outstanding excellence will mean much to the reputation of the institution. Only outstanding scholars should teach graduate students.

9.

Graduate Work and Research

Research and Its Importance

Scientific research, beginning about seventy-five years ago on an organized basis, has grown to be one of the most important activities in the world. Today all important industries are spending huge sums on research and are relying upon their research staffs to open up new areas of service to the public.

The main training ground for the research worker is the university. About 140 American institutions are offering training for the doctorate in from one to thirty-five fields. Less than fifty of these institutions are training 90 per cent of our research workers.

As time goes on, some additional institutions, from twenty to thirty of them, will probably enter this field; a number of those already engaged will expand their offerings considerably. Before World War II we were giving the doctor of philosophy degree to about 3,500 candidates yearly, but 5,293 in 1948-49. While these men and women have met the requirements of their respective institutions for the degree and have undoubtedly done some research work, a very large proportion have shown no marked ability in this line and will publish little beyond

their doctor's theses. How many will qualify as able research workers by the product of their later life, it is impossible to say. I would estimate that not more than 10 or 15 per cent will become distinguished research workers, and not over 15 per cent more will earn their living on the basis of their research output. These figures will vary with the field of study.

The truth is that while the 10 or 15 per cent of the graduate students who have real talent for research should be stimulated to develop this ability to its maximum, those of mediocre research ability should be given adequate training and inspiration to become teachers, with less emphasis placed upon research. Of our 1,850 colleges and universities, probably 1,000 desire that their professors hold the doctor of philosophy degree, but are wholly indifferent to any research they may do. The requirement that staff members obtain the doctorate as a proof of their advanced scholarship is increasing. In the face of this demand, it is undesirable to exclude those from the graduate schools who do not excel in research ability. It appears to me that some clear distinction between the graduates who excel in research ability and those who do not so excel should be made in the degree conferred upon them. My idea would be to graduate the able research man Ph.D. *summa cum laude*, and the scholar simply Ph.D., or give the former the D.Sc. and the latter the Ph.D.

The university, as distinguished from the college, needs not only able research men to direct the research training of candidates for doctor of philosophy, but also men who are skillful teachers, regardless of their research experience. Through a confusion in policy, the universities and some colleges employ men with the doctorate who are second or third rate at research and will accomplish little in that field, and who at the same time are not competent teachers. The university needs both good research men and good teachers. Very few excel in both lines. I have no criticism against employing men with the doctorate as teachers, if they are capable as such. But especially for freshmen and sophomores we need excellent teachers, to whom research should be a secondary matter.

In any case, there is a larger demand for able research men

than the universities can supply. The percentage of men and women graduating with a first degree who have the qualities demanded for research is small. These same persons are offered many inducements by industry, business, the law, medicine, engineering, and other fields. The graduate school can hope to secure only a small proportion of these outstanding graduates. I believe that if the best minds were recognized in the freshman year and challenged with the advantages of a life of research or research and teaching, many would be attracted and could be recruited to the graduate schools. Also, their undergraduate courses might thus be shaped to give them the foundation needed for their proposed graduate work. To expect to recruit many such men for advanced work toward the end of their senior year is futile; it is too late then.

Research, like teaching, is under the direction of the faculty. The president has little to do with it. Even in the preparation of the budget he fixes only the larger appropriations; specific sums for individual research are usually arranged by the deans or department heads.

Professors dislike to be pinned down in research work. They object on the ground that no general statement can be accurate, that each study must be considered on its merits. This is true, but the president in an institution where research is carried on should have some idea of what the professors are talking about. Also, research is a very important matter in our universities; their reputation depends in considerable degree on the research they do and upon its quality. Perhaps half of the entire budget of some institutions is spent on research.

It is important to stress the great difference that exists among various types of research in the time consumed and the cost. A research problem in chemical engineering on the production of a desired product from crude petroleum, involving the development of a method and the construction of a satisfactory pilot plant that will produce the product, will cost a large sum. On the other hand, a research resulting in the production of a few grams of material in the chemical laboratory will be quite inexpensive.

Contrast the difference in time consumed in developing a strain of oats resistant to a rust and producing sufficient seed for distribution to farmers to propagate the strain, with a laboratory study of the physiology of a plant. The former will require far more time than the latter. So research studies differ greatly in time consumed and in money spent.

H.

Cost of Research in Time

The time required by an able scholar to produce a creditable publication differs in the laboratory sciences from the social sciences, and from one subject to another. Estimates made by several leading men reveal that an average of 1,500 hours, varying from 500 to 3,000 hours, are required for the laboratory work on which a scientific paper is based. Not infrequently, after the work has been done it does not justify publication. In addition, probably from 100 to 150 hours are required for library work and writing the report. In research where laboratory work is not involved, much more time for library work and writing is required. Where field work is involved, a great deal of time is consumed beyond campus boundaries.

For the professor who is on the graduate faculty, advanced students are available for most of the detailed laboratory, library and field work. The time consumed by the professor is limited (1) to conferences with the graduate student, from one to four hours a week, for three to five years; (2) to his seminar; (3) to supplementary library work; (4) to writing the paper to be published. While these labors may extend over two, three, or four years, they will probably not occupy more than 200 to 300 hours in total for each research project. The graduate instructor with five to seven students, graduating two men a year with the doctorate, assuming that he signs jointly with the student, should be able to produce two papers a year with not more than 1,000 hours of time consumed. This means half his time.

Of course, as one considers the numbers of a faculty and their output, this estimate, while correct for some, is certainly wrong for many. Departments will vary. Several students may work

along similar lines, one helping the other. In another department, each student will be working at a distinctive subject, so different from the others that only the professor can be of much help.

The value of the thesis for the doctor of philosophy degree lies in the student's learning how a master mind works in his field, how it attacks the various problems that arise. The student must come continuously, for a considerable time, into close contact with his chief, who must give him the time needed for detailed discussion. The student also will learn the limitation of knowledge to be found in books. The differences between fields of research and the concern of the professor for his students explain why some men give a student one hour a week; some, two hours or more. Usually, it is the practice of the professor to speak briefly to each graduate student daily. In general, ten graduate students working on research is a reasonable maximum for any professor, although in some cases exceptional men have handled twice this number. Of all the men in an institution directing work for the doctorate, the great majority have from one to five students on research at one time.

While this represents my own opinion after considerable discussion with men whose judgment I respect, there is little agreement among various groups of university research men on the time required for research.

H.

Cost of Research in Money

It is possible to make a crude estimate of the cost of research by dividing the total money spent specifically for research by the number of published papers. This estimate must be inaccurate for two reasons: considerable research results in no papers being published; thus the divisor is too small. On the other hand, considerable research is paid for in the regular educational budget, exclusive of specific research funds, making the numerator too small. These variants tend to balance each other.

At Iowa State College over a period of seventeen years, 1928-29 to 1944-45 inclusive, \$9,672,797 was spent specifically

for research. During that period, 5,028 papers were published. On this basis, \$1,980 was spent, on the average, for each paper. The expenditures for each problem varied greatly. The above expenditures were exclusive of the general administration and operation of the plant. In an organization where all expenses are included, the cost would be from 50 per cent to 100 per cent higher, or \$3,000 to \$4,000 for each research project. The figures given cover the period as indicated above. This work would cost more now. The National Research Council estimates the average cost of a research project as \$5,000.

We might then say that each published research paper represented 1,500 hours in time and \$3,500 in money expended. The above figures include no research by the Institute for Atomic Research in which the costs are higher.

H.

Further Observations on Research

Another matter worthy of attention is, What may we expect of a competent research man in production? If he is teaching classes six or eight hours a week, we may regard him as devoting part time to research, let us say 900 to 1,000 hours in the college year. He might reasonably be expected to supervise six to eight research workers and produce, with his students, two papers a year, two students graduating with the doctor of philosophy degree. This is a conservative estimate, and many able men would produce more. The value of a research man who was doing less than half as much should be questioned.

What savings result from using graduate students as instructors? We must assume that nearly all competent graduate students will be subsidized. Using them as half-time instructors certainly saves money. Assume we pay a graduate assistant \$1,000 for half-time teaching. If we substitute a full-time, experienced teacher at \$3,500 or \$4,000 for two graduate assistants, and continue to support the graduate students on fellowships at \$1,000 each with no teaching service, our expenses will go up from \$2,000 to \$5,500 or \$6,000. But the quality of the instruction would probably be materially improved.

On the other hand, if only students with a taste for teaching and who are competent to teach are employed, and if they are adequately supervised, they will do good work and will obtain a valuable experience in teaching.

Why is not more research carried on in the usual denominational or independent liberal arts college? In the first place there is too little time. In a college year of nine months, exclusive of Sundays, there are about 235 days. At eight hours a day, a man has 1,890 work hours. After teaching twelve to fifteen hours a week and attending conscientiously to his other college duties, how can a man find the time for 1,500 hours of research? You say that, of course, he cannot do it all in one year. Agreed. But if he produces one paper over a period of three to four years, is that sufficiently inspiring to hold him at work? Of course, he will lack association with interested workers in his special field under those conditions. Usually he would be unable to secure the funds for essential equipment and other expenses. Also, the library of such a college would be inadequate for his needs. We must conclude that research is impossible for 90 per cent of the staff in our average independent college.

As a matter of fact, few men seriously interested in research will teach in an independent college. Usually they will remain in a university where recognition and opportunity for research are present.

If especial skill in the direction of graduate and research work is desired in the president, the dean of the graduate school should be selected for that office. He would be acquainted with all the productive scholars on the staff; he would be favorably known to all of them; he would be honest and dependable. Such a choice for president would usually prove satisfactory.

H.

Allotment of Research Funds

In fairness to those engaged in research, funds must be provided for the work to be done. Sometimes such monetary aid is furnished by industrial concerns that are interested in some

specific project; but in most instances, the support for research, especially in the pursuit of individual problems, must be found within the income of the institution. Now and then a legislature will appropriate a fixed sum for research during the biennial period. In that case the college administration must make the decisions and distribute the grants to the departments or individuals who are working on problems.

One method of doing this is to create a committee of eight or nine persons who know something about research. The dean of the graduate school might well be appointed by the president to act as chairman. The committee then sets up general rules of procedure, and after circulating information, invites applications for grants. The applicant states the nature of his project and follows this with a description of the work he wishes to do with a fairly detailed list of the expenditures involved. When the application is received, the committee discusses it; and if in their judgment the project has merit, an inquirer is appointed from the membership of the committee to talk with the applicant. The inquirer can through sympathetic approval secure additional information and a clear concept of the purpose, methods, and possible results of the proposed research. When the committee meets for final action on the request, it will have before it the original papers and the report of the inquirer. Discussion with questions follow, and a decision results that is fair to the research project and acceptable to the guardians of the funds. As the work goes on, the committee should keep in touch with the progress of the research work.

Since I have seen this bit of administration machinery in action, I have confidence in the competence and fairness of such a committee to allocate funds.

M.

When Should an Institution Enter on Graduate Work?

Many of our stronger four year colleges offer graduate work for a limited number of master's degrees. A reasonable estimate of the cost of this work would be to allow one hour per week

of a professor's time to each candidate for the degree. If he had only one graduate student, he might squeeze this one in with his regular teaching load; but if there were two or more, his teaching schedule should be cut down at the rate of one hour per graduate student. If his salary were \$4,500 and he had three graduate students, on the basis of a fifteen hour load, one-fifth of his salary, or \$900, could be charged to the three graduate students.

As soon as an institution moves into work for the doctorate, several other factors enter: (1) At least one professor must be known for creditable research work and the publication of numerous papers. This teacher would quite certainly be receiving \$6,000 or more. (2) The library in the field in which the student worked would have to be adequate and this would mean a goodly array of complete files of various journals in that field. (3) There would have to be a fellowship or an instructorship available for each graduate student, as almost every graduate student, especially in science, is supported by some stipend. (4) There would have to be funds available to meet the cost of needed equipment, supplies and special books. I believe that \$4,000 to \$5,000 should be available annually to meet the expenses, directly and indirectly, of each student admitted to candidacy for the doctor of philosophy degree. A professor with five or six graduate students should not carry more than one-half the regular teaching load, so half of his salary should be charged to graduate work.

Before offering any kind of graduate work for the doctorate, it should be remembered that all departments are ambitious, and the cost of expanding into other departments must be considered. If adequate funds are available, and if the gains are sufficient to warrant the expense, consideration should be given to the fact that more or less emphasis is bound to be shifted from good teaching to research. Is the future growth and support of the institution sufficient to warrant the move?

One other aspect of the matter is important: Our leading universities offer graduate work in from thirty to thirty-five fields. This is a very costly business. The California Institute of Tech-

nology and the Massachusetts Institute of Technology offer the doctorate in less than one-third that number of fields, but their type of work affords a natural barrier to expansion. Every institution in the early stages of developing fields for the doctorate should fix limits within which it can work with distinction. Nothing but discredit can result from the degree offered by an inadequately staffed and equipped department. Work could best be supplied in fields where natural advantages are apparent.

I am satisfied that the policy in regard to graduate work is a matter to which trustees should give careful attention. In 1948-49, 138 institutions conferred the doctor of philosophy degree. I question whether three-fourths of these are prepared to offer such advanced work. In the same year, 438 institutions conferred the master's degree, many of which, also, are open to question.

In no institution should graduate degrees be conferred without the approval of the trustees. The trustees should fully recognize the expense of graduate work before permitting it to be established.

H.

Admission to the Graduate School

There are two conflicting factors affecting admission to the graduate school. On the one hand, only the truly able, outstanding students seem capable of doing creditable graduate work; this tends to limit enrollment. On the other hand, all of our graduates are at work in the world; and if some can manage to return to the university for further study, it is a good thing. It seems wrong to shut them out. This tends to lower admission requirements. The situation is further complicated by the fact that many graduates who entered the teaching profession did not make outstanding undergraduate records, and certainly these people need more training.

Conditions of this sort are met by different institutions in various ways. The graduate students of Princeton University were limited before the war to 250 by trustee action. This number was

apportioned among the departments as seemed to meet the situation best. No more may be admitted until some graduate student either graduates or withdraws. This keeps the quality of the students very high, and for Princeton it is a sound policy.

Massachusetts Institute of Technology has a similar plan: The number of graduate students is fixed as at Princeton. Neither of these institutions offers graduate work in education, so no problem of training high school teachers is raised. Many graduates do enter college and university teaching, however.

At many institutions students admitted to the graduate school are limited to those who were graduated from college in the upper third or upper half of their class. This eliminates those who were either dull or lazy, yet avoids a rigid limitation on enrollment.

With few exceptions, only the highest 5 or 10 per cent in a class are promising material for graduate work. Of this group, again only 5 or 10 per cent will have real aptitude for original research. However, as large numbers graduating with master's or doctor's degrees do not pursue research after leaving the graduate college, high research ability need not be required of all who are admitted.

Especially in our state universities, the restriction to the upper third or half of the class will exclude some really desirable students. Many from the lower two-thirds who enter the teaching profession prove to be able teachers or administrators, deeply interested in their work. They need graduate instruction both for their own development and for promotion requirements. Records of professional success should be accepted toward admission to the graduate school.

A number of graduate schools specify only a baccalaureate degree for admission. However, this does not mean admission to study for a degree; this privilege is limited by various restrictions.

There is sometimes an embarrassing feature which occurs in dealing with graduate students. A young man of low or mediocre ability will work closely with his major professor, becoming a slave, actually, in the professor's service. The latter greatly appreciates the student's help and continues him for selfish reasons until the professor feels compelled to urge the young man's admission to

candidacy for the doctorate, although related departments know he does not qualify. The graduate dean and faculty hesitate to overrule the strong recommendations of the department head.

While the need for men and women with the training required for the master's and doctor's degree is great, American universities have admitted and graduated more such students than has been warranted by the quality of their scholarship.

In 1948-49, 50,827 master's degrees and 5,293 doctor of philosophy degrees were conferred.

H.

Financial Assistance to Graduate Students

A large proportion of all graduate students are on some kind of a subsidy that approximately covers their expenses. I should say that outside the field of education, this is largely true. Students in education, also, are frequently on scholarships or fellowships, but many come to summer school during their vacation or for a year's work when they have saved enough money. They then return to increased salaries as a result of their accomplishment.

The subsidy for graduate work is justified insofar as it helps to prepare teachers more efficiently. Certainly more than half of all candidates for the doctorate degree look forward to teaching as a profession.

In many of our state universities, the fellowships or graduate assistantships awarded graduate students require half-time work in teaching freshmen and sophomore classes. This certainly lowers the quality of the teaching in a large percentage of cases, unless these graduate assistants have been selected carefully for their teaching ability. While some prove to be excellent teachers, many are inexperienced, have little natural teaching skill, and are so absorbed in their own research work or advanced study that they give little attention to their teaching.

If each department using graduate students as instructors would set up an adequate system for training and supervising them, more could be said in favor of the practice. When one talks

to the heads of departments, the problem is usually brushed aside with the statement that supervision is being given or that they can't afford it. I was never able to make any appreciable progress along this line. I doubt if any real progress can be made until a college official with sufficient authority supervises the teaching of all graduate student instructors. I am not suggesting that such an official train these men and women himself. He could, however, see that such training was in effective operation in each department, and force the retirement from teaching jobs of all whom he found to be doing poor teaching, thus compelling the departments to take better care of the situation.

Wherever research touches the teaching of freshmen and sophomores it generally reduces the quality of the teaching. In some instances, it is so inferior to good high school teaching that the students are shocked and disgusted.

We must train many more capable men and women of fine character and personality in our graduate schools. In order to secure students of that type, the institutions must offer to meet their financial needs in large part, but not at the expense of proper instruction in the freshmen and sophomore classes.

H.

Authorship in Publishing Results of Doctoral Theses

There is diversity of practice in the matter of publishing theses, partly due to departmental custom and partly to individual policy.

In some cases the paper is published under the name of the major professor with acknowledgment in the paper to the graduate student who has done the work. In some cases it is published jointly under the name of the professor and the graduate student. In other cases it is published under the name of the graduate student alone, with acknowledgment in the paper to the professor directing the work.

To me this variation is undesirable, often misleading, and should be corrected. It seems to me clear that a doctoral thesis should be published under the joint authorship of the directing

professor and the graduate student. I hold this view for the following reasons:

1. In most graduate schools, quite a number of the best men are so fully occupied with large numbers of graduate students and their teaching duties that they are unable to carry on independent research. If the graduate student is assigned the sole authorship of the paper, the professor's name never appears. This is ridiculous and unnecessary.
2. If the professor publishes the paper under his own name alone, it is unfair to the student who has spent from one to three years of hard work on the subject. His name certainly should be listed as joint author.
3. The professor is known in his special field; his name with that of the graduate student would give weight and an appropriate introduction of the new Doctor of Philosophy to the research men in his field. It would give more rather than less significance to the thesis.
4. A professor occasionally believes that the graduate student has worked so hard and has done so well that he deserves to be given the sole credit of authorship. I would contend that such a man will publish later many more papers under his own name, and that this first paper would receive more attention if published under the joint authorship of professor and student.
5. In the graduating ceremony, frequently the professor under whom the thesis was written presents the man who is candidate to the dean of the graduate school for awarding of his degree. He thus presents his student to the audience. By publishing the thesis under a joint authorship, the professor presents his student to the men in his field of work all over the country.
6. While I have never directed graduate work, I cannot conceive that the part of the major professor in producing the thesis is of minor importance. Even with the ablest graduate students, the influence of the major professor in conference for from one to three years on a piece of research must be profound. The less able student would be only an instrument in the hands of the professor. His subject, his methods of work and all that he did would come directly from that source.

For the above reasons I look forward to a day when all papers resulting from a doctor of philosophy thesis will be published jointly by the professor who directed the work and the student who did the work and received the degree.

H.

Authorship in Publishing Results of Doctoral Theses

My colleague maintains that the name of the professor under whom the dissertation has been written should appear as a joint author on the title page of the thesis. To this position, I take some exception.

The thesis of the graduate student is supposed to be a piece of individual work. It is the business of the professor to discuss with the student the topic and field of the dissertation, and to suggest where material is to be found. The candidate does his search for material, makes his own bibliography, organizes the material, and writes his thesis. The supposition of thesis writing is that the graduate student has reached sufficient maturity to produce a scholarly piece of work. Co-operative authorship with too much guidance stands in the way of independent work by retarding the purpose of a thesis as a doctoral requirement.

I have seen a good deal of abuse arising from joint authorship. A professor has a special piece of work he wants done and uses the graduate student as a helper, and so looks upon him as an assistant, instead of an independent student. In the days when the German university was regarded highly as a source of graduate work, the head of a laboratory required that all theses worked out in his laboratory bear his name as senior author. The procedure is now followed in some of the American universities largely for the purpose of glorifying the head of the department. It can be said that now and then, especially in the field of science, the head has a co-operative piece of work that requires research on several problems. These projects are co-ordinated and constitute a joint piece of research. In such an instance, the names of the workers should appear on the title page.

Nor do I feel with Hughes that more attention would be given

to the student's thesis if the name of the professor under whom the student works appeared on the title page. The best aids to the wider circulation of the thesis are the names of the department and the university in which the work has been done. When my colleague writes that he looks to the day when all papers resulting from a doctor of philosophy thesis will be published jointly by the professor directing the work and the student who did the work and receives the degree, I think he overstates his case. What is needed in these days is greater independence and self-reliance on the part of students. This desirable quality, in my opinion, cannot be secured by such supervision as suggested in Hughes' comment.

In addition to the doctor of philosophy degree, the colleges and departments of education in some of the larger institutions have conferred the doctor of education degree without a thesis requirement; but courses have been added which the candidate is required to finish before receiving his degree. The argument for this procedure is that the student learns more by giving his time to his studies. There is something to be said for this requirement for the degree. The candidate hopes to teach or work as an administrative officer and does not expect to do research. Nevertheless, I think the lowering of the requirements for the doctorate in any field is a mistake. A thesis is, after all, a test of a candidate's ability to formulate his conclusions after considerable investigation. The value of such a procedure is very great; in following it, the candidate gains something that no other method affords.

M.

Joint Research—Interdepartmental Committees

As research grows increasingly valuable, it becomes more and more difficult for many desirable projects to be handled by a single man. Important projects tend to fall within two or more usually accepted fields of research.

Corrosion is an example. At the Massachusetts Institute of Technology, research on this subject is under a committee

representing chemical engineering, metallurgy, chemistry, physical chemistry, electrochemistry, and marine engineering. Similar committees representing all departments concerned are set up to deal with research on accoustics, air conditioning, heat transfer, housing, and solar energy conversion.

The old research method of one individual's carrying on research alone, in semi-privacy, cannot solve many vitally important problems. Ability to work agreeably with others becomes important. Research used to be a field where extreme introverts were directed. A selfish desire to work alone limits the value of a research man.

H.

Writing Books

Many research men look with more or less scorn on book writing. As a matter of fact, there is scarcely any field where an able man can be more useful.

As the field of knowledge broadens, it becomes more and more difficult to decide what should be included in a textbook. Furthermore, Americans do not excel in writing textbooks that are both clear and interesting. We are prone to use technical language unnecessarily. Englishmen surpass us as intelligible writers on technical subjects. We need more experts in the field of science who can write good textbooks.

Textbooks for pupils in the seventh and eighth grades and high school are of immense importance. These young people must learn the most that they will ever know right there. From four to six years must embrace all they will learn of our total knowledge. What is to be included, what omitted, how much space for each subject, are difficult decisions that ought to be made by the wise and learned. Then to write so that it will intrigue the largest number of students! Many textbooks hold not a shade of fascination for anybody. They are written on the basis of take it or leave it policy. Our future leaders in thinking are there now among the upper grade and high school students, ready to be fascinated and inspired, ready to enter the realms of science or of

the humanities for the benefit of the world. Yet there are those who scorn the writing of textbooks.

Outside of textbooks, writers are badly needed—gifted writers who know some field of science. While perhaps a few million men and women more or less understand the advances that are being made in science, there are scores of millions who do not understand any of it. If we had writers who could popularize such advances in books and magazines, they would be of tremendous value in bridging the gap between the pioneers in science and millions of our citizens.

Far too much scientific writing is addressed solely to the learned in a specific field. This is not to say that such articles are not valuable; they are valuable but not enough. One feels that scientists are afraid people outside their field might understand their writings. Hence they use far more technical words than necessary. We need more popular writers who can be understood by the masses and whose writings interest and intrigue them.

An enormous number of college texts lack all elements of fascination and allure. Too often they set the standard for the professor who uses them. They entirely disregard the fact that any man studies eagerly what interests him. No effort is made to charm or excite the student in the great field of knowledge under discussion. One might easily conclude that the writer himself has no genuine interest in his field and writes only under compulsion.

I maintain that any really able writer of books, textbooks for children or college youth, or popular books for the masses, is quite as valuable a staff member as the research man who produces one or two learned papers a year with the help of graduate students, for the benefit of the very few.

H.

University Research Foundations

With the great increase in the volume of research, the problem of patents and the income from patents on the basis of work done on college time and in college laboratories has grown. Perhaps

this problem has been especially acute in publicly supported institutions, but the situation is largely the same everywhere.

An increasing number of institutions (52 in 1951) have established research foundations to handle patents based on the discoveries of staff members. The foundations apply for the patents and meet all the costs. The patent rights are assigned to the foundation, which then bears all the expense of defending the patent and assumes all the responsibility for exploiting the production and sale of the patented article. Conditions of operation vary among the several foundations.

Some institutions prefer to ignore the patent problem entirely. They fear the possible commercialism resulting and the deflection of valuable men from research to the pursuit of patents. I doubt if this fear is justified. In the first eleven years after the foundation at Iowa State College was incorporated, 4,070 research publications were issued and 117 patents applied for, only a few of which were of real value. Most research results certainly will not justify financially any attempt to patent them. Patentable research results will always be exceptional.

Of the 117 patents applied for by the Iowa State College Research Foundation in the eleven year period, 10 were rejected, 23 expired, 51 were granted and 23 were pending. The foundation had forty-six active agreements from thirty-nine of which some income accrued.

The average staff member is not a businessman; he has meager knowledge as to the patentability of a process. He hesitates to pay for a patent and has small resources with which to defend a patent in litigation. He has little understanding of the way to handle the business and to exploit the patent. In all these matters a research foundation can be of great aid.

At Iowa State College, the research foundation sets aside a fixed percentage of receipts for administrative expenses and litigation expenses. It thus has available resources for dealing with all expenses regardless of the income from any individual patent. The net resources of the foundation are available only for the promotion of research.

The amount of net income from the patent paid to the staff member who assigns the patent to the foundation varies from 10 to 25 per cent among the majority of foundations.

Patents and income from patents involve difficult questions on any campus where much research is in progress. While certainly a research foundation does not answer all questions or stop all discussion, we feel that it provides the least objectionable way of dealing with patents.

H.

Wider Use of University Foundations

This organization device can be used for other purposes than that of research alone. The placing of research funds in the control of a separately incorporated foundation gives the board operating freedom that it does not have under a college charter. The control of such a foundation by the selection of trustees from the administrative officers, members of the board of trustees and college staff insures that the policies are not antagonistic to those of the college. Public institutions are hampered constantly by state finance officers who demand that all receipts of the state college or university shall be deposited in state accounts and drawn upon only by the approval of the state finance officers. Recently, legislatures have created state building commissions which are given a lump sum to be used by the building commission as its members may determine. Incidentally, the governor of a state where such a commission exists can use the authority placed in the commission to help his political ambitions.

When such developments in state control of an institution's funds are fully established, the freedom of the institution is considerably handicapped; and if the control is pushed to limits, it may result in curtailing the usefulness of the institution. The wider use of a university foundation can be helpful in protecting a public college or university. For instance, scholarship funds established from private gifts can be administered by it. Even gifts for building could be placed with the foundation; and in that way, free the construction from entanglement with contractors

and architects who secure jobs as politicians rather than as experts in the building and planning fields.

Some abuses may arise when the trustees conclude that they can go into business and, thus, free from taxation the earnings produced by the operations of the business. This is an evasion of the purposes of the tax exemptions allowed educational institutions. The ethics of public responsibility should eliminate any such methods in conducting an educational institution. There is, however, in the use of a university foundation, a genuine instrument by which an institution can protect private funds against misuse by overambitious state officers.

M.