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THE PLACE OF RESEARCH IN THE COLLEGE[1]

IT is a common idea, all too common, that research should be left to the universities, research institutes and the great corporations.

"The primary function of the college is to teach!" is a statement often made with misleading emphasis. All good educators agree on the dominant position of teaching in the college, but many know that teaching attains its highest degree of efficiency only when the research attitude of mind is developed in the student and a research atmosphere fostered in the institution. I know teachers whose scholarship and teaching have been vitalized by enthusiasm over their own research problems. The limited time spent on these problems paid rich dividends not measured in dollars alone.

The general misunderstanding of the true nature and the methods of research is appalling. The typical research professor is not, as so many fear, a retiring and very peculiar genius irritated by teaching duties and interested only in his own selfish problems. Instead of neglecting teaching the ideal teacher brings to his lectures the freshness of originality and gives to his words the ring of authority. There are, of course, brilliant men who have no place on a college faculty, but there are also many, ever so many, priding themselves on their exclusive attention to teaching, whose words are as dry dust in the mouth.

Pure research is sometimes damned with the triumphant question, "Of what use is it?" Let J. J. Carty, of the American Telephone and Telegraph Company, give answer. "The pure scientist is the advance guard of civilization." Herbert Hoover adds, "Our whole banking community does not do the public service in a day that Faraday's discoveries do us daily." In speaking of the chemical research on coal-tar that has given the world a thousand beautiful dyes such as were never known before, indispensable medicines, liquid fuels, wood preservatives, high explosives and many other remarkable products, H. H. Gray pays a merited tribute to originality. "After all, only mind can transform the pence of coal-tar into the sovereigns of fine chemicals. Capital can draw the dividends and labor can plume itself on its indispensability, but it is mind which performs the miracle."

[1] Address given at Wittenberg College on the occasion of the dedication of the Laboratory for Chemistry.

It is idle and unfair to quote a few examples of silly and futile research as proof that the whole business would be a waste of college time and money. Sane supervision will protect it from abuse.

There is far too much stress on the informational side of college teaching. We boast that we train the student to think and indignantly deny that we are fact-stuffers, yet most college faculties withhold from the student the most effective method of thought ever developed, the scientific method, the research method. The worst of it is that some of our leaders pride themselves on thus cheating the undergraduate out of his intellectual rights and privileges. The faulty habits of thought that should be trained out of college students are summarized in a forceful way by Fairchild (pamphlet issued by the Character Education Institution of Washington).

INTELLECTUAL IMMORALITIES

(1) Carelessness in observations.

(2) Inaccuracy in determining units to be counted in statistical research.

(3) Slovenliness in logic, fantastic explanations.

(4) Generalizing beyond one's data.

(5) Confusing opinions with knowledge.

(6) Contentment with "discussion."

(7) Egoism allowed to crowd one to the invention of "new" theories for personal distinction.

(8) Inventing interesting theories for the sake of selling them in books, articles, lectures and conversation.

(9) Formulating an hypothesis on weak bases of facts, and then becoming blind to facts in opposition.

(10) Emotionalism during research, "I believe" instead of "I have proved."

(11) Opposition to a theory merely because of ignorance and stupidity, "I can not see how."

(12) Rushing into print with a report of research work that justifies no conclusions.

(13) Cowardice in supporting a verified generalization because it is unpopular and conflicts with selfish interests.

(14) Impatience, unwillingness to proceed step by step through a research.

(15) Indulgence in dense verbiage for the sake of appearing superlearned.

(16) Poularizing tentative generalization for the sake of personal publicity.

(17) Resort to the authorities, or to sarcasm and ridicule, against data, arguments and verifications.

"Verification" seems to have been too little appreciated in college circles as a factor essential to all research supposed to be on the scientific level. We must do more than indulge in "views, theories and endless discussions."

An indignant believer in the scientific method of thinking writes me, "My cousin is the wife of a great scientist, but she has lost her senses over the modern fake imitations of psychology and writes articles without any conscience as to verification of her generalizations; the spirit of the fantastic thinker is in her rather than that of the scientist."

Ira Remsen believed in the ethical virtues of research. The essential honesty of a scientist with his problem appealed to Remsen as making for superior character. The late Charles D. Walcott, former secretary of the Smithsonian Institution, went further and insisted that a good research man ought to make a good Christian and a good Christian ought to make a good research man because both are in search of truth.

Herbert Hoover well says, "If we would command the advance of our material, and to a considerable degree, of our spiritual life, we must maintain the earnest and organized search for truth. We could well put such an appeal wholly upon moral and spiritual grounds; the unfolding of beauty, the aspiration to knowledge, the ever-widening penetration into the unknown, the discovery of truth, and finally, as Huxley says, 'the inculcation of veracity of thought.'"

If we hope to inspire the college youth we must make him feel that he is drinking from a fresh spring of knowledge rather than from a stagnant pool. As one keen student remarked, "I notice that the teaching is better when there is some research going on around the corner."

Oberlin's great librarian, Azariah Root, in the last year of a scholarly life, announced to a college committee, "What Oberlin must do is to spend more money on research and to encourage it in every way in order to keep our faculty from growing stale." Oberlin is probably doing as much in research as any pure college, but there is much more to do. An inspired faculty develops an inspired student body.

"Research by stealth" is an unpleasant phrase used to describe the situation in some colleges where the professor is expected to spend his entire time in routine teaching. A recent questionnaire disclosed the fact that only a very limited number of college presidents are willing to encourage research by financial aid for productive work. Some others are willing to have national honor brought to the college by research publications of its faculty if no expense is involved. This short-sighted policy cheats the students by driving away the ambitious, productive scholars of the faculty.

Without a staff of productive men how shall the college meet the challenge of the gifted students? Informational teaching is not adequate, but sound instruction in the research method of approach to all problems will stimulate the gifted student to his best. Even a freshman will ignite from the right sort of

spark, although he will not actually engage in research. Instead of describing achievements to him in the final form the instructor can lead him in fancy, step by step, through all the difficulties preliminary to great discoveries, disclose the original plans and hopes, and arrive at the climax of successful achievement with dramatic force. It is more than the historical method, it is the living, breathing, thrilling method of teaching.

In actual practice undergraduates respond eagerly when asked to walk occasionally in the footsteps of the great masters of the past. Many of them get from the experience "a sense of unlimited possibilities, of adventure and of exultant hope." They can be thrilled with the conception of research as service to humanity in conquering yellow fever, in making the surgeon's work safe with antiseptics and merciful with anesthetics, in averting a predicted world wheat famine, in making every man your neighbor by marvelous improvements in communication and transportation, and by reducing the working day of fifteen hours, common a century ago, to the modern day of eight hours with its increased possibilities for health, comfort, culture and the pursuit of happiness. To prove to the youthful mind that the pure research of Faraday, Henry and others made possible the electrical industry which in the United States now multiplies the man-power of our population is to give a vivid impression of service. Slaves rushing along a wire at the touch of a button to run our errands, lift us to the lofty floors of our office buildings, run our washing machines, sweep our floors and save us from drudgery even as a thousand captives once slaved for a petty king of the long ago!

Beyond the question of inspiring the undergraduate and training his mind in the mastery of the varied problems of life is the moral obligation on the college to acknowledge its debt to the past by adding something new to the sum total of knowledge. Is it right for a great institution of learning to hand out facts other faculties have gathered without sharing in production? Carlyle exclaimed, "Produce, if it be but the pitifullest infinitesimal fraction of a product, in God's name produce."

The sciences, it must be admitted, have done more than the non-sciences in recognizing this obligation. Professor John R. Commons, of the University of Wisconsin, has extended this statement to include the universities, "To acquire knowledge—the existing knowledge—is the retail store method, the hand-me-down method. The research method is just opposite; it is the discovery method. We do not acquire knowledge, we discover knowledge, using the dig-it-up method. In economics, in sociology, in philosophy, in all those sciences which have to do with the great laboratory of human life throughout the community, we have not yet learned the laboratory method, the dig-it-up method."

The American Historical Association, in a recent report, admits that fewer than one fourth of the holders of the Ph.D. degree in history are productive scholars. A quotation from this report follows: "Presidents, especially of the smaller colleges, insist on having Ph.D.'s on their faculties, not because they expect or wish them to be productive scholars, but largely for advertising purposes. The large universities are thus crowded with mediocre graduate students, many of whom can not be taught the technic of research except with great difficulty. It is still more difficult, and often impossible, to inspire them with a passion for research. One important reason for lack of production is a widespread belief that research does not pay. It is alleged that many who are productive fail to gain the reward they might reasonably expect; that presidents of colleges and universities give lip-service to research, but do not take it into consideration to any great extent in making promotions or increases in salary; that, therefore, Ph.D.'s seek to advance by teaching, wire-pulling and 'social stunts.'"

Bertrand Russell and the Bishop of Ripon are suggesting that if scientists desist from discovery for ten years the rest of the world might catch up and adjust itself to a condition of tranquility. This is an admission of weakness, not an acceptance of a challenge. Evidently the eight hundred thousand college students of this country need an insight into the scientific method of collecting facts by many accurate, unbiased observations, of classifying and comparing facts, of explaining the facts with a theory or generalization, of rigidly and honestly testing the theory and of using the tested theory to predict future behavior.

There are, of course, difficulties in making research an integral part of college teaching. Many men now on college faculties, though trained to research, in the struggle for the Ph.D. degree have allowed this acquired talent to atrophy. Now they shrink from any belated demand for productivity. It is difficult to blame them. Rather let us blame the college for overloading such men with mere routine teaching and for a general failure to recognize, encourage and reward a proper amount of productivity. The cost is a veritable lion in the path, but must it forever stand in the path to the highest excellence?

Adequate reward for research will doubtless bring on its attendant evils. Publications of an inferior order will be cited for promotion, but it is easy to get the judgment of leaders in a given field as to the quality of original work. Time will, in a few in-

stances, be frittered away on silly struggles to be original, but why not, in the future, deny to such men the opportunities to continue this waste? "To him that hath (the Divine spark) shall be given, and to him that hath not shall be taken away."

The Division of Educational Relations of the National Research Council suggests:

WAYS TO AID RESEARCH IN COLLEGES

Give research a place in faculty meetings on a parity with teaching problems.

Give research, as a matter of course, recognition in the budget of each department of study; grants for apparatus, literature, research assistants, etc.

Have special research fund for special grants, this to be administered by the research committee. Emphasize dignity and importance of this committee.

Give stenographic and clerical assistance to faculty members to conserve their time and energy for teaching and research.

Cut down hours of teaching.

Large faculties, small classes.

Leaves of absence, on salary, for intensive study.

Consultation trips by college men to the research centers for advice and conference and reading.

Exchange of teachers between universities and colleges (and perhaps exchange of research men between industry and the colleges).

Assistance toward expense of attending professional society meetings.

Research as well as teaching success recognized as a basis for promotion.

Special professorships for those markedly successful in both research and teaching, with added time and assistance for research, and additional salary.

Appointment of occasional research associates giving full time to research.

Encouragement of research for the M.A. degree; also special stipends for M.A. students who shall assist professors in their research.

Research scholarships for outgoing seniors and for recent graduates to study in research institutions.

Develop the library for assistance to research as well as to teaching.

The appointment or election of a standing research committee on the college faculty is vitally important.

FUNCTIONS OF A COLLEGE RESEARCH COMMITTEE

Promote appreciation of importance of research on the part of all members of the college community, including trustees, administrative officers, faculty students and donors.

Survey and list the researches in progress in the institution.

List the more important researches published in the past from the college.

Gather and classify information in regard to the entrance of graduates upon research, and list the ablest men among the graduates of the college.

Learn, classify and list the assistance needed for: (a) researches in progress, (b) researches it is desired to undertake. Assist in plans for securing such aid.

Publish these items for circulation in the college community.

Publish an annual report for circulation in the college.

Assist in securing cooperation between faculty members in research.

Study and suggest possible correlations between researches under way in the college.

Consider publication of research results—perhaps advisable, especially for studies of local environment. Publication assistance is especially needed in the so-called "humanities." Avoid encouraging publication of unworthy papers.

Secure a liberal research fund, grants from which shall be administered by the research committee.

Exchange with local committees in other colleges information as to methods and success in promotion of research.

Arrange for presentation to the students, by men from the several departments and from outside the college, of the life devoted to research, in the several major fields. This is important in securing recruits for the life of research.

Encourage departmental clubs which shall report and discuss research and newer phases of progress in knowledge, discussing also the men through whose research mankind have made great advance.

Encourage work by semi-research methods in the curriculum, putting some of this work as early as the sophomore year.

Encourage establishment of societies and fraternities which reward research ability.

Present research to community by lectures and exhibits.

Urge value of administrative assistants to relieve faculty members of detailed committee work.

Ten years ago Oberlin College, at the request of the National Research Council, elected a science research committee and made it a standing committee of the faculty with all the privileges thus implied. The small original committee set a high standard of election. Every man on a science faculty was asked to submit a list of his research publications exclusive of his doctor's thesis. If his independent work published in journals of good standing measured up in quality and quantity he was recommended for election, which always followed as a faculty endorsement. It is now considered an honor to be a member of this committee. At occasional dinners the members discuss the situation and plan for the future.

In addition to this group of scientists a "Committee on Productive Scholarship" is now being formed in somewhat similar fashion. However, the qualifications include authorship of books (other than mere compilations) and musical compositions of merit as well as scientific research. Obviously productive

work in the entire faculty will be encouraged and made prominent.

All this is eminently worth while if we agree with President Angell, of Yale, who urges that "Individual initiative, resourcefulness, ingenuity, imagination, vision, must be kept at a high pitch all along the line."

HARRY N. HOLMES

OBERLIN COLLEGE

EARLY PSYCHOLOGICAL LABORATORIES[1]

LABORATORIES for research and teaching in the sciences are of comparatively recent origin. They may be regarded as part of the industrial revolution, for there is a close parallel in causes and effects between the development of the factory system and of scientific laboratories. The industrial revolution began with the exploitation by machinery of coal and iron in England; it may perhaps be dated from the use of the steam engine of Watts in the coal mines of Cornwall about a hundred and fifty years ago.

The laboratory had its origin fifty years later in Germany as part of the scientific renaissance following the Napoleonic wars. The University of Berlin was founded by Wilhelm von Humboldt and Frederick William III in 1810. The first laboratory of chemistry was opened by Justus von Liebig at Giessen in 1824. This was followed by similar laboratories at Göttingen under Wöhler in 1836, at Marburg under Bunsen in 1840, and at Leipzig under Erdmann in 1843. The first English laboratory was the College of Chemistry, now part of the Imperial College of Science and Technology of the University of London, which was opened in 1845 by von Hoffmann, brought from Germany by Prince Albert. Benjamin Silliman founded at Yale University the first American laboratory for the teaching of chemistry.

Prior to the industrial revolution the artisan worked at home, sometimes with 'prentices, who were often his children. The factories, the mines and the systems of transportation, with their machinery, their skilled overseers and division of labor, their owners and entrepreneurs, their exchange of commodities and ideas, created a remarkable economy in production, so that now each individual may perhaps work half as long and consume twice as much wealth as formerly. But there are serious drawbacks in the lack of freedom and initiative of the workman, in the loss of joy in creative work. The situation in the laboratory is similar. A professor may have many associates, assistants and students; expensive apparatus and extensive libraries may be installed; division of labor in each laboratory and among laboratories can be planned; there may be exchange of ideas and of information on the progress of research; students are taught in large groups. Production is greatly increased, perhaps quadrupled, as in the industrial system. But the scientific man is subject to administrative controls; he is no longer free; he must compromise with others and teach all sorts of students. The system is useful for the production of a large mass of routine work; it may not be favorable to creative genius.

Anatomy has been called the mother of the sciences; dissecting rooms go back to the medieval universities of Italy. Observatories, museums, botanical gardens, academies of science and university schools, where research was undertaken and in which students and assistants were taught and trained, preceded organized laboratories. Chemistry is the gold transmuted through alchemy; we have all seen on the stage the laboratory of Faust. Christian fathers say that when "the sons of God saw the daughters of men, that they were fair and they took them wives," as told in the sixth chapter of Genesis, these fallen angels taught the fair daughters of men the arts of astrology and alchemy. Scientific men who do not care for special creations may assume that there has been a gradual development from the time of the first experiment by an anthropoid ape, or it may be by a paramecium or an electron. If, however, we want an official beginning for the first scientific laboratory, it will be the laboratory of chemistry at Giessen, the hundredth anniversary of whose foundation was celebrated three years ago.

Chemical laboratories were followed by laboratories of physics and biology. I worked in the first American biological laboratory in its early days. It was established at the Johns Hopkins University by Newell Martin, a student of Huxley, who at the Royal College of Science had founded the first laboratory of biology. From the laboratories of Martin and Brooks at the Johns Hopkins have proceeded many of our most eminent biological workers. The Johns Hopkins also led in the establishment under Welch, Mall, Abel and Howell of laboratories in the medical sciences. But there is obviously no sharp line of demarcation between the modern laboratory and earlier groups of workers, such as the great school of zoology conducted by Agassiz at Harvard.

The first laboratory of psychology was established by Wilhelm Wundt. In an article on the Leipzig laboratory, published in *Mind* in 1888 and submitted to Professor Wundt, I give the date as 1879. The fiftieth anniversary of the founding of the labora-

[1] Address on the occasion of the inauguration of the Psychological Laboratory of Wittenberg College, Springfield, Ohio, October 21, 1927.