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SIGMA XI AND THE FUTURE[1]

Members of Sigma Xi, Initiates and Guests:

For many years it has been the custom in our chapter upon the occasion which each year corresponds to this, for the president of the chapter to read an address in order to explain the more clearly to those whom we are honored to receive into membership the spirit of Sigma Xi. In some instances this address has taken the form of a description of a piece of research; in others a general statement of the function of Sigma Xi in furthering the cause of research. Much as I should like to be relieved of the honor of addressing you this evening, I feel that it would ill become me to change so time-honored a custom. And accordingly I beg your indulgence while I discuss some of the problems and the obligations before Sigma Xi, at least as I see them. This subject seems to me to be particularly appropriate just now because of the uncertainty of the conditions to be met in the new era, into which, we are all agreed, we are entering.

First, however, permit me to review briefly the history of Sigma Xi—this with the double purpose of acquainting our new members with the origin and development of the society which, to-night, they are joining, and of furnishing a foundation upon which logically to discuss the problems before us. For we must build the future upon the experience of the past.

To those of us whose educational home is Cornell, Sigma Xi has a peculiar significance, for it was here, thirty-three years ago, namely in 1886, that the society was founded, and it is from here that the society has spread, until now chapters are found in nearly every large institution of learning in the country. How was it that these young men, in this

[1] Presidential address before the Alpha (Cornell) Chapter of Sigma Xi, May 17, 1919, upon the occasion of the initiation of new members.

young university, at that time less than a score of years old, came to found a society which has exerted such a marked influence upon the progress of science? Perhaps they had absorbed something of the spirit of the place, a spirit of faith in the future, which, in the early days made Cornell a leader in so many lines of university activities, and by the very originality and boldness of the idea which they conceived foreshadowed that for which the society now stands.

We shall probably never have a complete account of the events in the spring, summer and autumn of 1886 that led to the formal establishment of the society. The existing records are very meager; many of them undated; and what has been written is largely the result of piecemeal compilation. I can, however, give you a glimpse of those early days, so full of interest and inspiration to us of the present generation as we look backward, by letting one of the founders speak for himself—Mr. W. H. Riley, of the class of '86, and a charter member of the Alpha chapter:

> You asked me to tell you about Sigma Xi. Well it has been so long ago that I have forgotten most of the details but I will tell you as much as I can remember. During my last three years in Cornell I ate with a bunch of boys who were mostly Arts students and most of them very good students. Every spring some of the boys won their Phi Beta keys and of course these were the occasions of congratulation and discussion. In the spring of 1886 two of my best friends received their keys, which started me to thinking that there should be some honors bestowed on the scientific students who had done good work. I discussed the question with W. A. Day, my chum, an engineering student, and we grew very enthusiastic over it. At this time there was an instructor in Sibley College, Mr. Frank Van Vleck, with whom we were very intimate. He was a graduate of Stevens Institute and was brought to Cornell by Dr. Thurston when he came from Stevens. We mentioned the subject to Mr. Van Vleck one evening while seated under the trees on the corner of Factory (now Stewart) Avenue and State Street, in front of our boarding house; he was much taken with the scheme and thought it should be worked up immediately. This was about the first of May. From that time until commencement we often held meetings, the three of us, under the trees or walking down town. Mr. Van Vleck consulted the faculty and Mr. Day and myself the students. Everybody thought it was a good scheme, but as graduation was so near we could not get them aroused. The week before commencement we had a meeting and decided to stay awhile after the close of college and work the matter up, but I was called home directly after commencement. Mr. Day and Van Vleck stayed until they had everything planned out. We had some correspondence during the summer but it has all been mislaid. Mr. Van Vleck presented his scheme in the fall of 1886 and a society was formed.

The idea then originated with these three men: Messrs. Riley and Day, of the class of '86, and Mr. Van Vleck, an instructor in Sibley College and a graduate of Stevens Institute of the class of '84. With them there were associated in perfecting plans in the autumn of 1886, six other young men: three of them graduates of Rensselaer Polytechnic Institute, of the class of '86, then students at Cornell, and one each from the Cornell classes of '86, '87 and '88—young men, under twenty-four, all of them. They planned a society whose watchword should be "Friendship"; and they joined hands "in forming a brotherhood in science and engineering which should promote and encourage by strong personal attachments of friendship the highest and truest advances in the scientific field" and which should "lend aid and encouragement to those newer brothers, who, likewise laboring in the same spheres, were aspiring to honored positions." They agreed to "lend their efforts to the establishment of an organization to be publicly known as the 'Society of the Sigma Xi.'"

About the same time the late Professor Henry Shaler Williams, then professor of geology at Cornell, realizing the need of an honorary society for scientific students, similar to Phi Beta Kappa, drew up a plan for a society to be known as "The Society of Modern Scientists," the object of which should be to recognize by some mark of honor, "those who exhibit special ability in investigating, understanding and interpreting the facts of nature in the various branches of modern science, in order to encourage high attainments among

the future students of Cornell University and of other kindred institutions."

These two movements, independently and stimultaneously started, soon came into contact, and finding so much in common, at once joined hands, keeping the name of the organization already perfected by the younger men, but extending its scope and influence according to the council and advice of the older man. Shortly after, apparently in the winter of 1887, four faculty members and five graduate students were invited to become members of the new organization. In the spring of 1887 is recorded the establishment of two chapters, one at Union College and one at Rensselaer. For some reason comparatively little progress was made in further extending the movement although six more chapters were authorized by the parent chapter and plans for the organization of still others were made. None of these, however, were established, and after many discouragements some of the leaders became disheartened, thinking that after all the time was not ripe for such a movement. But finally a charter was voted to Kansas in 1889. This was the status of the society until 1893, when a convention of the four chapters was held in Ithaca, at the call of the parent chapter and a national organization was formed. In 1895 a charter was granted for the establishment of a chapter at Yale, and from that time on there has been a steady increase in the chapter roll. At present there are thirty chapters, in nineteen different states, with a total membership of nearly 12,000 of whom about 2,500 are resident in the universities where chapters are located, and are therefore classed as *active* members, while the remainder, not being directly resident in the chapter, are called alumni, or non-active members.

During its third of a century of existence the motto of the society has been "Companions in Zealous Research"; its object, to encourage "original investigations in science, pure and applied"; and it has sought to accomplish this purpose, in the main, by three different classes of activities: first, by holding meetings for the discussion of scientific subjects and by printing such scientific material as may seem desirable; second, by establishing fraternal relations among investigators in scientific centers; and third, by granting the privilege of membership to such students as, during their college course, have given promise of future achievements in the field of science. While the activities of the several chapters have been varied to suit local conditions, it has been their common object to emphasize that which all investigators have in common: that indefinable something which goes by a variety of names; which "can be felt but not itself investigated"; that something within him which the investigator satisfies by seeking out the truths of nature and then making them known to his fellow men, with a faith, usually unexpressed, that some day these same truths would make the world better, though perhaps a busier, place to live in.

Such then has been the origin, development and activities of the society to which we belong. It is to be hoped that we will carry with us into the future these same ideals, and perhaps many of these same activities, which have made so much for the success of the society in the past. But without doubt the world is now entering a new era, a new order of things, in which every institution, whether political, economic, educational or scientific, will face new conditions, new obligations, and new opportunities. Just as the scientist, in his field, is a pioneer, so he should be among the first, if not the leader, in making his field ready for this new order of things. We may then well ask: Can Sigma Xi adequately discharge her responsibilities in this new era without an extension, perhaps a radical extension, of her former activities and influence? The very form of the question indicates a negative answer.

Before discussing these extensions, I should like to point out that the sphere of influence of Sigma Xi has, up to now, been confined almost exclusively to university circles. With the exception of that at Washington, the chapters are all located at universities. This is not so significant as is the fact that only those who are members of the university community can be *active* members. The result is that over

three quarters of those who have been elected are alumni, or non-active members, and have no connection with any chapter, or indeed with the society. And another point is that the activities of the society have been largely internal, in the same sense, roughly speaking, that a fraternity exists for the benefit of those who are members of it, and whatever outside influence it exerts is of a passive, rather than an active kind. The young investigator may aspire to the honor of an election to membership, but there is at least a gain of truth in the definition that "an honor is that which one does not appreciate *after* one gets it."

Broadly speaking we may classify the fields in which Sigma Xi may extend its influence as local, national and—it may be a dream, but I am going to add—international.

The local problems confronting each chapter are more or less peculiar to the chapter, and in discussing these I can only speak of conditions existing here at Cornell. How can we, right here at home, lend still further encouragement to "original investigations in science, pure and applied"?

One of the most important problems discussed by President Schurman in his recent annual report is that of raising the standard of scholarship in the university. The very fact that the president has seen fit to raise this question in an official report indicates how serious the situation seems to him. For solving this difficult problem various means have been suggested, such as the establishment of scholarships, prizes, honor courses and the like. Each of these will doubtless be effective, but no one of them can be considered a cure-all. Any solution must be based upon the fundamental object of a university course, which, I take it, is *not* to make of a student in four years a walking encyclopedia, but rather to teach him a *few* facts, and in four years, to inspire in him such habits of study and scholarship as will make him a student for the rest of his life, whether his field be philosophy or engineering, so that his *real* studies will begin, not end, on commencement day. For, that man is successful in the practise of his profession who, in his college course or elsewhere, has gained confidence in his ability to undertake and accomplish successfully things which are new to him and which very likely have never been done before. The man who lacks this confidence, one might even say habit, of independent thinking, is likely to become a mere clerk or mechanic and to stay at the bottom of the ladder.

Now, you may teach facts and the relation of one group of facts to another—all that part of knowledge which we may classify as encyclopedic—but, try as you may, you can not teach by aid of any sort of artificial stimuli, life-long habits of study and of independent thought. These can come only *by inspiration and example,* for both of which the student must look, indeed it is his right to look, to the faculty, if he is to get full value from the four years of his time which he spends here. Or, looking at the university as an economic unit in society, *we can not expect to turn out a productive student body from a comparatively non-productive faculty,* non-productive not so much because of lack of interest in scholarship and research as because of lack of opportunity.

One of the properties of matter is that which we call inertia, by virtue of which a body at rest remains at rest unless acted on by some outside force, or if in motion remains in motion unless brought to rest by some outside force. The application of this principle extends, at least in a qualitative way, far outside the realm of material things. In our ordinary, every-day life we call it habit. It takes force, of one kind or another to make habits and it certainly takes force to break them.

It was probably in unconscious recognition of this principle that the remark was made some time ago, that while it might be true that students would study if interested, it was also true that in order to become interested they must be made to study. Because of the inertia of the human intellect, this probably applies, more or less, to all of us, *to the faculty* as well as to the students. If therefore, we would have a scholarly, productive faculty, by means of which to turn out a productive

student body, it follows that we must first *require* productive scholarship of the faculty *as a part of its duty to the university.* The interest in original work, thus aroused by compulsion if you will, will be self-sustaining and will accomplish the double purpose of setting an example to the students, by means of which, I firmly believe, many of our problems of undergraduate teaching will be solved, and of accomplishing that other prime function of any real modern university: the adding to the sum-total of knowledge.

Now, I would not presume for a moment, to suggest what alterations in the educational and the financial policies of the university may be necessary to bring about this much-to-be-desired condition, nor would I attempt to outline what part Sigma Xi may play in ensuring an increased recognition of the value to the student body, to the faculty, to the country, of more original investigations "in science, pure and applied." But what I do wish to point out is that here is a problem, right in our midst, which touches the very foundations upon which Sigma Xi is built, and to ask whether it is not our duty, officially as a society, to lend our organization, our ideals and our traditions "to encourage higher attainments among the future students of Cornell University." If we really believe in that for which the society stands, I regard it our duty to take an active part in the solution of this problem.

Coming now to an extension of the activities of the national organization, may I mention briefly two items already under consideration.

First, an extension of the chapter roll: For many years the society has exercised the greatest care in the admission of new chapters—this, without doubt, being due to the early experiences above mentioned, of the parent chapter. It has been felt that any institution, before being granted a charter, should have demonstrated beyond any doubt, its ability to maintain a high standard of scientific work. Now, however, with the increasing strength and stability of the society, we feel that, even though there may be a small risk involved, it is safe to go a step farther by granting charters to such smaller institutions as may have given distinct promise of creditable research activity. We may therefore expect a considerable increase in the chapter roll in the next few years.

Second, Sigma Xi fellowships: It has always been a matter of regret that neither the chapters nor the national society could directly engage in research. However, under the able leadership of our national president, Professor Stieglitz, of the University of Chicago, a movement has been started to enlist the support of the 12,000 members of the society, by asking for annual contributions from each member of say one or two dollars, for the establishment of at least two fellowships (more if possible) of a value of $1,500 or $2,000 each, one in the physical sciences and one in the biological sciences; these to be awarded each year on some sort of a competitive basis. The value of these fellowships would lie not so much in the satisfaction that we would feel in actually engaging in research, as in increasing the stability of the national organization by furnishing some tangible thing around which would center a common interest. At present the problems of the several chapters are so largely local and so little national that there is need for something to bring them closer together.

This movement at once suggests an obvious, though perhaps a radical change in our past procedure. When Sigma Xi was founded it was perfectly natural that its activities should be confined almost exclusively to university centers. Then the university *was* the home of pure science, and to a large extent of applied science. But now, due in part to the increasing economic importance of scientific work, and in part to the extent to which teaching duties are allowed to encroach on the time of the professor, conditions have radically changed. You have only to glance over the papers presented at the meetings of the scientific societies to realize that more and more research in pure science is coming as a by-product from the ever increasing number of governmental and industrial re-

search laboratories, on such a scale as to overshadow the output of the universities. And as for applied science, I need only mention a few recent developments, from one field, namely physics; such as: the tungsten lamp, which is worth annually to the country a sum expressed in hundreds of millions; the thermionin X-ray tube, which in addition to revolutionizing some phases of medical practise, has given to the investigator in pure science an instrument of research the value of which can hardly be overestimated; the wireless telephone, the beginnings of which as a factor in our economic life we have not yet begun to appreciate; multiplex telegraphy and telephony, by which many messages, part telephone and part telegraph, may be sent simultaneously over the same pair of wires with a consequent reduction in the cost of operation; improvements in the methods of maintaining, measuring and recording high temperatures, so important in many industrial processes; the high potential kenotron, a device which will probably clear Pittsburgh and every other city of its cloud of black smoke; a clearer understanding of the requirements of the human eye in the matter of artificial illumination; these, and countless other devices, all coming from outside of universities, may well raise the question as to whether we can *now* say that the university is the home of science, either pure or applied. If the university *is* the home of science, then it must be said that science is a large part of the time away from home, and even when at home occupies only a corner of the attic. If the universities would keep science *at* home they must provide the main suite on the first floor.

In other words, looking at it from whatever standpoint you please, it is certainly true that pure science as well as applied science has outgrown the universities. Unless therefore we wish to apply a purely arbitrary definition to "original investigations in science" we must extend the active influence of Sigma Xi beyond university centers. The fact that the investigator in applied science is given equal recognition with the investigator in pure science at once indicates that the society raises no questions as to what use shall be made of the results of the investigation. It should likewise make no difference where the work is performed, whether in a government laboratory, an industrial laboratory or a university laboratory, so long only as the investigator is sincerely looking for "the truth."

So far as formalities are concerned, this extension can be very simply made, for it is only necessary to make active members the ten thousand (approximately) non-active members, who collectively represent practically every industry, and every educational institution in the country. We would then have available adequate machinery for spreading the society's ideals so as to cover the whole field of science, and not simply that portion of it which is found in universities. To do this seems to me not simply a duty which we owe to our alumni members, but an opportunity to extend our sphere of influence—an opportunity, the neglect of which would be an unpardonable waste of our "natural resources."

But it might be asked: what can we do with 12,000 members scattered throughout the country which is not being done by the several engineering and scientific societies. There is this difference: These, in the main are at work advancing knowledge in their respective fields. Sigma Xi, however, includes all science; and could undertake common problems such as, for example, a campaign to increase the popular appreciation of the value of scientific research. Such a campaign would have to be carried on in a very dignified, judicious way, but I believe there is need for it. It is one way to express the contribution of Sigma Xi up to the present by saying that the society has attempted to make science appreciated by scientists. The next logical step is to make science appreciated by those who are *not* scientists: to correct the popular impression that it is only necessary for some inventor to conceive a new idea, and behold, a wonderful new invention, such as the wireless telephone, springs full grown as from the head of Zeus; to point out the tireless research be-

hind such a device as this and that it is the people of the country in the long run who profit by the work of the investigator; and that such work is worthy of more stable support than the chance generosity of some multimillionaire. From an economic standpoint scientific research is a well-established business, not the mere whim of a few individuals; a business involving perhaps a long-term investment but which nevertheless is just as worthy of support, and economically just as important, as is the postoffice department or the railroads, differing from these only in the fact that these supply the present generation while scientific research, like the public schools, is for the next.

Whether we shall see government support of research in pure science depends, I believe, only on whether the scientific societies of the country, of which Sigma Xi is as representative and potentially as influential as any, can agree upon and present to Congress a concrete statement of the responsibilities of the federal government in this matter as well as a workable plan for administering such support. In a democratic country it seems impossible that ever again should it be left to accidental philanthropy to provide funds for building the very foundations of economic and industrial progress.

Of the possibilities of making the influence of Sigma Xi international, little need be said except in amplification of the statement that even now the matter is under informal consideration and will probably come before the society for formal action some time within the next two years, in response to inquiries from two foreign countries, England and Norway. The sentiment of the society, so far as voiced, is in favor of such an extension, and there seems to be nothing either in our constitution or our traditions which prevents. May we not look forward therefore with much hope to an international fraternity of scientific workers, the influence of which, even though sentimental rather than scientific, will serve as one additional bond to tie together that which we all hope to see some day: a great family of nations. F. K. RICHTMYER

CORNELL UNIVERSITY

ZOOLOGICAL AIMS AND OPPORTUNITIES

IN its recent numbers SCIENCE has printed two addresses made before the Baltimore meeting of the American Association for the Advancement of Science last winter, both of which deal with the same general subject; the aims and purposes which in the present critical period of the world's history should guide or influence zoological and botanical work, and the opportunities offered and responsibilities imposed by the present conditions on those engaged in such work.

Both of the addresses contain much that is interesting and inspiring and make suggestions that are well worth trying out, but neither of the two speakers seems to have felt it necessary to extend his survey of the field beyond the two subjects of teaching and research, though of course including under the latter heading investigation for practical and economic purposes as well as for the increase of knowledge without immediate prospect of its application. This limited conception of their proper aims and obligations is unfortunately held by a large proportion of scientific workers, probably more often because it falls in with their inclinations and convenience than because of any conviction of its sufficiency; it may have answered well enough in the earlier stages of the development of science and may still do so in some departments of it, but it is now very far from sufficient in the case of zoology, botany, ecology, forestry and other allied branches. The rapid economic expansion of the present time is making demands on natural resources to an extent that was never before approached, and improved and quicker means of transportation are extending the resulting destructive effects to every part of the world. Only prompt and scientifically directed effort can save from complete and permanent destruction and disappearance a large part, and perhaps much of the most interesting part, of the subject matter with which these sciences deal. It is only those with more or less scientific knowledge of animals and plants who can see in advance the need of protective or remedial measures and