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THE AMERICAN SOCIETY OF NATURALISTS
PRESIDENTIAL ADDRESS[1]

ON several occasions during the last few years, indeed, ever since my election to the honorable position which I occupy to-night, I have been asked "What is the use of continuing the existence of the Society of Naturalists?" When one is in the full enjoyment of an honor so greatly appreciated as that which I now enjoy it is a veritable cold douche for some well-meaning but not altogether tactful friend to suggest that the honor may after all be an empty one and that the presidential chair I occupy is that of a society so moribund that it would be a kindness to let it turn its face to the wall and enter into its eternal rest. But a cold douche may have a highly salutary effect both in tempering a too great elation and in bringing one into the proper frame of mind for considering whether, after all, there may not be force in the suggestion. Gentlemen, I have passed through these experiences, I have considered calmly and, so far as possible, impartially the condition of the society and its relations to other organizations, and a reaction has set in. My appreciation of my position is reestablished and I am now more convinced than ever before that the Society of Naturalists has still an important part to play in the advancement of scientific achievement on this continent.

The society makes for the solidarity of those sciences which, in older days, were included in the term natural history. It was originated for the purpose of pro-

[1] Delivered on December 31, 1907.

moting that solidarity and its existence has been a struggle to maintain it against an increasing tendency toward segregation. Twenty years ago it was an organization of great vitality, including in its membership practically all the leading exponents of natural history in the eastern states, and its meetings were a stimulus and an inspiration to all who were privileged to attend them. But the very cause which called it into existence was destined in the course of a few years to sap its foundations. It was the outcome of the remarkable growth of interest in scientific education in this country which occurred in the eighties of last century and was associated with the establishment of two important departures in collegiate and university instruction.

One of these departures was the introduction into our college curricula of the course in general biology, inaugurated in England with so great success by Professor Huxley and fostered in this country by Huxley's one-time assistant and coadjutor, Professor Newell Martin, whose interest in the success of this society was both active and lasting. The establishment of this course of study, so philosophical in its conception, had the effect of disintegrating the older discipline of natural history, with certain results by no means in harmony with the ideals which the course was intended to realize. For its establishment led, in the first place, to a severance of geology from biology, a result not in itself to be deplored from the standpoint of efficient instruction, but, unfortunately, geology, as then understood, included both the dynamic and historical aspects of the subject and hence its separation from biology led also to the separation of paleontology. For the geologist paleontology is a means to an end but it is an essential constituent of biology. Further, the establishment of the course in general biology brought about an increased interest in zoology somewhat at the expense of botany, since the great majority of those in charge of the teaching of general biology were trained in zoological methods. This state of affairs undoubtedly acted detrimentally to the progress of botany, but we all rejoice to see that science so ably rising superior to her disadvantages and now coming again into her own.

Practically concurrent with the recognition of general biology as an undergraduate study was the development of graduate instruction as a proper and important part of the work of our larger universities, and as a result it became possible to supply the demand for teachers of this or that science with men thoroughly trained in modern methods and conversant with the literature of their specialty. For naturally graduate instruction tended toward specialization.

And this was the tendency that "like a worm i' the bud" fed on the "damask cheek" of the young society. The same interest in scientific education which led to the establishment of the society led also to increasing specialization, and solidarity gave place to segregation. The physiologists, as their numbers and influence increased, established a temple of their own where they might worship exclusively the goddess Function; the geologists, too, deserted the common shrine and fled to the mountains and valleys to erect in the groves altars to Pluto and Neptune; and the anatomists, ignoring the fact that their special cult was but a side issue of the broader worship of animal morphology, forsook the company of their fellows and wandered off to secluded spots where they might, without offence and free from disturbing suggestions from their coworkers, set up as an idol—a cadaver.

And so of the original membership there were left true to the parent society only the zoologists and the botanists, the latter at that time few in number, and the question

had to be faced whether the Society of Naturalists should become a strictly zoological assembly, should be allowed to lapse, or should continue to exist as a possible bond of union between the specialist societies. The *tertium quid* seemed the most satisfactory solution of the difficulty and the secession of the zoologists as the American Morphological Society gave opportunity for the reorganization of the Naturalists as a parent society beneath whose wing the several offspring might assemble yearly for mutual encouragement and fellowship. This new relation of the society of necessity curtailed its activities by reducing the time available for its sessions, but it still remained faithful to its original purpose, as it does to-day.

But additional factors came into the question. The rapid growth of the scientific spirit in the middle west which began in the later eighties and the nineties, one of the most striking features, it may be remarked in passing, in our educational history, called to that section of the country many enthusiastic naturalists who felt the need of maintaining just those wider interests which the society endeavored to promote. The society then had to determine whether it would extend its influence to this new territory and hold occasional meetings outside the pale of the northeastern states, but at the time it seemed that the limitations of the sessions to localities readily accessible to the majority of the members would better tend to conserve the energies of the society. It was recommended, however, that the naturalists of the central states should form a branch organization, which would do for that section of the country what the parent society did for the eastern territory, and this was done. But the growth of the scientific spirit in the more western section was not yet completed, nor is it even now. And with the increasing growth there arose a greater community of interests and more perfect intercourse between the two sections, leading eventually to the realization that occasional meetings of the one organization in the territory of the other, far from having a weakening influence, would further the objects for which both were striving. Hence the present arrangement, which, however, still requires modification in one respect, namely, in that of placing the Central Branch in the position to which its importance and influence entitle it—an equality with the parent organization.

A second factor of more recent development has been the irruption of the American Association for the Advancement of Science into the quiet and sociable serenity of convocation week, and the consequent desire on the part of some that the association should assume responsibility for all the fostering which the different scientific societies may require. Personally, I am not at all sure that the association as a mother by adoption can satisfactorily perform the functions of the real parent. In a family, real and adopted, so large and with such diverse interests, it seems almost certain that one or more unfortunate individuals may find themselves unable to secure the necessary shelter beneath the maternal wings and be forced to perch disconsolate upon the edge of the nest, "remote, unfriended, melancholy." A gradation of individualities is the rule in nature, and in our social combinations. Between the organ and the person there is an intervening individuality and it is that individuality which is lacking in the organization of the association, but which is represented by this society. The solidarity, which is the *fons et origo* of the Naturalists is, I am well aware, the aim also of those who desire absorption into the association, but under the present organization of that body the solidarity of the biological sciences would, by the absorption, be lost,

and they would become, if I may be permitted to misquote a celebrated definition, members of an indefinite, incoherent heterogeneity, instead of, as now, parts of a definite, coherent homogeneity.

I have thus briefly sketched the history of the Society of Naturalists with the object of showing those among us who may not be familiar with its past, how steadfastly it has clung to its original purpose through all the crises which have threatened its existence. Is not the idea for which the society stands worthy of such consistency? And are there not questions pressing in upon us to-day which stand in need of consideration by the united strength of the society?

These interrogations have been answered in part by the discussion of this afternoon. The undertakings of biologists are becoming broader year by year and are more and more demanding cooperation for their successful completion. The time-honored discipline of natural history has been divided into numerous specialties, each of which is as wide as the whole field of natural history as our fathers and grandfathers knew it. Encyclopedists were possible in their days, although even then it required an exceptional ability to be a master of the entire field. But encyclopedism died in this country with such men as Louis Agassiz, Leidy and Cope, and we of to-day find our capabilities fully tested in mastering one small division of the older discipline. We may comfort ourselves somewhat with the thought that the limitations of to-day are not due so much to differences in the men as to differences in the scope of the subjects. The lakes of our predecessors have broadened to seas and the seas to oceans whose farther shores are far beyond the limits of any one man's horizon, and hence specialization has become a necessity, and where but a few years ago we had zoologists, we now have systematists, anatomists, embryologists, cytologists, experimentalists, statisticians and ecologists. But let me quote the words of one of our distinguished members: "*Union* is just as essential a part of the law of progress as division. If specialization is a necessity, so is organization. But there is this difference between the tendencies—that the one precedes the other and comes into recognition first. Specialization has already forced its way to the front, and is nearly everywhere recognized as a necessity; organization follows, but lags lamentably behind the needs of the times." Throughout the organic world we see continually contrasting forces combining to produce progress. We have variation and heredity, division of labor and organization. Specialization is with us, and the Society of Naturalists is but striving to add the other factor which makes for progress —cooperation.

The necessity for cooperation in scientific research is no new need evoked by the increasing specialization of the times. Even in the days of Lord Bacon it was presented as a desirable ideal, and nowhere can we find a more definite advocacy of its employment in the investigation and application of scientific problems than in the plan set forth in the *New Atlantis* of the duties of the fellows of Solomon's house. Such a complete plan is, however, impracticable so long as human nature remains as it is. We would all be "interpreters of nature" or at least "lamps." But to function thus we must needs cooperate with our fellows, we must meet together to tell of our investigations, to learn of those of others and to take counsel with our coworkers as to the further elaboration of our results. And it is this form of cooperation that the Society of Naturalists promotes. If the society did nothing further than to bring us all together on occasions such as the present its existence would be fully justified.

But can not its influence be enlarged? Are there not problems bearing upon the advance of the biological sciences which require the cooperative action of just such a body as this for their solution? We have listened to-day to suggestions concerning cooperation in problems of investigation and of these I need not speak further. But there is another field in which, I believe, the society, by its influence, can accomplish much that will, both directly and indirectly, aid in the advancement of the biological sciences. In the early days of its existence this society took great interest in the question of scientific instruction in our schools and colleges, and I recall especially two reports submitted to the society on this question, one by Professor William North Rice and the other by Professor S. F. Clarke, which contained much that was of value and undoubtedly of influence in shaping the scientific course in many of our schools and colleges. This was many years ago, and now, with the increased interest which obtains in scientific instruction and after the numerous discussions and reports on the place of scientific studies in our secondary schools, it would seem that the time is again propitious for a pronouncement upon the subject from such an organization as this.

Partly from lack of time, but more especially from lack of the necessary information, I can not venture to discuss all the phases of this question. But do we as a body of working biologists properly understand the conditions of science-teaching in the schools, and have we shown sufficient interest in bringing it to that state of efficiency which its importance demands? In later years a wave of nature study has passed over our primary schools, driven by Froebelian breezes. But, unfortunately, in many schools it seems that the Froebelianism which should blow as a gentle zephyr has been permitted to increase to a hurricane and the wave of science study, instead of being an educational blessing, has carried devastation on its crest. Two of our members, Professors Hodge and Bigelow, have accomplished much by their endeavors to establish nature study upon a proper basis and their work deserves a greater meed of credit than it has hitherto received. But even yet, so far as my observation and information extend, the teaching of nature study is in many schools in the hands of inefficient instructors, untrained in the methods and purposes of such instruction, and the result is a minute crumb of solid food overlaid by a heavy coating of mawkish sentimentality. The principal aim of nature study should be to train the child to the observation of natural objects and phenomena and to awaken in his mind a healthy curiosity as to their meaning and significance. In other words, its purpose should be to develop in the child the scientific spirit, which is not inborn but requires development. Its primary object should not be a directly utilitarian one and it should certainly not be used as a means of evoking an unhealthy and unnatural sentimentalism when no sentimentalism should exist. Surely in a search for the sentimental nature is the last place to which we should turn. Perhaps the causes of the mistakes in nature study are largely due to conditions which are beyond our control, but have we done our duty in upholding the hands of our fellows who are striving for efficient instruction, in calling the attention of those in authority to errors in method, and in endeavoring to set science teaching in the primary schools upon a proper basis?

We are accustomed to regard the German system of scientific instruction as very efficient and yet it is noteworthy that a joint committee for the German Zoological Society and the Gesellschaft für Naturforschenden Freunde und Aertzte is now

at work upon the question as to how science teaching in the schools may be brought to a proper degree of efficiency. If a need for improvement is felt in Germany, is it not likely that it is present also with us? How often have we heard a colleague in one or another of the scientific departments state that he would sooner receive into his classes students entirely unfamiliar with his subject, than those who had received some training in it in the high school? An occasional statement of this sort might be attributed to that indiosyncrasy which is popularly regarded as a characteristic of a university professor. But it is made too frequently to be altogether due to that cause, and allowing for a certain amount of rhetorical exaggeration, the statement is an indication that a need for improvement in science teaching in our high schools certainly exists. From what body could the initiation of a movement for the improvement of instruction in the biological sciences more appropriately come than from this society? In passing, let me recall that at our last meeting in this city we had the pleasure and profit of listening to an eloquent and serious arraignment by our then president, Professor Sedgwick, of the prostitution of scientific teaching to the intemperate propagandism of a powerful organization. Have we as a body or individually followed up that deserved indictment as we should? The recent publication in SCIENCE of a letter from the organization in question shows that the snake is not even scotched and that with cool effrontery the organization proposes to continue its dictation of what text-books of physiology shall be used in our public schools.

And even in connection with our college courses, in which the majority of us are more directly interested, there is opportunity for this society to exert a healthful influence. Our college education is at present in a stage of transition, and it is difficult at the moment to determine what will be the final outcome. But in one direction at least there seems to be a definite tendency and that is toward a more distinct cleavage between undergraduate and post-graduate work. It is showing itself in our professional schools, which are more and more approaching the ideal condition in which they will represent post-graduate courses, students being allowed to enter upon the special work of the schools only after they have laid a broad foundation for their professional studies by completing a collegiate course. In other words, the professional schools are beginning to recognize the value of a broad training as a preparation for successful specialization. This movement should receive a hearty support from this society, for it is at one with its aims and it is a movement for whose further expansion there is still ample space. Up to a few years before the organization of this society the completion of the literary curriculum meant the completion of one's education; the man who was entitled to write A.B. or some such letters after his name was the final product of our educational system. True, there were higher degrees, A.M. and what not, but the training for these was more or less perfunctory and unorganized, and there were also occasional students who had the opportunity to carry on their studies beyond the ordinary four years of the university curriculum. The majority of these, however, found it to their advantage to pursue their later studies in the old world universities, and especially in Germany, which first had recognized the advantage of making the university something more than the mere dispenser of knowledge already acquired. In 1876 the cleavage between undergraduate and post-graduate studies—similar to that between the German university and gymnasium—became established in this

country, and now there are few of our large universities which do not recognize it in giving prominence to university work in what are called graduate schools.

But in one respect the conditions in our graduate schools are very different from those obtaining in the German universities, for the instructors in our graduate schools are also, almost without exception, teachers in the undergradute or collegiate department and are comparable, as some one has pointed out, to a Gymnasiallehrer who also lectures in the university. And in this lies a serious defect, for it has led to the encroachment upon the collegiate course of studies which properly belong to the university or graduate course. The enthusiastic teacher who is also an investigator finds his greatest pleasure in leading his students on toward investigation and he is too often inclined to carry them with him into that kind of work before they have received a foundation of sufficient breadth and solidity to make such a course advisable. And the adoption of an extensive system of electives in the collegiate course has favored the development in this way of precocious investigators who so frequently are like the seeds which fell in places where they had not much earth and forthwith sprang up, "and when the sun was up they were scorched; and because they had no root they withered away."

I have recently been looking over a number of college calendars with a view to ascertaining the extent to which specialization might be carried by undergraduates. And let me say in passing that as a result of the examination of the calendars my opinion as to the intellectual capabilities of the American undergraduate has been greatly increased. The young man who can successfully thread his way among the multitudinous courses with their limitations and continuations as stated in the larger calendars, and from these select as consistent and suitable a course as the majority do, manifests a degree of intelligence and perspicacity which augurs well for the race.

It would be both unprofitable and tedious to give you the complete results of my studies in this direction, but I may briefly indicate what I found to be the case in regard to specialization in one subject, namely zoology, in three or four of our leading colleges. The different standards employed in estimating the credit value of a course renders an exact comparison of several colleges somewhat difficult, but so far as I can understand the schedules presented the results are as follows: In four of our most influential universities I find that a student out of the total number of scheduled hours may elect in zoology in A, 33 per cent.; in B, 41 per cent.; in C, 45.5 per cent., and in D, 68.3 per cent. This represents undergraduate work only and the enormous inequality of the courses in the different institutions is most striking, D university, for example, allowing over twice as much specialization in zoology as A. This difference is necessarily associated with great differences in the amount of time devoted to the humanities or non-scientific studies, and these also stand in relation to the amount of specialization in scientific studies as a whole, which the various curricula permit. Thus in A a student in zoology may take an additional 30 per cent. of his studies in other sciences, making a total of 63 per cent. of scientific studies; in B he may take 44.3 per cent. additional in science, or a total of 86 per cent.; in C an additional 44 per cent., or a total of 89.5 per cent.; and in D 26.7 per cent., or a total of 95 per cent. Or, to state the reverse of the story, a student in A may secure his A.B. degree only after taking 37 per cent. of his work in non-scientific studies; a student in B may graduate with 14 per cent. of his studies in non-

scientific subjects; a student in C with 10.5 per cent. of non-scientific subjects; and a student in D with only 5 per cent. It seems certain that one or other of the extremes must be utterly bad in principle. The one represents a broad collegiate training upon which the student may build a specialized university course, the other is extreme specialization by which the student is carried into the graduate type of work before he has acquired a well-rounded collegiate training. Indeed, it may be pointed out that in the extremely specialized course the student is allowed to devote ten hours a week throughout his final year to research in zoology.

I do not wish it to be understood that such narrow courses as have been mentioned above are frequently taken. Indeed, I believe that the great majority of students of their own accord choose rather a broader course, and, furthermore, in some institutions elections must be approved by a member of the faculty or by a committee, a system conducing to some extent to the prevention of extreme specialization. But such courses as I have indicated are possible; indeed, in the institution D a student who expects to teach zoology is openly advised to elect as many as possible of the courses offered in that subject, that is to say, to elect the extremely specialized course mentioned above. Surely such advice betrays a sad misunderstanding of the proper functions of the college and university and must tend in the long run to prejudice rather than to advance the claims of zoology to a place among the so-called culture studies.

Nor do I wish to imply that zoology is the only grievous offender in this respect. Results similar to those already given may be obtained from the study of possible elections in other courses, both scientific and non-scientific. A student may graduate from college without ever having seen the inside of a laboratory or listened to a single course of lectures on a scientific subject during his four years of attendance. And to give such a student an imprimatur which should imply that he has received a broad collegiate foundation is a crime against good scholarship.

But this is not the occasion for a general discussion of this question; we are concerned with it especially as it relates to biology. I may say, I believe, without an imputation of Chauvinism, that biological investigation on this continent stands second in quality to none, and it should be our endeavor to see that quality is not sacrificed to quantity. A multitude of effusions characterized by narrow specialism will advance the position of biological research far less effectually than a more moderate product in which thoroughness is combined with a scholarly appreciation of the scope of the problems in hand. This latter desirable conjunction will not be secured by devoting a considerable part of a student's collegiate course to university studies. An instructor in collegiate courses may and should, by both precept and example, set forth the methods of the investigator and endeavor to awaken in his students the spirit of the investigator. But let him see that a vaulting ambition is not allowed to o'erleap itself, and secure for his students that broad outlook which alone can produce the scholarly investigator. That extreme specialization should be even possible in an undergraduate course is a serious mistake. It narrows the field of vision and is a serious obstacle to the carrying out of the cooperation so much needed in biology. And cooperation implies solidarity, the main plank of the platform upon which the Society of Naturalists stands. Surely there is still work for the society both in advocating a system of training in our schools and colleges which will make cooperation in investigation pos-

sible, and in promoting the solidarity among biologists which will make cooperation feasible.

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COOPERATION IN BIOLOGICAL RESEARCH[1]

THE idea of cooperation in science is not new; our universities, learned societies and publications represent or involve forms of cooperation that are well established and have demonstrated their usefulness in the progress of science. Without them, progress would be painfully slow. They are, in fact, the very framework and supporting skeleton of science, without which there might be life indeed, but at most aimless amœboid movement, no dignified or effective progress.

I suppose it was not intended that the present discussion should concern itself with such old established organizations, but rather that it should deal with needs that have arisen as a result of recent growth of science and its increasing specialization, and which are not adequately met. Organization must keep pace with specialization, if the true objects of specializing are to be attained.

The last decade has witnessed the origin or farther development of institutions planned to meet the specific needs of the present, and organized to anticipate the growing demands of the future. I name various departments of the national government, the Carnegie Institution of Washington, the Wistar Institute of Anatomy and Biology, the Rockefeller Institute for Medical Research and the McCormick Institute for the Study of Infectious Diseases. These institutions recognize the fundamental importance of research for the well-being, nay, for the very life, of the commonwealth, and they also recognize cooperation as the vital principle in the conduct of research. The institution that inbreeds, that does not seek for the original and productive investigator, and that does not lend its own cooperation and secure his is on the high road to ineffectiveness.

I believe, however, that the full conception of cooperation in scientific research is not usually grasped and that the logical outcome of the principle is, therefore, not really understood: An organization may be formed that proposes to make cooperation with scientific men and institutions its main business; it may propose to seek out the original investigator wherever he may be found and to support his work in every possible way; it may welcome every new branch of scientific investigation and propose to favor it according to its importance and its needs; and yet such an institution may not be fully cooperative. It may be privately controlled; if so, its impulses are primarily benevolent and not free, guided by tradition and charter and not by the native interests of the governing body, and for these reasons apt to fail to profit to the fullest extent by the fertilizing influences of new conceptions.

The fundamental idea of cooperative organization is a free association of individuals that proposes definite ends and effects an organization to attain them. The members of the organization are at the same time the court of last resort; they may elect representatives as a board of management, or as officers of the organization; but the representatives are responsible to the organization for the conduct of affairs. The functions of such an organization are not benevolent, but free, for the members are vitally interested in the conduct of its affairs and they are themselves the governing body. The organization is plastic, responding to new ideas, so long as membership in it is determined by broad prin-

[1] Discussion before the American Society of Naturalists, December 31, 1907.