SCIENCE

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CONTENTS:

*OUR SOCIETY.**

SEVERAL travellers of the eighteenth century, among them especially Guettard, Alexander and Schoepf, gave more or less important information respecting the geological structure and mineral resources of our country; but geological work, properly so-called, began only with Maclure's studies in 1806. Born in Scotland, Maclure came to this country in early youth and, embarking in business, acquired a fortune long before reaching middle age. He returned to Europe to spend several years in the study of natural science, but came again to America in 1806 to take up his geological work, which continued until 1808.

The publication of his results, presented to the American Philosophical Society on January 20, 1809, led others to make studies and soon afterwards there appeared numerous papers dealing with geological subjects. Professor Samuel L. Mitchell, a devoted follower of Werner, infused much of his enthusiasm into a group of youthful students in New York and induced Professor Archibald Bruce to establish the *American Journal of Mineralogy*, which, beginning in 1810, reached its fourth and last number in February, 1814. Though small and short-lived, this journal served a useful purpose; it contained good papers by

* Presidential address delivered at the annual meeting of the Geological Society of America, New York, December 28, 1898.

Akerly, Gibbs, Godon, Mitchell, Silliman and others; it did much to nurse the scientific tendency which led to founding the New York Lyceum of Natural History in 1817, and some have thought that it aided in like manner the founding of the Philadelphia Academy in 1812. *Bruce's Journal* was succeeded in 1818 by *Silliman's American Journal of Science*, which from the beginning exerted a notable influence upon the development of geological thought and work in our country.

By 1820 students of geology had become so numerous that the American Geological Society was organized in New Haven, Connecticut, where meetings were held certainly until the end of 1828. The last survivor of this Society died in New Haven only a few weeks before the formal organization of our Society in 1888. The prominent men in 1820 were Ackerly, Bruce, Cornelius, Cleveland, the two Danas, Dewey, Eaton, Gibbs, Godon, Hitchcock, Maclure, Mitchell, Rafinesque, Schoolcraft, Silliman and Steinhauer, but there were some young men who began to publish within two or three years afterwards and who were destined to occupy prominent places in geological literature; of these, Emmons, Harlan, Lea, Morton, Troost and Vanuxem were already engaged in investigation.

Before another decade had passed there were groups of geologists in New England, New York and Pennsylvania, while Olmstead and Vanuxem had made preliminary surveys in North Carolina and South Carolina, Troost had begun the survey of Tennessee and Hitchcock that of Massachusetts.

In 1832 the Pennsylvania geologists, feeling much in need of an official survey of their State, organized the Geological Society of Pennsylvania, to arouse public interest and so to bring about the survey. The volume of publications contains papers which attack geological and economic problems of the first order. The investigations were not confined to Pennsylvania, but committees were appointed to examine important matters in other States, that the worth of geological work might be made obvious. Beyond doubt, the efforts of this Society had much to do with securing the First Geological Survey of Pennsylvania, though no member of the Society was appointed on on the staff. It is the fashion now and then to laugh at these old papers. True enough, in the light of our present knowledge, many of the statements respecting Appalachian structure are absurd, but they were made by men who, without State aid, without instruments and without maps, laid a foundation upon which the keen-eyed men of the First Pennsylvania Survey built the superstructure, which endured close re-examination by the second survey and proved the honesty and ability with which the work had been performed.

But geology was becoming too broad in scope and its workers too numerous to be embraced in a merely local society, even though the list of correspondents was as large as that of the active members. The work in Massachusetts was approaching completion; that in New Jersey had been completed; the Surveys of Maine, Connecticut, New York, Pennsylvania, Maryland, Delaware, Virginia, Ohio, Michigan and Indiana had been begun, and before 1840 New Brunswick, Rhode Island and Kentucky were added to the list. Several of these Surveys had large corps of workers, pushing their studies with all the enthusiasm of a new calling. In the Appalachian region of Massachusetts, New York, Pennsylvania and Virginia serious problems were encountered which could not be solved within the compass of a single State. A right understanding of the work done in one State was necessary to a right understanding of the work done in the adjoining State. Correspondence proved a failure;

incidental or casual talks led to misunderstandings; systematic conference was necessary with generous contribution by each of his knowledge to the other.

On April 2, 1840, as the result of a conference held at Albany in 1839, eighteen geologists met at the Franklin Institute, Philadelphia, and organized the Association of American Geologists, with Professor Edward Hitchcock as the first Chairman; among these were the State Geologist of Massachusetts, six geologists of the New York Survey, six of the Pennsylvania Survey, two of the Michigan and three not connected with any public work. Mr. Martin H. Boye is the only survivor of the eighteen. The succeeding meetings in Philadelphia and Boston were attended by many geologists, of whom only Boye, O. P. Hubbard and J. P. Lesley remain. A volume published in 1843 contains several papers which made a deep impress on American geology; here are the five great memoirs on Appalachian conditions by the Rogers brothers; Hall's noteworthy discussion of the Mississippi basin section; Hitchcock's elaborate discussion of the 'Drift;' as well as numerous contributions by other members.

Professor Hall said on one occasion that the inspiriting effect of these meetings could not be overestimated. As one of the youngest members, he was impressed by the mental power of those great men, all untrained in geology, except Taylor, whose training under William Smith proved advantageous in many ways but very disadvantageous in others, as it had provided him with a generous stock of well-set opinions. Though wholly self-taught, working in a country sparsely settled, without barometers, without railroad cuts, oil borings, mine shafts or any of the advantages so necessary for us, those men had elaborated systems, had made broad generalizations, had learned much respecting the succession of life and had discovered the keys which, in later years, were to open mysterious recesses in European geology.

But the geologists were not permitted to flock by themselves. The advantages of contact were so manifest that the naturalists asserted their claims to relationship with sufficient energy to secure admission in 1841, and the name Association of American Geologists and Naturalists appeared in the constitution adopted at the 1842 meeting. The number of scientific men was still comparatively small, and in most of the colleges the several branches of natural science were embraced in one chair, so that there were many professors who could lay claim to the title of geologist, physicist, naturalist or chemist, as they pleased. Men of this type, as well as physicists, chemists and mathematicians, constantly urged the propriety of broadening the scope of the Association so as to admit workers in all branches of science.

In 1842 the first series of surveys practically came to an end, and the geologists were scattered, many of the younger men being compelled to enter other callings. The Association held its meetings regularly, but its strength diminished, and in 1848 it yielded to the outside pressure, becoming merged into the American Association for the Advancement of Science, which threw its doors wide open to all entertaining an interest in any branch of science. The first meeting of the new organization had a roll of 461 members.

Comparatively little was done in geological work between 1842 and the close of the Civil War. Professor Hall maintained the New York Survey, after a fashion, but at very considerable pecuniary cost to himself; surveys were carried on in a number of States, but, except in Illinois and California, they were mostly reconnaissances by small corps; the annual appropriations in several instances were little more than enough to pay travelling expenses, so that

the work and the reports were practically gifts to the States. The Federal Government sent topographic expeditions into the Western country, most of them accompanied by a surgeon who had more or less knowledge of geology. Under such conditions the number of geologists did not increase, and when the American Association was divided into sections, in 1875, the geologists and naturalists became not Section A, but Section B.

The rapid development of the country's internal resources during the war and the attendant growth in manufacturing interests made necessary increased efficiency in scientific training, and enormous gifts were made to our leading institutions for that purpose. The importance of geological knowledge had become very evident during the development of iron, coal and oil resources, and the geologist found himself elevated suddenly from a place surrounded by suspicion to a post of honor. As an outgrowth of the restless activity due to the war came anxiety to learn more accurately the resources of our Western domain beyond the 100th meridian. The War Department, through its Engineer Corps, organized the Fortieth Parallel Survey, in charge of Clarence King, and two years afterwards authorized Lieutenant (now Major) George M. Wheeler to undertake what afterwards became the United States Geographical Surveys West of the 100th Meridian. Mr. King's survey was primarily for geological work, that of Lieutenant Wheeler primarily for topographical work, but each in its own field did all the work, geological or topographical, necessary to the accomplishment of the allotted task. The Interior Department had charge of Dr. F. V. Hayden's surveys, beginning in 1867, as well as of the work prosecuted by Major J. W. Powell after 1870. The consolidation, in 1879, of all the organizations then existing put an end to useless rivalries and made possible the formation and execution of broad plans requiring a high grade of preparation in those engaged upon the work. But while these surveys were advancing in the Far West great activity prevailed in the older area. Within a decade after the war ended State Surveys were undertaken in New Hampshire, New Jersey, Pennsylvania, Ohio, Indiana, Kentucky, Michigan, Wisconsin, Minnesota, Iowa, Missouri and other States, while the Canadian Survey, which had gone on uninterruptedly from the early forties, was made more extended in character. Several of the State Surveys, being well supported by generous appropriations, employed large corps of assistants, paid and volunteer, and were prosecuted with great energy. Under these conditions Section E, that of Geology and Geography, grew rapidly and soon became one of the strongest portions of the American Association.

The conditions which rendered imperative an association of geologists in 1840 were the present conditions in 1880, but more oppressive. The problems of 1840 were chiefly those of a narrow strip within the Appalachian area; those of 1880 concerned the whole continent. Geologists were increasing in numbers, but opportunities for making personal acquaintance were few; meetings of societies in midsummer could be attended only by those who were not connected with official surveys or were detached for office work. Workers were gathering into little groups on geographical lines, and there was danger that our geology would become provincialized. Members of one group regarded those of another with a feeling not altogether unrelated to suspicion; letter-writing took the place of personal communication, with too often the not-unusual result of complete misunderstanding, with the attendant personal irritation or worse.

In 1881 the tension was such that several

geologists connected with official surveys urged the formation of a geological society to bring about closer bonds among geologists; and they succeeded, at the meeting of the American Association, in securing the appointment of a committee to consider the matter. The geologists of the country were consulted, and a report, showing that the consensus of the replies favored the organization of such a society, was presented in 1882 as well as in 1883, but without any result. The Association's Committee on the International Geological Congress considered the question in 1887 and announced approval. Professors N. H. Winchell and C. H. Hitchcock, as Chairman and Secretary of the 1881 Committee, issued a call asking geologists to assemble at Cleveland, Ohio, on August 14, 1888, to form a Geological Society.

A large number of geologists and other members of Section E assembled on the afternoon of that day. Professor Alex. Winchell presided and Dr. Julius Pohlman was Secretary. An earnest discussion respecting the type of society to be founded occupied most of the afternoon. The plan suggested in the call looked only to an expansion of Section E of the American Association by holding meetings at times better suited than summer to the convenience of geologists. But a difference of opinion quickly developed, for some knew that no such expedient would suffice, that the conditions called for something more definite. Loyalty to the American Association, which for forty years had been the bond between scientific men, held many back from an extreme position. Yet every one recognized that little injury could come to the Association, as, at best, only a few geologists could attend summer meetings. In any event, it was clear that the interests of geology required the formation of a society with severe restrictions upon membership and with publications which would be a credit to American science. A compromise prevailed, whereby the Original members, entitled to take part in organization, must be members of Section E of the American Association, and that all members of Section E might enroll prior to the first meeting if they so desired. This last provision caused not a little anxiety, as membership in any section of the Association predicates nothing more than a friendly feeling for science—whatever that may mean.

A committee* was appointed to prepare a plan of organization with a provisional constitution. The committee's report, on the morning of the 15th, provoked debate, as the provisional constitution placed a positive limit upon the membership by permitting, after the organization, only working geologists and teachers of geology to become members and by requiring a three-fourths vote for election. The organization was to be effected when the list of Original members contained one hundred names. The provisional constitution, with a few unimportant amendments, was agreed to unanimously and a committee continued as a committee of organization. The details of arrangements were placed in the hands of Professors A. Winchell and Stevenson.

Happily the high dues and general belief that no society could be formed on the proposed basis kept the list of Original Fellows from being swollen by those whose relation to geology began and ended with attendance upon the American Association's meetings. The committee was enabled from the very outset practically to choose the men who should make the society. The required number having been obtained by the 1st of December, a meeting was held at Ithaca, New York, on December 27, 1888. Only thirteen were pres-

*This committee consisted of Alexander Winchell, J. J. Stevenson, C. H. Hitchcock, John R. Procter and Edward Orton.

ent, but ballots of preference had been received from seventy-two Fellows, in accordance with which the organization was completed by the election of President, James Hall; Vice-Presidents, James D. Dana and Alexander Winchell; Secretary, John J. Stevenson; Treasurer, Henry S. Williams; Councillors, John S. Newberry, John W. Powell and Charles H. Hitchcock.

The matter of publication was discussed at great length, but no definite decision could be reached, and a committee was appointed to consider the whole question, with instructions to present a report at the summer meeting. Another committee was appointed to prepare a permanent constitution, to be presented at the next meeting.

The Advisory Committee on Publication, another name for Professor W J McGee, made an elaborate investigation of the whole question of publication and, in August at Toronto, presented the report, accompanied by a printed example of the form recommended. This report was adopted and, at the close of the following meeting, Dr. McGee was chosen as first Editor that the recommendations might be carried out faithfully. Our Bulletin, which marked a new stage in scientific publications, owes its excellence of form and accuracy of method to his indefatigable persistence. His determination to secure exactness in all respects proved not wholly satisfactory to many of us, but, before he demitted his charge, the justice of his requirements was conceded on all sides. The discipline to which the Fellows of this Society were subjected by the first Editor has served its purpose, and editors of other scientific publications have found their labors lightened and their hands strengthened in efforts to produce similar reforms elsewhere.

Fears and misgivings abounded when it was discovered that this Society was a success from the start. The American Association for the Advancement of Science had been the one society for so many years that attempts at differentiation seemed to be efforts to cut away the pillars of scientific order. But the fears were merely nightmare. Our Society has proved itself an efficient ally of the Association.

Our net membership at the close of the first year was 187. The new constitution placed severer restrictions upon membership by requiring a nine-tenths vote for election, the ballot being by correspondence and shared in by all the Fellows. This has kept the number within reasonable limits, and we now have 237 Fellows, our roll including almost all of those, who, by strict construction of our constitution, are qualified for membership. Owing to the rigid administration of our affairs by Professor Fairchild and Dr. White, who have piloted us for eight years, our financial condition is satisfactory, and the income from the permanent fund now goes far toward covering the cost of administration.

Throughout, the Society has held closely to investigation; the recondite problems, those of little interest to many, of no interest to most, are those which have held the attention of our Fellows—work in pure rather than in applied sciences; there has been no trenching upon the field of the mining engineer. As a storehouse of fact and of broad, just generalization the volumes of our Bulletin are excelled by those of no similar publication.

We close our first decade justly gratified by success and full of hope for the future. Some of those who led us and gave us reputation at the beginning are no longer with us; Hall, Dana and Winchell, the first three Presidents, passed away in reverse order; Cope, Cook, Sterry-Hunt, Newberry and a few others have gone from us, but the Society retains its membership with changes unusually small, showing no ordinary degree of physical force and *esprit du corps* on the part of its Fellows. As we look back

we recognize how far this Society has been of service to us as men; in not a few instances misunderstandings have been removed and coldness or suspicion has been replaced by personal friendship. American geologists are no longer a disorderly lot of irregulars marching in awkward squads, but form a reasonably compact body, though as individuals they may owe allegiance to Canada, the United States, Mexico or Brazil. Every one of us has felt the inspiriting influence of personal contact.

But our Society has to do with the world outside of itself and outside of its immediate line of thought. It must have more to do with that world in the future if the outcome for science is to be what it should be, for the time is approaching rapidly when we must seek large sums for aid in prosecuting our work. To retain the respect of the community and to retain influence for good we must be able to justify the existence of a society devoted to investigation as distinguished from application. The question *Cui bono?* will be asked, and the answer cannot be avoided.

This is a utilitarian age—not utilitarian as understood by those who bemoan the decay of æsthetic taste; or of those who feel that in the passing of Aristotle and Seneca there has come the loss of intellectual refinement; or of those others who bewail the degeneracy of a generation which has not produced a Kant, a Newton, an Aristotle, a Laplace, a Humboldt or an Agassiz; all regarding the decadence as due to the degrading influence of material development and overpowering commercial interests.

These pessimists stand at a poor point of view, where the angle of vision is narrowed by many lateral projections. One may say, without fear of successful contradiction, that, in so far as actual knowledge is concerned, students of our day receiving graduate degrees in the more advanced universities stand on a somewhat higher plane, each in his own group, than did the celebrated men just named. The student now reaches beyond where they ended, and still is at only the threshold; for, in most instances, years of labor are required of him before he can receive recognition as an efficient co-worker. Men towering far above their fellows and covering the whole field of knowledge will never be known again. Kant, Newton, Humboldt stand out from their fellows as sharply as lighthouses on a level shore; but there are many Kants, Newtons and Humboldts to-day. Prior to the last seventy-five years the field of actual knowledge was insignificant and a man possessing large powers of observation grasped the whole. Seventy-five years ago one man was expected to cover the whole field of natural science in an American college. Should any man pretend to-day to possess such ability he would expose himself to ridicule.

It may be true that this century has given to the world no great philosopher—that is, no great philosopher after the old pattern. But one must not forget that philosophy has to face a difficulty which was unknown in the last century. The unrestrained soaring of philosophers into the far-away regions of mysticism is no longer possible, for facts abound and the knowledge which is abroad in the land must be considered in any well constructed system. Some have maintained, if not in direct statement, certainly in effect, that study of material things unfits one for metaphysical investigation. Undoubtedly it would hamper him in some kinds of metaphysical research, as it would fetter him with a respect for actualities, but it would fit him well for other kinds. Aristotle, Kant and, in our own time, McCosh and Spencer attained to high position as philosophers and in each case possessed remarkable knowledge in respect to material things.

The assertion of lost intellectual refinement and of depraved æsthetic taste is but the wail for an abandoned cult. It is but a variation of the familiar song which has sounded down the generations. The world was going to destruction when copper ceased to be legal tender, as well as when Latin ceased to be the language of university lectures; art disappeared when men ceased idealizing and began to paint nature as it is; religion was doomed to contempt when the Bible was translated into the vulgar tongue; and the pillars of the earth were removed when the American Republic was established.

But in a proper sense this is a utilitarian age. Everywhere the feeling grows that the earth is for man, for the rich and for the poor alike; that those things only are good which benefit mankind by elevating the mental or physical conditions. Until the present century the importance of the purely intellectual side of man was overestimated by scholars, and matters connected with his material side were contemned. With our century the reaction was too great, for even educated men sneered at abstract studies as absurdities, while they thought material things alone worthy of investigation. But the balance is steadying itself, and at each oscillation the index approaches more closely to the mean between the so-called intellectual and material sides. Devotees of pure science no longer regard devotees of applied science as rather distant relations who have taken up with low-born associates.

There appears, at first glance, to be very little connection between great manufacturing interests, on one hand, and stone pecking at the roadside or the counting of striæ on a fossil, on the other. Yet a geologist rarely publishes the results of a vacation study without enabling somebody else to improve his condition. About twenty years ago one of our Fellows began to give the results of reconnaissance studies made during vacations. These concerned certain fault lines, and the notes included studies upon coal beds and other matters of economic interest involved in the faults. The coal beds were all bought up; railroads were constructed; mines were operated; towns were built; a great population was supplied with work at good wages, and many men were enriched. But according to the latest information no one has offered to re-imburse the geologist his expenses, nor has any paper in the whole region suggested that the geologist had anything to do with bringing about the development.

Geological work in this as in other lands was originally vacation work, but eventually the investigations became too extensive and the problems too broad for the usually limited means of the students. Meanwhile, it became manifest, as in the case just referred to, that important economic results were almost certain to follow publication of matters discovered by geologists, so that men interested in economics were ready to assist in securing State aid to advance geological work. As one of our Fellows remarked the other day, economic geology has been the breastwerk behind which scientific geology has been developed by State aid.

Ducatel's reconnaissance proved the importance of Maryland's coal field and the survey was ordered; the Pennsylvania Geological Society discussed coal fields until the Legislature gave the State a survey; the geologists of New York promised to settle, finally, the question of the occurrence of coal within the State; and so in many other States.

The United States Geological Survey had a somewhat different origin, for the economic side did not attain importance until a late period. Soon after the annexation of California the necessity for railroad communication with the Pacific became appar-

ent, and Congress ordered exploration of several lines across the Rocky Mountain region. At that time, the early 'fifties, the perplexities of American geologists had reached a maximum. Most of the old State surveys had come to a close, rich in economic results and still richer in problems to be solved only by elaborate investigation, too extended and too costly for those days. The observations made by Wislezenus and army officers in New Mexico, by Fremont and Stansbury farther north in the Rocky Mountain and Plateau regions, as well as by Culbertson and Norwood in the Dakota country, had stirred the curiosity and awakened the interest of geologists everywhere. Strong pressure was brought to bear on the Secretary of War for the appointment of geologists to positions on the several parties. The efforts were successful and the appointments were made, though in most instances the geologists were physicians and appointed as acting surgeons in the army. This was an important advance in scientific work, for, almost without exception, exploring parties under the War Department from that time were accompanied by naturalists. The Civil War brought the Western work to a close, but when peace returned it was taken up again and geology was recognized as a necessary part of it, until at last the fragmentary works were placed in one organization and the Survey established as it now exists.

In all of the later geological surveys the element of economics entered more largely into consideration and was emphasized in the legislative enactments. Men recognized that geological investigation had led to the discovery of laws, most important from the economic standpoint, and they were anxious to have the knowledge utilized in a broad way.

Looking over the history of the old surveys one sees clearly that their origin was due solely to a desire for solution of problems in pure science. The credit for the economic outcome of the scientific work is due to the geologist alone, to whom the appropriations were given, practically as a gift. The Legislators soothed their consciences by lofty speeches respecting the duty of the Commonwealth to foster the study of Nature, but they generally had an aside to be utilized as a justification before their constituents—"especially when there is a very reasonable chance that something of value will be discovered to the advantage of our Commonwealth."

The New York survey had for its possible outcome the determination of the coal area. The work was completed with great exactness, for it proved that the State contains no coal area whatever. Though only negative in results for the State, this survey has proved of incalculable service to the country at large, for it first elaborated the lower and middle Paleozoic sections; the scientific work, continued along the biological line, defined accurately the vertical limits of fossils and provided means for removal of difficulties where the succession is incomplete and for tentative correlation in widely separated localities, an apparatus whose usefulness cannot be overestimated from an economic standpoint.

If the man who makes two blades of grass grow where only one grew before be a public benefactor, what shall be said of the geologist who turns a desert into a garden? This was done by the first survey of New Jersey, which differentiated and mapped the marls of that State, giving a complete discussion of their nature and value. Great areas of the 'whites and barrens' have been converted not into mere farm lands, but into richly productive garden spots. In later years the second survey, now almost forty years old, did, as it is still doing, admirable work along the same lines; the study of structural geology gave a clue to the causes of restrained drainage, and in not a few in-

stances showed that relief from malaria could be obtained with unsuspected ease, and that many miles of noxious swamp could be converted into lands well fitted for residence.

The first survey of Pennsylvania was purely scientific in inception and execution. Economic questions had little of interest for its head, and in the work their place was very subordinate to those in pure science; yet the outcome was inevitable. The study of the Appalachian folds and the discovery of the steeper northwesterly dip revealed the structure of the anthracite region and made it possible to determine the relations of the anthracite beds; the vast extent of the bituminous area and the importance of the Pittsburg coal bed were ascertained during the search for facts to explain the origin of the coal measures; the ores of the central part of the State were studied with rigorous attention to detail that the problem of their origin might be solved. But these and other scientific studies brought out a mass of facts which were seen at once to possess immense importance, and the reports were published broadcast. New industries were established; old ones, previously uncertain, became certain and developed prodigiously; the coal and iron interests moved at once to the front, so that, within two or three years after the survey ended, 'Tariff' became the burning political question throughout the State. The results of the second survey were even more remarkable in their influence upon the development of the Commonwealth and the increased comfort of the population.

Among the earliest results of the first survey of Michigan was the determination of the value of the salt lands and the announcement of iron ore in the Upper Peninsula. The successors to this survey, but under the United States supervision, made studies of numerous localities and determined the excellence of the ores. Unquestionably, the importance of the deposit became known to capitalists very largely through the reports of this survey, though at that time economic geology had no charms for its head. Much of the enormous development of the Lake Superior iron region was due to the influence of the later survey between 1869 and 1873.

The first Ohio survey, made sixty years ago, was at greater disadvantage than the Pennsylvania survey, yet in the first year the coal area was defined and during the second the geologists determined the distribution of the several limestones and sandstones which, as building stones, have become so important. The second survey was made effective at once by the tracing and identification of the Hocking Valley coal, which brought into the State a vast amount of new capital and changed the face of a great district. The third survey determined the distribution of oil and gas, the relations of the coal beds and the characteristics of the clay deposits in such fashion as to remake the manufacturing interests of the State.

The Mesabi and Vermilion ranges of Minnesota contain deposits of iron ore which, for the present at least, appear to be even more important than those of northern Michigan. Almost fifty years ago J. G. Norwood, while studying the easterly end of the region, discovered the Mesabi ores; a few years later Whittlesey, after a detailed examination farther west, predicted the discovery of similar ores, a discovery actually made in 1866 by Eames, who was then State Geologist and engaged in studying the Vermilion range. Though not utilized at once, these announcements were not forgotten and systematic exploration was begun in 1875, when the need of high-grade ores at low prices made necessary the opening of new areas. Almost at once, the State Geological Survey determined the extent of the ore-bearing region,

differentiated the deposits and removed erroneous impressions respecting the extent and distribution of the ores. The effect of discussion and of the positive fixing of areas has been to increase development and to cheapen ores of the best quality so far that Bessemer steel can be manufactured more cheaply in the United States than elsewhere, in spite of the fact that wages are still higher, not simply numerically, but in purchasing power, than in any other iron-producing country. An examination of the reports which have brought about this result compels one to say that the anxiety for economic results does not appear to have been an impelling motive during the work. There were perplexing geological problems to be worked out, and the solutions could be discovered only by the most painstaking work. This investigation led to the economic results.

The United States Survey retained its original character for a number of years, the studies being devoted almost wholly to pure science. There were those who looked upon the elaborate petrographical work as merely an elaborate waste of public funds; who, like the member of the Ohio Legislature, regarded fossils only as 'clams and salamanders' and considered the diagrams of sections as merely bewildering humbug, while they asserted that attention ought to be given to other matters, which, however, they were not always ready to designate. But the outcome of these studies was the inevitable; petrography has its applications now in the investigation of building stones, and it has proved of service in aiding to determine the source of precious metals at more than one important locality. The determination of fossils has led to the proper definition of the great coal horizons of the Upper Cretaceous; the close study of stratigraphical relations made possible a wide development of artesian well systems in the Dakotas, just as similar work in England led to the same practical result; while the study of climatic and structural conditions was brought to bear on the great problem of our arid lands with no mean results.

But these illustrations must suffice, not because they exhaust the material—for every official survey on the continent affords illustrations—but because this is an address, not a history, and already the time allotted has been exceeded.

It is the old story—the same in geology as in other branches. The kind of work for which this Society stands lies more closely to the welfare of the community than is supposed even by men in high position and of far more than average intelligence. This work is responsible in large part for the industrial progress of our continent, which we must regard, in spite of protests from those who lament the dominance of commercialism, as the force which has made possible our great advance in physical comfort as well as the equally great advance in literary culture and æsthetic taste. Coal, iron and oil, chief among our products, have been so much the objects of minute study by closet investigators that improvement in processes of manufacture has not been a growth, but rather a series of leaps.

We give all honor to applied science, yet we cannot forget that it is but a follower of pure science. The worker in pure science discovers; his fellow in applied science utilizes; the former receives little credit outside of a narrow circle; pecuniary reward is not his object and rarely falls to his lot; the latter has a double possibility as an incentive, large pecuniary reward and popular reputation in case of noteworthy success. The two conditions are well represented by Henry, the investigator, and Morse, the inventor and promoter.

Men are ignorant of their debt to closet workers because the facts have never been

presented. As geologists and as citizens of no mean countries we ought to present this matter clearly to men whose fortunes have come through application of principles discovered by obscure workers. Such men are quick to perceive the justice of the claim and usually are ready to pay a reasonable interest on the debt.

The world must advance or retrograde; it cannot stand still. Continued advance in physical comfort and intellectual power can come only through intenser application to investigation along the lines of pure science, which can be made possible only by affording increased opportunities for research in our colleges and by the expansion of research funds held by societies such as this.

John J. Stevenson.

New York University.

FISHES OF THE SOUTH SHORE OF LONG ISLAND.

Investigations carried on by the New York State Museum from July to September and continued by the U. S. Fish Commission until near the close of October, 1898, in the waters of the southern part of Long Island resulted in the collection of eighty-four species of fishes belonging to the region.

The work of collecting began July 21st, at Southampton, from which place excursions were made to Shinnecock, Mecox and Peconic Bays and to the ocean beach. The writer was assisted by Mr. Barton A. Bean, on behalf of the U. S. National Museum, during the first month of the explorations. Great South Bay was the scene of operations from August 12th until October 19th.

Fine-meshed seines, a gill net of two-inch stretch-mesh and a trawl line with about 200 hooks were the principal means of capturing the fishes, and a few interesting species were obtained from the haul seines and set nets of fishermen on the ocean beach and the pound nets in Great South Bay.

A noteworthy feature was the absence of many fishes which had been taken during the summer and fall months in previous years. Among them are: *Albula vulpes*, *Etrumeus sadina*, *Clupea harengus*, *Pomolobus æstivalis*, *Stolephorus argyrophanus*, *Fistularia tabacaria*, *Sphyræna borealis*, *Decapterus punctatus*, *Vomer setipinnis*, *Trachinotus falcatus*, *Trachinotus argenteus*, *Lagodon rhomboides*, *Leiostomus xanthurus*, *Acanthocottus æneus*, *Hemitripterus americanus* and *Platophrys ocellatus*. Two things contributed to this condition, the prevalence of southerly winds, causing rough seas on the ocean beaches, and high water temperature which kept the migratory fishes well to the north of Long Island until late in October. A very serious hindrance to seining in most parts of the bays was the abundance of living and dead sea weeds near the shores, and another great obstacle was found in the sunken stakes scattered by ice and storms from the fences used as sea-weed collectors.

The sand shark (*Carcharias littoralis*) was abundant on the grassy shallows south of Toby's Flat until the middle of September, when it migrated westward. It preyed upon mullet, eels and flatfish, and, on account of its habit of swimming slowly near the surface, was easily captured by spears from a row boat. A young mackerel shark (*Lamna cornubica*), about three feet long, was caught in a gill net set in the ocean off Southampton. Other sharks secured were the dusky shark (*Carcharhinus obscurus*), the smooth dogfish (*Mustelus canis*) and the horned dogfish (*Squalus acanthias*).

The skates represented three species, *Raja erinacea*, *ocellata* and *eglanteria*, all of which were sufficiently common. They were often found feeding in shallow water near the shores, especially in the evening and night. A large male was taken by the hands, on the night of October 17th, in a