Gilman (D. C.)

The Benefits which Society derives from Universities

AN ADDRESS

BY

D. C. GILMAN

President of the Johns Hopkins University

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PUBLICATION AGENCY OF THE JOHNS HOPKINS UNIVERSITY
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NOTE.

The following address was delivered before the officers, students, and friends of the Johns Hopkins University, on Commemoration Day, February 23, 1885. Part of it was subsequently given before the Literary Societies of Rutgers College in New Brunswick, New Jersey, and before the Convocation of the Regents of the University of the State of New York in Albany. In issuing this pamphlet, I had intended to add some illustrative notes, but the delay occasioned by the repetition has diverted me from this purpose, and I leave the text, without comment, in its original form.

D. C. G.

ADDRESS.

Ladies and Gentlemen:

TO be concerned in the establishment and development of a university is one of the noblest and most important tasks ever imposed on a community or on a set of men. It is an undertaking which calls for the exercise of the utmost care, for combination, coöperation, liberality, inquiry, patience, reticence, exertion and never ceasing watchfulness. It involves perplexities, delays, risks. Mistakes cannot possibly be avoided; heavy responsibility is never absent. But history and experience light up the problem; hope and faith give animation to the builders when they are weary and depressed. Deeply moved by these considerations, I desire to bring before you, my colleagues in this work, without whose labors all would be a failure, you who are Trustees, and you who are teachers, before the citizens of Baltimore, and before this company of students pressing forward to take the places of authority in the work of education and administration—before you all, my

friends, I wish to bring some aspects of university life, which, if not new, may perhaps be stated in terms which are fresh, with illustrations drawn from our own experience.

I ask you to reflect at this time on THE RELATION OF UNIVERSITIES TO THE PROGRESS OF CIVILIZATION, and I begin by assuming that we are agreed substantially on the meaning of both these terms. The word university, as applied to a learned corporation, is several hundred years old, and in all times and lands has embodied the idea of the highest known agency for the promotion of knowledge and the education of youth. Civilization is a new word, hardly introduced a century ago, though the idea which it embodies is as old as organic society. Guizot, to whose eloquence we owe the popularity of this term, avoids its formal definition, declaring in general terms that civilization is the grand emporium of a people, in which all its wealth, all the elements of its life, all the powers of its existence are stored up. "Wherever," as he goes on to say, "the exterior condition of man becomes enlarged, quickened or improved, wherever the intellectual nature of man distinguishes itself by its energy, brilliancy and its grandeur; wherever these two signs concur, and they often do so, notwithstanding the gravest imperfections in the social system, there man proclaims and

applauds civilization." Assuming, then, that by university the highest school is understood, and by civilization the highest welfare of mankind, let us inquire into the influence which the advancement of knowledge by means of superior educational establishments has exerted or may exert upon the progress of society.

A little reflection will remind us of five great agencies by which modern Christian civilization is helped forward: first, THE FAMILY, unit of our social organization, recognized by Aristotle as the basis of society, and styled by modern philosophers "the focus of patriotism" (Lieber) and the very "starting point of social morality" (Maurice); next, TRADE or COMMERCE, the exchange of one man's products for another's, the traffic between communities and nations; third, LAW and CUSTOM, written and unwritten, the enforcement of duties and defense of rights, the equitable adjustment of conflicting claims; fourth, RELIGION, the acknowledgment of personal responsibility to an infinite and all controlling Power. The last to be named is KNOWLEDGE, the recorded observations and experience of our race in ancient and in modern times, or in other words SCIENTIA, science in its broadest significance.

These five influences working in dwelling houses, market places, state houses, churches, libraries and schools, control our modern life; and

that state of society is the best, in which domestic virtue, mercantile honor and the freedom of exchange, obedience to law, pure and undefiled religion, and the general diffusion of knowledge, are the dominant characteristics. We are only concerned at present with the last of these five factors.

The means by which our race has acquired knowledge and preserved its experience are manifold. The inhabited world is a great laboratory, in which human society is busily experimenting. Observation, exploration, and reflection have been allied in interpreting the physical characteristics of the globe, ever since the primeval law, Subdue the earth, was heard by primitive man; experiments in social organization have also been made on a colossal scale, and in little microcosms; war has taught its pitiful lessons; superstition, irreligion, vice and crime as well as literature, art, law, religion and philosophy have all been teachers; customs, traditions, epics, creeds, codes, treaties, inscriptions, parchments, books, pyramids, temples, statues, museums, schools, pulpits, platforms have all been employed to perpetuate and diffuse the knowledge which has been acquired; but ever since Europe emerged from the darkness of the middle ages, UNIVERSITIES have been among the most potent of all agencies for the advancement and promulgation of Learn-

ing. Their domain, the republic of letters, has been wider than the boundaries of any state; their citizens have not been restricted to any one vocabulary; their acquisitions have been hid in no crypt. They have gathered from all fields and distributed to all men. Themes the most recondite, facts the most hidden, relations the most complex have been sought out and studied, that if possible the laws which govern the world might be discovered, and man made better.

In one of our halls, there hangs a diagram which I never pass without pausing to think of its significance, listening as I would before the sphinx to discover if it has any message for me. It contains a list of European universities founded since the dawn of modern states,—a period of more than seven centuries, a list of over two hundred names. Every state in Europe, every great city, has its high school. Popes, emperors, kings and princes have been their founders; ecclesiastics, reformers, republics, municipalities, private citizens, munificent women have contributed to their maintenance. Wherever European civilization has gone, the idea of the university has been carried with it, to North and South America, to Australia, even to India, China and Japan; it came with the Virginians to Williamsburg, with the New Englanders to

Cambridge and New Haven; it was planted in California before there was an organized state on the Pacific slope.

The idea is often vague, sometimes perverted, commonly half-developed, at times inflated,—nevertheless it contains this principle of life, that in every civilized community there must be a high school, capping, crowning, binding all other institutions for the advancement of learning.

Allow me to turn your attention to some historical illustrations.

Notwithstanding the great renown of Charlemagne, greatest of monarchs between Caesar and Napoleon, the fact that his empire was founded upon the principle of superior education is not so familiar; but a recent writer (Mr. Mullinger) has given us an instructive essay on the schools of Charles the Great and a still more recent writer, (Mr. R. L. Poole) has made a study of their influence. "If his reign marks the dividing line between ancient and modern history," says the latter, "it is not only by virtue of its political facts but also because he begins the education of the Northern races,—fitting them in time to rule the world as the Romans had done before them."

A monk of St. Gall has preserved for us what purports to be an authentic account of the mode in which learning was introduced

into the Frankish empire, and although the extract is long I am sure it will not weary you, as I read from the translation of Mr. Poole.

"*When*," says the monk, "*the illustrious Charles had begun to reign alone in the western parts of the world, and the study of letters was everywhere well-nigh forgotten, in such sort that the worship of the true God declined, it chanced that two Scots from Ireland lighted with the British merchants on the coast of Gaul, men learned without compare, as well in secular, as in sacred writings; who, since they shewed nothing for sale, kept crying to the crowd that gathered to buy, If any man is desirous of wisdom, let him come to us and receive it; for we have it to sell. This therefore they declared they had for sale, since they saw the people to traffic not in gifts but in saleable things, so that they thus might either urge them to purchase wisdom like other goods or, as the events following shew, turn them by such declaration to wonder and astonishment. At length their cry being long continued was brought by certain that wondered at them or deemed them mad, to the ears of Charles, the king, always a lover and most desirous of wisdom: who, when he had called them with all haste into his presence, enquired if, as he understood by report, they had wisdom verily with them. Yea, said they, we have it and are ready to impart to any that rightly seek it in the name of the Lord. When therefore he had*

enquired what they would have in return for it, they answered, Only proper places and noble souls, and such things as we cannot travel without, food and wherewith to clothe ourselves. Hearing this he was filled with great joy."[1]

Several instances in modern history may be cited, in each of which the close of a great civil commotion has been marked by the foundation of a university. One of them is quite familiar. A little more than three hundred years ago, Leyden, so lately freed from the horrors of a siege, "so lately the victim of famine and pestilence, had crowned itself with flowers." The university was to be inaugurated. In the grand procession rode a female figure, the Holy Gospel, attended by Four Evangelists; then came other allegorical figures, emblematic of Law, Medicine and the Liberal Arts, and then the magistrates and dignitaries. Down the Rhine floated the semblance of Apollo and the Muses, and each Professor, as he advanced, "was kissed by Apollo and all the nine muses in turn," whose salutatations found further expression in "an elegant Latin poem." I have taken these statements, as you doubtless surmise, from the pages of Motley, to show you the enthusiasm of the Low Countries in respect to their university; but a truer impression of the work then inaugurated would be given by recounting the roll of the

great men who have taught in that university and of the great scholars whom they have trained. Grotius, Descartes, Scaliger, Boerhave, Wyttenbach, Arminius and Gomar were among the early scholars who resided in Leyden, and the list might be extended until it reached our own contemporaries and our own countrymen.

A few years earlier, when the Reformation in England was nearly completed, Henry the Eighth re-organized the University of Cambridge and laid the foundations of that splendid college, which might be called a university in itself, if ever a college could claim the more comprehensive name, Trinity College, which before the century had passed, trained for the world that great triumvirate whose statues glorify the approach to the chapel, Isaac Barrow, Lord Bacon, and Sir Isaac Newton, *qui genus humanum ingenio superavit.*[2]

The foundation of the University of Berlin is a noteworthy modern instance of the erection of a great high-school, in a time of national sorrow. The story has often been given and was recently made the opening passage in an inaugural address by Helmholtz. Prussia had been overrun by France, the resources of the state were almost exhausted, but Frederick William the Third, led on by William Von Humboldt, Stein, and other great intellects, determined to infuse new spirit into a despondent people, by conferring on them

the greatest benefit which it was in his power to bestow, a university, founded on such a liberal plan, that it rose at once to the very front rank.

So within our recollection, that monarch's greater son, the Emperor William, when Strassburg had been reclaimed by Germany, determined that it should be the seat of a university, and already that new foundation stands among the strongest and best of German high-schools.

These examples of universities founded each of them at the close of a sharp social crisis, often occur to my mind when I remember that our foundation was projected at the close of a civil war, and was established in the firm belief that it would bind together in the love of Literature and Science, all classes and all creeds. A physician who has lately died in communion with the Roman Catholic Church, has often said to me, "I tell everybody that there is one thing on which we can all agree, and that is the university," and another, of the same religious creed, has just written me, "I sincerely hope to see your prediction as to all Christian forces come true. Life is too short, and there is too much good to be done, to have any force or energy wasted in barren controversy."

I have made these historical allusions, most of which I am well aware are familiar, in order to raise the questions: Why is it that universities are

so highly esteemed? What are the advantages which follow their foundation? Remembering that a university is the best organization for the liberal education of individuals, and the best organization for the advancement of science, apply the double test,—what is done for personal instruction, and what is done for the promotion of knowledge, and you will be able to judge any institution which assumes this name.

Ask, first, is it a place of sound education? Are the youth who are trained within its walls, honest lovers of the truth,—are they learned, are they ready, are they trustworthy? When they leave the academic classes, do they soon find a demand for their services? Do they rise in professional life? Are they sought for as teachers? Do they show aptitude for mercantile, administrative, or editorial life? Do they acquit themselves with credit in the public service? Do the books they write find publishers? Do they win repute among those who have added to the sum of human knowledge? Have they the power of enjoying literature, music, art? Can they apply the lessons of history to the problems of our day? Are they always eager to enlarge their knowledge? Do they become conservative members of society, seeking for progress by steady improvements rather than by the powers of destruction and death? Are

they useful, courteous, coöperative citizens, in all the relations of life? Do the charities, the churches, the schools, the public affairs of the community receive their constant consideration? Are there frequent manifestations among them, of unusual ability in science, in literature, in oratory, in administration? As the roll of the alumni increases and the graduates are counted by hundreds and not by scores, does it appear that a large proportion are men of honorable, faithful, learned and public spirited character? These are the questions by which as the years go on, a university is to be tested, or to sum all questions in one, is it proved to be a place for the development of manliness?

I beg leave to dwell a little longer upon this text, because I think there is danger of its importance being overlooked. The material resources of a university, the aggregate numbers who attend its courses, its numerous buildings, its great collections appeal to everybody,—only those who look at results, are competent to give a conclusive opinion, and their opinion cannot be formed in one decade. A generation is the briefest period for a fair review. When the year of our Lord 1900 comes, this foundation will be a quarter of a century old. To that remote tribunal we appeal for judgment on our work of to-day. But we may anticipate this final

verdict, and ascertain by our own inspection and inquiry what is done in any institution for the education of youth, what opportunities are afforded, how those advantages are regarded by the most intelligent young men, and what kind of scholarship is developed at the termination of the academic course.

Here let me protest against the common method of estimating intellectual work by numerical standards alone. I have heard it said that some men are possessed by a statistical devil. They can only think in figures; they will ask, in respect to a new acquaintance, how much is he worth; of a library how many volumes; of an orchestra how many pieces; of a college how many students. I have known the expenses of an institution made a dividend, and the number of scholars the divisor, the quotient representing the cost of each pupil. All this is wrong, absolutely and wholly wrong. If such a standard were allowable, the largest number of scholars taught by the cheapest teacher would be the greatest success. It is not the number but the quality of students which determines the character of a high school. It is important to count; it is better to weigh.[3]

Having spoken of what the university does for individuals, I add that it has a second function. It benefits associated as well as individual man. It renders services to the community which no

demon of statistics can ever estimate, no mathematical process ever develop. These functions may be stated as the acquisition, conservation, refinement and distribution of knowledge.

These carefully chosen words I proceed to explain.

First, it is the business of a university to advance knowledge; every professor must be a student. No history is so remote that it may be neglected; no law of mathematics is so hidden that it may not be sought out; no problem in respect to physics is so difficult that it must be shunned. No love of ease, no dread of labor, no fear of consequences, no desire for wealth will divert a band of well chosen professors from uniting their forces in the prosecution of study. Rather let me say that there are heroes and martyrs, prophets and apostles of learning as there are of religion. To the claims of duty, to the responsibilities of station, to the voices of enlightened conscience such men respond, and they throw their hearts into their work with as much devotion, and as little selfishness, as it is possible for human nature to exhibit. By their labors, knowledge has been accumulated, intellectual capital has been acquired. In these processes of investigation the leading universities of the world have always been engaged.

This is what laboratories, museums and libraries signify. Nothing is foreign to their purpose, and

those who work in them are animated by the firm belief that the advancement of knowledge in any direction contributes to the welfare of man. Nor is research restricted to material things; the scholars of a university are equally interested in all that pertains to the nature of man, the growth of society, the study of language, and the establishment of the principles of intellectual and moral conduct.

2. Universities are conservative. They encourage the study of the history, the philosophy, the poetry, the drama, the politics, the religion, in fine, the experience of antecedent ages. Successors of the ancient monasteries, they keep alive in our day the knowledge of ancient languages and art, enrich the literature of our mother tongue, hold up to us the highest standards of excellence in writing and enable us to share in the thoughts of the noblest of our race. Let me especially remind you that to the universities men turn instinctively for light on the interpretation of the Scriptures. When new manuscripts are discovered, or new versions are proposed, or new monuments are unearthed, it is to the universities, where the knowledge of ancient and remote tongues has been cherished, that the religious world looks for enlightenment and guidance. Their dominant influence is highly spiritualizing; I would even go farther and say

that it is truly religious. I am not unmindful that within the academic circles men are found whose spiritual insight is but dim,—so it is in all other circles,—but I assert without fear of contradiction, that the influence of study is, on the whole, favorable to the growth of spiritual life, to the development of uprightness, unselfishness and faith, or, in other words, it is opposed to epicureanism and materialism. In belief, there are tides as there are in the ocean, ebb and flow, ebb and flow; but the great ocean is there, with its deep mysteries, unchanging amid all superficial changes. Faith, with all its fluctuations, is as permanently operative in human thought as Knowledge.[4]

3. Universities are refining. They are constantly, by laborious processes, by intricate systems of coöperation, and by ingenious methods, engaged in eliminating human errors and in submitting all inherited possessions to those processes which remove the dross and perpetuate the gold. No truth which has once been discovered is allowed to perish,—but the incrustations which cover it are removed. It is the universities which edit, interpret, translate and reiterate the acquisitions of former generations both of literature and science. Their revelation of error is sometimes welcomed but it is generally opposed; nevertheless the process goes on, indifferent alike to

plaudits or reproaches. If their lessons are hard to the beginners, they lead the persevering to high enjoyment.

4. Universities distribute knowledge. The scholar does but half his duty who simply acquires knowledge. He must share his possessions with others. This is done in the first place by the instruction of pupils. Experience has certainly demonstrated that with rare exceptions, those men are most learned who produce most. The process of acquiring seems to be promoted by that of imparting. The investigator who is surrounded by a bright circle of friendly inquisitors and critics, finds his best powers developed by this influence. Next to its visible circle of pupils, the university should impart its acquisitions to the world of scholars. Learned publications are therefore to be encouraged. But beyond these formal and well recognized means of communicating knowledge, universities have innumerable less obvious, but not less useful opportunities of conveying their benefits to the outside world.[5]

These general principles I propose to illustrate by asking you to go with me around the circle of the sciences, that we may observe the part which universities have taken or should take in respect to various departments of knowledge.

Let me begin by saying that a university should discover and teach all that can be known of the Human Body. If you ask me why this is so important, I reply, in order that everyone may be able to lead a healthier, stronger and more rational life than is now possible for the want of more knowledge. Hospitals are essential to alleviate sufferings which have been encountered; physical training is of great value; but still more important to humanity is the laboratory in which are studied the laws of life. A celebrated physiologist declares that "a hundred years of life is what Providence intended for man," and others tell us that most of our minor ailments may easily be avoided, and the number of efficient days may be largely increased. Science has proved that many diseases which used to scourge the civilized world may be prevented, and it has recently brought us within sight of new discoveries which will still further interrupt the progress of pestilence. The discoveries of anaesthetics have marvelously alleviated the sufferings of humanity. The causes and remedies of cerebral excitement and degeneration have never been understood as now, and the possibilities have never been so great for the restoration to their normal activity of the powers which have been alienated. In view of these great results and of these anticipations,

it is clearly the duty of a university to study all the forms and functions of life which are manifested in organisms lower than man, all the laws which govern animal and vegetable growth, all that can possibly throw light on human physiology.

Those who are devoted to research of this kind, revealing with their microscopes the structure and the life histories of the minutest organisms, are constantly, and in most unexpected ways, coming upon new illustrations of the plan of creation, which have an important bearing upon the welfare of man. They are the interpreters of nature and the benefactors of humanity; and I do not hesitate to add that if there is any branch of learning which at the present time deserves the most generous support, it is surely Biology, because of its obvious relations to the health and happiness of every human being. I cannot but think that those who oppose its study will be ranked in future years among the obscurantists of the nineteenth century.[6]

Next, I mention as the subject for university study, Psychology, the nature of man's soul, the characteristics of his mental and moral activity. This science has lately made great progress,—it has improved its methods and enlarged its scope. Those who are devoted to it appreciate the inherited experiences of the human race and are not

indifferent to the lessons which may proceed from intuition and introspection; they study all the manifestations of intellectual and spiritual life; but, on the other hand, they are not afraid to enquire, and they know how to enquire into the physical conditions under which the mind works; they watch the spontaneous, unconventional actions of children; they investigate the laws of heredity; they examine with curious gaze the eccentricities of genius, and with discerning, often with remedial eye, the alienation of human powers, and they believe that by a combination of these and other methods of research, among which experiment has its legitimate place, the conduct of the human understanding and the laws of progressive morality will be better understood, so that more wholesome methods of education will be employed in schools of every grade. They acknowledge the superiority of the soul to the body, and they stand in awe before the mysteries which are as impenetrable to modern investigators as they were to Leibnitz and Spinoza, to Abelard and Aquinas, to Aristotle and Plato, the mysteries of man's conscious responsibility, his intimations of immortality, his relations to the Infinite.

I do not know whether philosophy is on a "return to Kant," or to common sense, but I believe that standing firm on the postulates, God, Soul

and Immortality, it will in years to come disentangle many perplexities, brush away heaps of verbal accumulations, and lead the mind to purer and nobler conceptions of righteousness and duty. I go even farther and, as I believe that one truth is never in conflict with another truth, so I believe that the ethics of the New Testament will be accepted by the scientific as well as the religious faculties of man; to the former, as Law; to the latter, as Gospel.

In confirmation of these views, let me quote to you the language of that one among us who is best qualified to speak upon this subject.

"The new psychology, which brings simply a new method and a new stand-point to philosophy, is, I believe, Christian to its root and centre; and its final mission in the world is not merely to trace petty harmonies and small adjustments between science and religion, but to flood and transfuse the new and vaster conceptions of the universe and of man's place in it—now slowly taking form and giving to reason a new cosmos and involving momentous and far reaching practical and social consequences—with the old scriptural sense of unity, rationality and love beneath and above all, with all its wide consequences. The Bible is being slowly re-revealed as man's great text-book in psychology, dealing with him as a whole, his body, mind and will, in all the larger relations to nature

and society, which has been so misappreciated simply because it is so deeply divine. That something may be done here to aid this development," continues the lecturer, "is my strongest hope and belief." [7]

The study of Society engages the earnest interest of another set of men, and the apparatus of their laboratory includes archæological and historical memorials of the activity of the race. The domain of history and political science has never been cultivated as it is in modern times. The discovery of primeval monuments and the interpretation of long hidden inscriptions, the publication of ancient documents once hid in monasteries and governmental archives, the inquiry into primitive forms of social organization, the development of improved modes of research, the scientific collection and classification of facts which illustrate the condition of ancient and modern communities and especially the interest awakened in the growth of institutions and constitutions, give to this oldest of studies the freshest interest. Papers which have lately been printed on rudimentary society among boys, on the laws of the mining camp, on the foundations of a socialist community, on the differences between parliamentary and congressional government, on the derivation of modern customs from the ancient beginnings of the Aryan

people, on the nature of communism and many more such themes afford illustrations of the mode in which the historical student among us, following the lines of Stubbs, Maine, Freeman, Seeley, Bluntschli, Roscher, and other celebrated workers, are advancing historical science, and developing the true historical spirit. The aim of all these inquiries is to help on the progress of modern society by showing how the fetters which now bind us were forged, by what patient filing they must be severed, and at the same time to work out the ideal of a society in which Liberty is everywhere, but "Liberty sustained by Law." [8]

Languages and Literature have always received attention in universities, and will always be dominant for reasons which are as enduring as language itself. We study tongues that we may know the men of other climes and other days; we study literature to enjoy it. As an aid to intercourse with people of other nations and for the purpose of keeping up with the record of modern science, nobody doubts that the modern languages are to be encouraged; but if we really would own the inheritance which is our birthright, if we wish to appreciate the master-pieces of literature, if it is well to put ourselves in sympathy with mankind, to laugh with those who have laughed, and weep with those who have wept, we must not be restricted to the writings of to-day. In science, it

has been said, read the newest and latest; not so in literature,—but the best. Isaiah and John, Homer and Æschylus, Cicero and Virgil, the Nibelungen Lied and Chaucer, Dante and Petrarch, are as full of life, beauty, instruction and entertainment to us as to former generations. But from the classical standard of excellence this busy world would soon depart, were it not that in every university there are scholars keeping bright the altar fires, and warming us with the glow of their enthusiasm, whenever we come under their influence,—sharpening too our wits by their critical acumen.

It is not uncommon, now-a-days, to hear objections to classical education, usually from those who have never had it, and declamations against dead languages, usually from those who have never learned them. But the Humanists may unquestionably leave it to the Geologists to fight the battle for antiquity. The latter assure us that the older the fossils the more instructive their lessons; indeed so much importance is attached to ancient animal life that the national government, with great liberality, encourages its study by promoting explorations, museums, and costly publications. Be it so; but let not the nation which does this, forget that men are of "more value than many sparrows;" that the oldest literature is not old or dead, but fresh and living in comparison with the bones of the

cave dwellers; and that though a megatherium is wonderfully instructive, an ancient Epic or a Drama is not unworthy of attention.

Jebb, in his life of Bentley, asserts that probably "the study of classical antiquity, in the largest sense, has never been more really vigorous than it is at the present day." We might add that classical poetry has never been so popular—else why these innumerable editions and translations? Why, after Worsley, Butcher, Bryant and their predecessors, are we reading aloud and smiling over the immortal Odyssey as it is given to us in the rhythmical prose of Palmer? This is a good sign; only it is well to remember that reading translations is not reading Greek, and, as Jebb goes on to say, we must not forget the difference between "the knowledge at second-hand," which the intelligent public can possess, and "the knowledge at first hand" which it is the business of the libraries and professorships of a university to perpetuate.

If the defenders of classical study would confine their argument to the line which was lately followed by Butcher, they would silence their opponents. "To Greece," he says, "we owe the love of science, the love of art, the love of freedom—not science alone, art alone, or freedom alone, but these vitally correlated with one another and brought into organic union. . . . The Greek genius is the European genius in its first and brightest bloom.

From a vivifying contact with the Greek spirit, Europe derived that new and mighty impulse which we call progress."

But I must not pass from the subject without a word upon the study of language in general, that faculty of the human race which was never half understood until the universities of Germany entered upon the study of comparative philology, by the introduction of Sanscrit study. With this new torch they have thrown a flood of light upon the nature of speech, the history of our race, the brotherhood of nations and the development of ideas which lie at the basis of all Indo-European civilization.

The Shemitic tongues have long been subjects of university study, especially Hebrew and Arabic —the former so much esteemed as the language of the Old Testament that it used to be spoken of as the language of Paradise, and the latter being regarded as a key to the ideas and religion, the ancient literature and science, of one of the largest families of men. Of late years the domain of Shemitic study has been widened; libraries long hidden have been exhumed on the sites of ancient Babylon and Nineveh; records, the very existence of which was unknown at the beginning of this century, written in characters to which there was then but the slightest clue, are now read and printed and studied as a part of the history of

mankind. Assyrian becomes a language of university study—not, indeed, for many scholars, but for a few, and the bearing of their discoveries is so important upon the language and history of the Hebrews that one of the most learned of English theologians has recently said that, in respect to certain of the obscurer passages of the Old Testament, the world must wait for the light which would come from Assyriology.

Certainly, if the history of mankind is worth studying, if the lessons of the past are of value, language and literature, the ancient, the modern, the primitive and the cultivated, will never be neglected among the studies of an enlightened community.[9]

When we turn from Man to his environment, we soon perceive that mathematics lies at the basis of all our knowledge of this world. To count, to measure and to weigh, are steps in civilization, and as we extend our powers in these directions, we find that even the distance and mass of the planets, the form of the earth, the velocity of light, the mechanical equivalent of heat, and the unit of electrical resistance may be accurately ascertained, and the results, with many of the ideas which they involve, may become a part of the intellectual possessions of every educated person. Yet when we reflect that hardly any branch of knowledge

is so depreciated by the average man as the modern advancement of pure mathematics, we must believe that its influence upon civilization is not sufficiently considered.

Professsor Cayley, in a recent address, alluded to the connection of mathematics with common life, on the one hand, and with the deepest questions of philosophy, for example the metaphysical ideas of time and space, on the other. As to its utility, he declared that he would defend this science as Socrates defended justice, quite irrespectively of wordly advantages,—and then he proceeds to show the relations of mathematics to the certainty of knowledge, and to emphasize the idea that mathematical science is not built upon experience but upon certain fundamental assumptions,—which are indeed found to be in conformity with experience. I wish that every student, however remote his studies may be from mathematical text-books, would turn to the opening passages of this discourse, and steady his own mental equilibrium by the assurance that the science which is most exact, and most satisfactory in its reasonings, is based upon fundamental postulates which are assumed and not proved by experiment. "In the theory of numbers," he says, "these are very remarkable instances of propositions observed to hold good for very long series of numbers,—and which are nevertheless untrue."

If you persist in taking the utilitarian view and ask me what is the good of Mr. Glaisher's determination of the least factors of the missing three out of the first nine million numbers, the volume containing the sixth million having lately been published;—or if you put a much more comprehensive question, what is the use of the Abelian functions, I shall be forced to say, I do not know; and if you press me harder I shall be obliged to express my conviction that nobody knows; but I know, and you know, and everybody may know, who will take the pains to inquire, that the progress of mathematics underlies and sustains all progress in exact knowledge.[10]

Whewell, the author of the History of Inductive Sciences, has brought out very clearly the fact that "the opening of Greek civilization was marked by the production of geometry, the idea of space was brought to a scientific precision; and likewise the opening of modern European civilization was distinguished by the production of a new science, Mechanics, which soon led to the mechanics of the heavens, and this step, like the former, depended on men arriving at a properly distinct fundamental idea, the idea of force. Henry Smith, arguing for the value of his favorite study to mankind, points out the injury which would come to the intellectual strength of any nation "whose notions of the world and of the

things in it, were not braced and girt together with a strong frame work of mathematical reasoning. It is something," he continues, "for men to learn what proof is and what it is not." The work in mathematics at Alexandria or Syracuse two thousand years ago, is as perfect in its kind and as direct and unerring in its appeal to our intelligence, as if it had been done yesterday at Berlin or Göttingen by one of our own contemporaries. In kindred language, Cayley, working forward as well as backward, and not unmindful, let us hope, of the Sylvestrian school upon this side of the Atlantic, in which he had been a master and a guest, thus concluded the address from which I have already quoted.

"Mathematics have steadily advanced from the time of the Greek geometers. Nothing is lost or wasted; the achievements of Euclid, Archimedes and Apollonius are as admirable now as they were in their own days. Descartes' method of co-ordinates is a possession forever. But mathematics have never been cultivated more zealously and diligently, or with greater success than in this century—in the last half of it or at the present time; the advances made have been enormous, the actual field is boundless, the future full of hope. In regard to pure mathematics we may most confidently say,

"'Yet I doubt not thro' the ages one increasing purpose runs,
And the thoughts of men are widened with the process of the suns.'"

Many who hesitate to assent to these views of the relation of pure mathematics to civilization, have no question whatever in lauding applied mathematics, especially astronomy and physics; and no wonder, for within the memory of this generation, the world has gained these five results of physical science, steam locomotion, telegraphy, telephony, photography, and electric lighting. The first three, it may be said, have revolutionized the methods of human intercourse; the fourth has multiplied infinitely the means of communicating knowledge to the brain by what Sir William Thomson, following John Bunyan, has termed the Eye-gate; and the fifth, still in its dawn, includes possibilities of illumination, which we are not likely to exaggerate. But I have no time to eulogize these recent gains of civilization; every word I can spare must be given to emphasize the fact which is most likely to be forgotten, that these wonderful inventions are the direct fruit of university studies. I do not undervalue the work of practical men when I say that the most brilliant inventor who ever lived has been dependent upon an unseen company of scholars, the discoverers and the formulators of laws which he has been able to

apply to methods and instruments. Nor do I forget that Faraday, like Shakespeare, was not a university man. But I mean to say that the manifold applications of science, about which everybody is talking, are only possible because of the abstract studies which universities promote. The electro-magnetic inventions which are now so multiform are only possible because scores of the greatest intellects of the century, one after another, have applied their powers of absolute reasoning to the interpretation of phenomena, which could have been elucidated in any part of the world, and at any epoch of the past, if only the right methods had been employed. As long as universities held aloof from experimental sciences, these discoveries were not made, but when laboratories for investigation were established, an alliance was formed by mathematics and physics, and a new type of intellectual workers was produced, men whose hands were as cunning to construct and make use of instruments, as their brains were cunning to develop the formulas of mathematics. Take the splendid list of leaders who have followed Franklin and Rumford. They may be called the School of Sir Isaac Newton, so much of their inspiration is due to him. Not all were trained in academic walls; but not one failed to derive help from the advantages which universities provide and perpetuate.

One of the greatest of these men, Sir William Thomson, has lately been here. He was invited to come because it was believed that he, more than any other foreigner, could give an impulse to the study of physics in this country. His lectures were on a subject so remote from ordinary thought that I do not suppose its announcement conveys to those who are unfamiliar with the present position of physical inquiries, the least idea of what the lecturer was to talk about. Nevertheless so great was the attraction of his powers, that a large company, two or three from England, one from Japan, several from beyond the Alleghanies, and many from this neighborhood, most of them teachers and professors of physics, here assembled daily for a month to catch what they could of his learning and his enthusiasm. His words were taken down and have been given to the public in the form of lecture notes, and have thus reached already the principal seats of learning abroad and at home, but the chief results of his visit will be seen as the years go on in the increased devotion of his followers to their science, and in their emulation of his enthusiasm and concentration. Could I give you a more interesting example of the way in which a university may encourage physical science?

Notwithstanding all the progress in physics and astronomy which has been made during a century, those who know the most about these subjects

will assure us that they are but at the alphabet of their science. Read the address of the astronomer of Princeton, on a recent occasion, in which he enumerates the impending problems of astronomy; or that of one of our own staff, when he reviews the condition of electrical science and declares that "as the region of the unknown is infinitely greater than the known,—there is no fear of there not being work for the whole world for centuries to come;" and he adds (to please I suppose the practical men) that in the applications of science, "the telephone, the telegraph, and electric lighting, are but as child's play to what the world will see." [11]

Chemistry is the child of the nineteenth century. The atomic theory, which lies at the foundation of all modern investigations, was announced by Dalton,—(that English Friend after whom it would not be amiss to name our chemical laboratory "Dalton Hall," as a tribute alike to his eminence and to the society in which our founder was also trained),—Dalton's law, I say, was announced between 1804 and 1808, so that we can trace more distinctly than in most sciences the exact influences under which Chemistry has grown up. Alchemy, the search for gold or for the philosopher's stone, never became a science, and contributed very little to the good of man; but when the universities of Europe, with their trained observers, their methods of accurate work, their habit of

publication, and especially their traditional principles of coöperative study, directed their attention to the fundamental laws of atomic combination, the science of Chemistry grew with rapidity, and with benefits to mankind which can never be enumerated. To no man were its early days more indebted than to Liebig,—"of organic chemistry the very source and fountain head,"—good as a thinker, good as an investigator, good as a lecturer, but better still, as one of his most illustrious pupils has informed us, "in the peripatetic teaching of his laboratory."

"It was at the small University of Giessen," says Hofmann, from whom I have just quoted, that "Liebig organized the first educational laboratory that was ever founded. This school forms an epoch in chemical science. It was here that experimental instruction such as now prevails in our laboratories received its earliest form and fashion, and if we are proud of the magnificent temples raised to experimental science in all our schools and universities, let it never be forgotten that they all owe their origin to the prototype set up by Liebig, half a century ago." The world appreciates the results which have proceeded from these laboratories,—let it also be remembered that they were the creation not of industrial fabrics, not of mercantile corporations, not even of private enterprise, but of universities, and that the motive

which inspired their founders and directors was not the acquisition of wealth, but the ascertainment of fundamental law.

The science which began with the century is going forward more rapidly than ever. Yet, if we examine a recent exposition of the principles of theoretical chemistry, we may discover that here, as in mathematics and in physics, the most expert perceive that the field which is open to investigation is much vaster than that which has been surveyed. Here, as everywhere else, the higher one ascends the greater his horizon. What good is to come to men from these researches it would not be wise to predict; but we may reflect on what has recently occurred. Within the last few months a boon has been conferred on humanity so great that all the cost of all the laboratories of all the lands in Christendom would have been a small price to pay for so precious a pearl. It came into the world never again to leave it, unheralded, unexpected, from the laboratory of science, to deaden for a few moments and then restore to life the organs of the sight, so that operations on the eye, hitherto dreaded, may be performed without the slightest pain. The chemists may modestly say that this discovery was an accident not to be compared in significance with the discovery of Avogadro's law. That may be so, yet this sort of accident does not happen in Africa or the Fiji

Islands—it "happens" where there are universities and laboratories, and trained men able and ready to observe, discover and apply.[12]

The hour has passed, and I have hardly introduced a theme which would be more appropriate for a volume than for a discourse. I have not spoken of the study of the structure of the earth, the physics of the globe, the laws of storms, the constituent rocks and minerals of this earth, the record of life hidden in ancient strata, the living kingdoms of animals and plants, the distribution of the races of men, the progress of archæology,—or of innumerable sub-divisions in the great branches of human knowledge. Such a task would be beyond my powers; I have only attempted to suggest what each one of you may study for the rest of your lives, as you watch the growth of universities and the progress of knowledge. I have purposely left for another occasion all questions pertaining to professional and technical education.

A few miles east of one of my former homes—the settlement of Berkeley, in California—there is an isolated peak of moderate height, from the top of which you may survey an area equal to that of the State of New York. From Mount Shasta on the north to Mount Whitney on the south, you may trace the jagged, often snow-white, crest which bears the name of Sierra Nevada. Here and there

a peak rises a little higher than its neighbors, and can be identified from the look-out; but human vision cannot see the chains beyond the chains, nor the marvellous valley Yosemite and the beautiful Lake Tahoe which are sheltered within the nearest range of hills. All that the eye can distinguish on the horizon are a few of the loftiest summits as it turns toward the east, and a glimpse of the Farallone islands as it turns toward the west. So to-day, from a hill not very high, we have looked upon a broad area, distinguishing only the chief features of the landscape,—but we have seen the mountains and the sea.