SCIENCE

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MUSEUMS AND THEIR PURPOSES.[1]

I HAVE to thank the secretary and curator of this academy for the opportunity to state publicly some thoughts which have been uppermost frequently in my mind during several years past, but which I have never had occasion to put into form. In the North-west, educational methods and institutions are yet in their formative stages. This is still more the case with scientific education and scientific institutions. But we are fast laying foundations for posterity to build upon, which we ought to plan with a far-reaching vision into the future. Our mistakes, if we make them, will be forever laid at our door; and our children and our children's children will condemn or approve of us and our labor in accordance with the degree of fitness that they find between the foundations that we lay and the superstructure which they may have to build thereon.

It is because I think I can see in the future of scientific work in Minnesota some glimpses of the outlines of that superstructure, that I wish to call your attention to some of the fundamental essentials that ought to enter into the foundation which we are called upon to lay. Minnesota is an empire, territorially of itself, and it will become the "empire state" of the North-west, politically, educationally, and financially, and it ought to become the leader in the North-west in scientific enterprise and organization. In this organization of scientific work in the State, the museums will play no inconspicuous part. It will be safe to say that at those centres where the museums are located will be found in greatest efficiency all the other scientific agencies, whether of laboratories, libraries, or lectureships. There is a fitness in their association, almost an invincible bond of attraction, which will ultimately overthrow all the accidental or artificial devices which, in our possible short-sightedness, we may throw about them to keep them asunder.

A museum was originally a temple in which the muses were worshipped or invoked. At Athens, a hill near the Acropolis was called the Museum because of the existence on it of such a temple. It was a place for study and high contemplation. Although we have outgrown the mythology of the Greeks, their literature and their institutions have so pervaded our language and institutions that we find the germs of some of our choicest civil and social growths sunk deep into that old civilization. Those germs have fruited, in part, in our day, and the fruit is somewhat different from what the germs seemed to foreshadow. The germ of the museum at Athens, fraught then with prophecy of poetry, art, and history, had but little promise of science. The muse of astronomy was but one of the nine whose shrines were in those temples. Scholars who sought the museum were inspired with visions of the beautiful and the poetic, or of the light and passionate frivolities of life. There was no muse of geology known, though that science, by her aid, was to be a potent factor in preserving and perpetuating the words "muse" and "museum" in the new civilization; nor any muse of biology, though the poetry of biologic science has since been a prolific branch of modern scientific literature. There was no muse of botany, nor of paleontology, nor of electricity. I think that if the Grecian Museum had continued to the present, the number of the inspiring muses would have been increased far beyond the mythical nine. That dynasty has passed away, and with it has almost been lost the original idea of the museum.

The word, however, which is imperishably stamped on the language of all modern civilized nations, remains. It bears a weird, and to the original nine who gave it origin and character and authenticity, almost an unknown signification. Let us look into this a moment, and endeavor to learn what is the modern meaning of this word "museum." We shall find that it bears three interpretations, or dominant ideas. First, there are museums designed for entertainment; second, there are museums intended for the instruction of the visitor; third, there are museums for research.

The modern so-called "dime museum" typifies the museum designed for entertainment, although in many such may be found some of the characteristics of the second class. It is a place of "curos'ties" and monstrosities, of cheap theatricals and legerdemain. Such have long been known, although under different names, in the principal cities of Europe and America, the most noted in this country being Barnum's Museum in New York City thirty-five or forty years ago. Here the visitor is wholly passive under the manipulation of the presiding genius of the place. He may enter the presence with any foreign, or even adverse sentiment. He simply is willing to be amused for half an hour.

The modern museum designed for instruction has a somewhat higher function and rank. Its purpose is to inspire in the visitor a thirst for knowledge, and in a degree to furnish that knowledge, at second hand. He seeks not that amusement may be lavished upon him, but he is at least willing to put forth an effort to obtain information. With this end attained he is satisfied. The instruction he has received remains in his mind unclassified and generally unassimilable. He knows more of the earth and of the things upon it when he retires from the place than when he approached it. Of his mental capacities his memory only is necessary thereafter to enable him to make useful that which he has seen. He is instructed and benefitted in so far as he appreciates and retains the ideas which the various objects have brought to his mind. Such museums are common. They accompany nearly all modern institutions of higher learning. They are patronized in proportion to the number of instructive objects they have on exhibition, or the variety and beauty of their specimens, or of the cases in which they may be contained. They serve, like travelling circuses, to attract the light-minded and the curious; but their service is higher than that of the circus, in the higher grade of information which they impart, and in the greater benevolence of the motive for which they are maintained. Such museums discharge an important function in education, and particularly in scientific education, and to this day they express the popular idea of a perfect museum. They may sometimes partake of the elements that characterize the third class, or the museum for research, and, in so far as they do, their sphere is raised nearer the true ideal. In general, however, they are far removed from the true museum, and from the germinal idea which was planted in the Grecian mind. You will note that the motive of the patron in both these cases is one of self-improvement or gratification. He has no object ulterior to that of being himself benefitted. There is, moreover, in the museum itself, no other purpose expressed, nor any possibility of any other purpose being accomplished by the visitor.

These appendages to the science departments of our colleges are considered desirable and even necessary. In the curriculum, however, for making scholars, and for rendering students capable in their turn of teaching other students, or in making well-informed, self-reliant scientists, they serve but as subordinate agencies. They do not answer to the ends of scientific instruction in that degree that is demanded by the scientific advancement of our day, nor in that degree with which the ways and means of classical instruction at this day answer to the classical learning of our day. The classical student, even when he begins the classics, is brought into immediate and personal contact with the thing which he studies. The problems presented to him,

[1] A lecture delivered before the Academy of Sciences of St. Paul, Minn., by Professor N. H. Winchell, State geologist.

require him to investigate the principles of the language for himself to the best of his ability, and the preceptor comes to his aid only when his translation is so faulty as to require correction. He is constantly at his wits' ends to discover the ideas hidden in the text before him. In those institutions, however, which are endowed with these exhibition museums, the scientific instruction is not usually a requirement to study the subjects by original investigation, but a requirement to read, listen, absorb, recite. It is an instruction on a parallel with early childhood. It is an inpouring process of imparting information. It is not by any means on a par with that instruction which everywhere is given the classical student. One imparts enlightenment, and the other mental strength and culture. There is justice in the claim set up for the study of the classics in such cases, viz., that they furnish a better mental training and culture. How much of this claim, which is common only among those who have never had a scientific training in the scientific method, is due to the prevalence of this kind of scientific teaching in our colleges, would be an interesting and fruitful inquiry, if thoroughly investigated.

Suppose, on the other hand, that scientific instruction were as thoroughly organized in all the colleges of the country as is that of Greek and Latin. Suppose on the analytic, or on the inductive method, all scientific truth were imparted to the student. This would, of course, be impossible in the ordinary undergraduate course without disturbing the present *status*, in which only mathematics and the classics are thus taught. Suppose the student were shown a list of scientific problems which he must solve, with only the guidance of his native resources, and a few hints from his instructor as to the principles involved. Then let another series be presented, which, while involving those already answered, should demand still further and wider investigation. Suppose a whole term be spent in that way; nay, let us suppose a whole year, yes, three or four years, and, in order to make a parallel case, let us require that before presenting himself for admission to the freshman class the student shall have spent a year or two in similar independent investigation within the preparatory school. Then let it be further supposed that this method of scientific instruction were well established, with competent instructors in all the colleges of the country, with a public sentiment sufficiently informed to sustain it, and that it had courses of study well organized and differentiated, leading to honorable degrees at graduation, and public emoluments inviting to its pursuit, — then, and only then, could the disciplinary value of scientific education be compared fairly with that of the classics.

You may see at once that an exhibition-museum, as an attachment to an institution dominated by the old ideas of education, is only expressive of the kind of scientific education which such an institution desires to impart. It is only the sign of the enslavement of the scientific idea, in all its educational machinery, by the classical. To my mind, the establishment of such a museum would not be the best way to introduce scientific instruction into any college, however successful it might be in touching the popular appreciation or in opening the popular purse. The best scientific instruction is based on other foundations, and pursues other methods, and reaches other ends.

The true museum is that which approaches nearest to the cardinal idea of the Grecian museum. Its aim is not to amuse, nor to instruct, but to afford that inspiration which shall enable the visitor to instruct others. The reverent devotee approaches such a museum with no selfish motive. He invokes his muse to inspire in him sentiments that shall benefit his fellow-men. When I say that there are but few such museums in our day, you will not question the statement. You will rather inquire whether there are any such in existence. Such a museum is based on a broader idea than the exhibition-museum, although its frequenters may be fewer. Scientific research, long-continued study, profound contemplation, and conference with the writings of others — these are the purposes of such a museum. In but few places is this carried out, but it is the fundamental and growing idea underlying some modern museums. The full fruition of this idea will be the culminating result of the germ which was planted in the early Grecian soil. Transferred to modern times, ripening in the sunlight of a new civilization, with its roots nourished by more genial influences, the germ of the Grecian museum produces in our day, or is beginning to produce, a fruit somewhat different, although generically it is identical with that which it bore under Athenian culture.

Modern society is beginning to awaken to the debt that it owes to modern science. Modern science is the savior and promoter of modern institutions, the generator and sustainer of modern civilization. I speak not of the influence of the Christian church in modern times, because the Christian church cannot be accredited with the revival of modern science, nor with the inauguration of modern civilization. The Christian church existed through the darkest epochs of the middle ages, and gave no aid to science. Modern science, which, in its ramifications into social affairs, is the distinguishing badge of modern civilization, rose in spite of the church, and against its active opposition. This is not the fault of Christianity but the fault of those who were responsible for misrepresenting Christianity. The germinal motive of the Grecian museum — the search after truth and the desire to be inspired by it — was also the germinal idea of Christianity. Its fruition is the effort to serve and to save others. Many generations passed during which the germ slumbered, or was smothered under the tares of human ambition and sophistry. At length it pierced through the adversities by which it was surrounded, and began to manifest itself by its good works, and by the good which it reflected upon its enemies. The church was the nominal custodian of the germ, and ought to have welcomed and enjoyed its first fruits; but it did not. The sturdy growth which it now presents to modern society has reacted upon the church, and the church begins to recognize what a nearly fatal mistake she made in trying to smother the young plant. She now perceives that the plant is very similar to her own, and that the fruits of the two are nearly identical. Whereas she had discarded it, at its first appearance, as a vicious and foreign weed, she now is willing that it shall be transplanted into her own field and shall be nurtured by the same hands.

It is only with this recent awakening of modern society to the usefulness and beneficence of modern science that the true idea of a true museum has become again apparent. This idea finds illustration in a few museums in all the great nations of Europe and America. The highest enlightenment is compatible with the highest efficiency of these organizations, for they are the great dynamos that keep the machinery of modern advancement continually moving. This, however, has been the result of a growth whose former stages were insignificant, and perhaps but faintly foreshadowed the form that the completed museum should take on. This growth had a natural philosophical as well as chronologic order. We might appeal to history to show this. From the lowest form of a museum meant for amusement simply, consisting of a collection of rare and grotesque objects, rose that which embraced the idea and purpose of education. With instruction, still variously larded with amusement, gradually came necessarily the last term of the series, viz., an eagerness for research. This last term, first put into ideal form by Lord Bacon in his "New Atlantis," near the end of the seventeenth century, in which he works the idea of a great national museum into his romance, was definitely recognized and enacted by parliament, in the establishment of the British Museum in 1753. The Louvre at Paris, containing the great national museum, was converted from a royal residence and playhouse when in 1789 it came into the possession of a republican government.

But I need scarcely mention, to this audience, those museums which exemplify the idea which I am trying to inculcate. If you call to mind those bee-hives of industry where are stored the choicest collections of years, or of centuries, representing all departments of knowledge, whether of natural science, or of history and antiquity, or of literature, or of art, in which the nations of the earth take the greatest pride, you see, perhaps, in Britain, the great British Museum, with its numerous departments and its libraries, or the United States National Museum at Washington, or some of the great continental museums. These great collections subserve the ends both of instruction and of research, but chiefly their purpose is to aid the student in research, although this was not the prime object in their establishment. As already

stated, however, when the second phase of museum-growth has been attained, viz., the idea of instruction, the last term of the series necessarily follows, and the museum takes on the last phase of its development — it becomes a place for research. It is by no means necessary that this last stage should exclude the functions of education and enlightenment. It is better that they co-exist. They aid each other. The instructed visitor may become an investigator, and the greater the number of enlightened visitors leaving its rooms, the greater the number of truth-seekers will be who frequent its laboratories and libraries.

As a museum takes on this highest function, however, it retires more and more from public gaze. Its cases and its drawers may be well filled with well-arranged and labelled specimens, and the casual visitor may imagine he has sufficiently seen the museum when he has passed through its public halls. But he has not seen the working of the museum in its highest departments. In the numerous laboratories are more specimens than those that are on exhibition. These are for the eye only of the true seeker after truth. The student-patron enters all the recesses, and has access to all the specimens. He alone invokes the muse in the spirit of the early Greek poet. Unobtrusively he solves his great problems. Unselfishly he proclaims the new truths to the world. His service is as sincere, and as necessary to the development of modern civilization, and to the apprehension of the laws of nature, whether they be the laws of gravitation or of brotherly kindness, as that of any truth-seeker or man-lover. The laboratories and recesses of these great museums, which are unseen by the public, are crowded with such devout truth-seekers.

We come now to consider in what manner this review can be made to apply to the people of Minnesota, and especially to the city of St. Paul.

On another occasion (Bulletin Minn. Acad. Sci., Vol. I., p. 389) I have attempted to set forth the superior advantages and inducements which Minnesota possesses for the cultivation of modern science. They need not be repeated here. I will simply refer to them. The lapse of eleven years since that time has served to confirm my statements, and to emphasize the reasons enumerated then for maintaining in the State a prosperous and active academy of science. I am still convinced that there will arise, either in St. Paul or in Minneapolis, an efficient scientific organization; and that its work, when duly established, will be of great benefit to the State along the line which is above indicated. It makes but little difference whether it be in St. Paul or in Minneapolis, nor under what auspices, or whether in both cities by a union of effort; its effect will be upon the whole State, and upon the North-west, and it will be the quickening and guiding power for the advancement of all practical and theoretical science, drawing about itself the enterprising and educated artisans of all classes, as well as the patient and studious investigators.

Such an institution would be a museum in the highest sense. I will try to sketch some of the prime essentials of such an institution, after the money is available for its establishment and support. It will not be necessary, were it possible, to state what amount of money should be placed at the back of such an institution, but I will permit you to estimate that as I proceed, and also to devise possible ways and means for raising it. To found anything, money must be had. Presuming, however, that the means for such a museum were at hand, I will simply outline a plan, and the equipment which should characterize it. We will assume that the institution will include within its scope only the natural sciences, so-called, although all sciences are natural.

The ideal museum should have, first, suitable permanent quarters for its local habitation. These quarters should be adapted to the uses to which they are to be put, and should be planned and erected with constant reference to economy of labor and time for the workmen who are to occupy it. This is so obviously necessary that it seems, at first, that it need not be stated. Yet its neglect is a common mistake. How often are the planning and construction of such a building put into the hands of some professional architect, with instructions simply to erect a building of good architectural proportions and fine appearance. In the main such a building should contain rooms for laboratories, for storage, for exhibition, classification, and, perhaps, for lectures.

Second, the ideal museum should have materials, in the form of multifarious collections, and the ways and means for increasing them, and of exchanging them with other museums. While some of these will be put on exhibition, at least those which have been sufficiently examined and classified, the larger portion will be kept in storage for the use of its collaborators.

Third, such a museum will be well supplied with apparatus and libraries, and the apparatus will consist of the best makes and of the latest improvements. I wish to emphasize the libraries. There is nothing that the scientific student so much needs and which he is most frequently without, as a library of those works which pertain to his science. He wishes to know what others have discovered, or what they have failed to discover, what methods others have followed, and what paths are still untrod. It is one of the difficulties of most scientific institutions, especially of new ones, to procure means for the scientific literature pertaining to the sciences which they are supposed to cultivate.

Fourth, for the efficient working of such a museum, there must be a corps of scientific collaborators, sufficiently paid to relieve them from anxiety for their comfortable subsistence, and that of their families.

Fifth, means for publication, either by lectures or by printing. It would be better that both these methods of publication be pursued. The former disseminates information quickly and cheaply. The latter is more formal, and more permanent, furnishing means for recording facts and principles with carefulness and thoroughness, and with a view to future reference.

Sixth, such a museum should have its administration unified and harmonized by being under the responsible charge of one man. There should be a plan for its work, outlined by the proper authority, and that plan, with the rules which it should involve for the government of all the collaborators, should be enforced with persistence and fidelity.

Are we ready for such a museum in the State of Minnesota, or for such an institution under any other name? Are the citizens of St. Paul ready to undertake such an enterprise? Have we the elements which enter into such an organization at our command, or any part of them? Have we the live nucleus round which such an institution can be built up? Have we the men who will devote themselves to its establishment and support?

I have seen something which Ex-Governor McGill has said recently on this subject, and it is so apropos that I will repeat it here: "There should be somewhere in Minnesota a great polytechnic school which would impart instruction in mineralogy, mechanics, and the various arts and sciences usually taught in such institutions. This should be established on a large, comprehensive scale, making it a university in its scope. Such an institution would attract the attention of all the country, be a lasting benefit to the city of its home, and meet a pressing public demand for industrial and technical education. St. Paul is the place for such a school, provided always she has the intelligent enterprise to establish it." These are the words of one of our ex-governors, whose means for knowing the needs and the facilities for higher scientific education in the State may be supposed to be the best.

There are numerous museums, and schools of technology, and so-called mining schools in the United States, which in a measure subserve the purposes which I have set forth for an ideal museum. The American Museum of Natural History in New York, the Museum of Comparative Zoology at Cambridge, the New York State Museum at Albany, the Philadelphia Academy of Sciences at Philadelphia, the School of Technology at Boston, supplemented by the museums and libraries that are adjacent, these are based essentially on the central idea of a true museum, such as we ought to have in Minnesota. Similar plans underlie the scientific work at several of the larger universities, but in these institutions the fogs of mediæval prejudice are apt to dwarf the growth of scientific work, and to overburden the few and struggling preceptors with the elementary instruction which ought to be required of the student before he enters the freshman class.

If we take an inventory of the elements which we have toward such an institution in St. Paul, we shall find the following: First of all, the St. Paul Academy of Sciences, which is apparently willing to serve the public in the cause of scientific enlightenment.

This may be considered the germ, which, by its growth, may quicken with its spirit all the other elements. Second, the Minnesota Historical Society, whose plan of organization, however far it has lapsed from it, is so broad that it embraces the objects which we seek, and which would be a powerful factor in any re organization for scientific work in St. Paul. Its library, its collections, and its good will would go far toward causing the State legislatures to vote enlarged funds for its sustenance, should the ideal museum be made to include this society. Third, the Public Library of St. Paul should be mentioned as one of the elements at hand which should be brought within the pale of this ideal museum. There may be other libraries and organizations of which I am not cognizant, whose usefulness and whose expressed aims would be better subserved by a combination with others.

Add to these elements an enlightened and wealthy community, largely in sympathy with the advanced science of the day, and, I think, we have mentioned every thing on which we can depend. There are, however, other nearly allied institutions which might be willing to co-operate, and, on the plan of "university extension," join in whole or in part in a general movement. I refer to Macalester College and Hamline University. Should all these elements express a willingness to join in the creation of a great central scientific institution, for which I would retain the name of "Museum," they should all be housed in one building or series of buildings, and should be brought under one administration. Their efforts would then be brought into sympathetic and harmonious activity, and instead of smothered jealousy, one of the other, each one would have its function so defined that they would help rather than hinder each other, and the result would be a conservation of energy and money, which now are sometimes lost by being duplicated from different sources, or by being ill-advised and ill-directed.

I have sketched out what appears to me to be the museum of the future in Minnesota. I have indicated what should be its plan and its purpose. I have shown the necessity existing for such a scientific centre in this State, and I have lastly enumerated the elements that might be united in such an institution in St. Paul. The immediate steps that should be taken to bring about such an end, it will be necessary for you to decide upon should it be attempted. For nineteen years I have had the hope that such a museum might arise in Minnesota, and that in my day I might be in a measure instrumental in bringing it about. I would like to inspire some of the wealthy friends of science who reside in St. Paul with the faith which started some of the great museums of the world, or with the consecration which actuated Agassiz, or Smithson, or Rensselaer, or Franklin, in founding the institutions which bear their names.

NOTES AND NEWS.

THE effect of adding aluminum to steel ingots was discussed at considerable length at the recent meeting of the American Institute of Mining Engineers, communications on the subject by Professor J. W. Langley of Pittsburgh and Professor J. O. Arnold of Sheffield being among the papers read. Professor Langley drew attention to the very small quantity of aluminum required to render steel castings perfectly sound. The aluminum, says *Engineering*, is added in small pieces of from a quarter to a half pound in weight, thrown into the ladle during the tapping after a small quantity of steel is already in it. The aluminum melts almost instantaneously, and diffuses with great rapidity throughout the contents of the ladle. For open-hearth steel, containing less than .05 per cent of carbon, five to ten ounces of aluminum are sufficient for each ton of steel, while for Bessemer steel the amount should be increased to from seven to sixteen ounces per ton. For steel containing more than .5 per cent of carbon the aluminum should be used cautiously in amounts of from four to eight ounces per ton. Professor Arnold described briefly the results of a number of experiments at the Sheffield Technical School, from which he concludes that the action of aluminum is about twenty times as powerful as that of silicon, and the resulting steel is tougher and sounder than when silicon is used, provided that certain precautions against piping are taken. He considers that the action of the aluminum is almost certainly chemical. The blowholes in ingots are due to occluded gases, and it has been proved by experiment that aluminum readily reduces carbonic oxide at a temperature below that of melting steel. In one experiment Professor Arnold blew forty gallons of pure carbonic oxide through a crucible of molten steel containing aluminum, with the result that the carbon in the steel was increased by thirty-five per cent, owing to the reduction of the gas. He concludes that by using aluminum, manganese can be dispensed with, and a considerable saving of time and fuel effected.

— A new antiseptic, said to have certain advantages over those hitherto in use, has been brought before the French Academy of Medicine by Professor Berlioz of Grenoble. Extreme solubility, harmlessness, efficacy, and rapidity of action are claimed for it. It is called "microcidine," and, as described by *Nature*, is a compound of naphthol and soda, is neither poisonous nor irritant, is twenty times as active as boric acid, and much more soluble than thymol, carbolic acid, etc. Microcidine has the form of a grayish white powder. In a solution of three grams per litre it is very slightly colored, but it does not stain either the hands or bandages. For family use it is said to be of great service.

— An apparatus has been recently constructed by M. Ducretet, says *Nature*, for getting quickly in the laboratory a fall of temperature 70° to 80° C. below zero, by means of the expansion of liquid carbonic acid. The inner of two concentric vessels contains, in alcohol, a serpentine metal tube communicating, through a tube with two stopcocks, with the carbonic acid reservoir outside, and opening below into the annular space round the inner vessel, in which are some pieces of sponge impregnated with alcohol. This two-walled vessel with coil is inclosed in a box. One stopcock being opened wide, the other slightly, the carbonic acid passes through the coil as snow, and turns to gas, with strong cooling effect, and any of it not vaporized in the coil is dissolved in the alcohol of the sponge. The gas escapes through a tube passing through the outer box. The instrument, called a *cryogen*, is pictured in *Cosmos* of June 27.

— Experiments have lately been made by Herr Regel (*Bot. Centralb.*) with reference to the influence of external factors on the smell of plants. In the front rank, as stated in *Nature*, appears the direct and indirect influence of light on the formation of etheric oils and their evaporation. In the case of strongly fragrant flowers (as *Reseda*), heat and light intensify the fragrance, which in darkness is lessened without quite disappearing. When the whole plant was darkened, those buds only which were before pretty well developed yielded fragrant flowers; the others were scentless. If, however, only the flowers were darkened, all were fragrant. Other plants open their flowers and smell only by night (as *Nicotiana longiflora* and *Nycterinia copensis*). When these plants were kept continuously in the dark, they, in course of time, lost their scent, as they lost their starch. On being brought into light again, both starch and fragrance returned. Besides light, respiration has a decided influence on the fragrance. Nycterinia, inclosed in a bell jar with oxygen, behaved normally, but with hydrogen the flowers did not open, and had no fragrance. In general, the opening of flowers coincides with their fragrance, but there is no necessary connection between these phenomena.

— Dr. Anderson, in a recent paper on steel read before the Iron Institute, London, explains the peculiar action of the solid iron when thrown into molten metal. When thrown into a pot of molten iron or steel the solid metal at first sinks, which shows that its volume per unit of weight is less than the heated metal. But soon the solid piece becomes heated, which causes it to expand, its volume is increased, and it rises and floats on the surface of the molten mass. The action is the same with both iron and steel. The experiment was frequently made by throwing a piece of iron into melted steel. It could be seen to go down, and one might think it was on account of the impetus which the iron had attained in falling that height, but as a matter of fact if the iron were put upon a fork and lowered, it would go down. In the course of a few seconds it came up again, and kept on expanding until the piece of iron was a considerable distance above the surface of the metal. Then it decreased in volume, and of course