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THE RELATIONS OF MEN OF SCIENCE TO THE GENERAL PUBLIC.[1]

BY T. C. MENDENHALL.

Just fifty years have passed away since a small body of enthusiastic students of Geology and Natural History organized themselves into an Association which was, for the first time in the history of this country, not local in its membership or its purpose. As the "Association of American Geologists and Naturalists," it was intended to include any and all persons, from any and all parts of the country, who were actively engaged in the promotion of Natural History studies, and who were willing to re-inforce and strengthen each other by this union. So gratifying was the success of this undertaking, that after a few years of increasing prosperity under its first name, the Association wisely determined to widen the fields of its operations, by resolving itself into the American Association for tne Advancement of Science, thus assuming to be in title what it had really been in fact, from the beginning of its existence. One of the articles of its first constitution, adopted at its first meeting, provided that it should be the duty of its president to present an address at a General Session following that

[1] Address by the retiring President of the American Association for the Advancement of Science. Indianapolis, August, 1890.

over which he presided. The performance of this duty cannot, therefore, be easily avoided by one who has been honored by his fellow members, in being called upon to preside over the deliberations of this Association; nor can it be lightly disposed of, when one realizes the importance of the occasion, and recalls the long list of his distinguished predecessors, each of whom in his turn has brought to this hour at least a small measure of the work of a lifetime devoted to the interests of science.

The occasion is one that offers an opportunity and imposes an obligation. The opportunity is in many ways unique and the obligation is correspondingly great. In the delivery of this address, the retiring president usually finds himself in the presence of a goodly number of intelligent people, representatives of the general public, who, knowing something of the results of scientific investigation, have little idea of its methods, and whose interest in our proceedings, while entirely cordial and friendly, is often born of curiosity rather than a full appreciation of their value and importance. Mingled with them are the Members and Fellows of the Association, who have come to the annual gathering laden with the products of many fields, which they have industriously cultivated during the year; each ready to submit his contribution to the inspection and criticism of his comrades, and all hoping to add in some degree to the sum total of human knowledge.

The united presence of these two classes, intensifies the interest which naturally attaches to an occasion like this, and not unnaturally suggests, that a brief consideration of the relations which do exist and which should exist between them, may afford a profitable occupation for us this evening.

In the beginning it may be truthfully affirmed, that no other single agency has done as much to establish these relations on a proper basis, as the American Association for the Advancement of Science. In the first article of its constitution the objects of the Association are defined as follows: —"by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of the United States, to give a stronger and more generous impulse and a more systematic direction to scientific research in our country, and to procure for the labors of scientific men, increased facilities and a wider usefulness." So perfectly do these words embody the spirit of the Association, that when more than thirty years later the constitution was thoroughly revised, none better could be found to give it expression. That it has been successful in promoting intercourse between those who are cultivating science in different parts of the United States, may be proved by the testimony of thousands who have come to know each other through attendance at its meetings. In a country whose geographical limits are so extensive as ours, and whose scientific men are so widely scattered, it is difficult to overestimate its value in this particular.

In giving a stronger and more general impulse and a more systematic direction to scientific research in our country, it has been singularly fortunate. Its meetings have been the means of disseminating proper methods of investigation and study throughout the land; hundreds of young students, enthusiastic but often not well trained, have found themselves welcome (sometimes to their own astonishment), and by its influence and encouragement, have been moulded and guided in the utilization of their endowments, occasionally exceptional, to the end that they have finally won a fame and renown which must always be treasured by the Association as among its richest possessions. Wherever its migratory meetings have been held, the pulse of intelligence has been quickened, institutions have been encouraged and strengthened, or created where they did not before exist, and men of science have been brought into closer relations with an intelligent people.

But it is in relation to the last of the three great objects, to accomplish which the Association was organized, namely, "to procure for the labors of scientific men, increased facilities and a wider usefulness" that it has been, on the whole, less successful. It is true that when we look at the history of science in America during the past fifty years; when we see at every point evidences of public appreciation, or at least appropriation of scientific discovery; and most of all, when we observe the enlargement of older institutions of learning to make room for instruction in science, and the generous donations to found new technical and scientific schools, together with an occasional endowment of research, pure and simple; in view of all these, I say, we are almost constrained to believe that scientific men have only to ask, that their facilities may be increased, and that their labors could hardly have a wider usefulness.

Unfortunately, this pleasing picture is not a true reflection of the actual condition of things. The attentive observer cannot fail to discover that the relation between men of science and the general public, is not what it should be in the best interests of either or both. In assemblages of the former, it is common to hear complaints of a lack of appreciation, and proper support on the part of the latter, from whom, in turn, occasionally comes an expression of indifference, now and then tinctured with contempt for men who devote their lives and energies to study and research, the results of which cannot always be readily converted into real estate or other forms of taxable property. It cannot be denied that the man of science is at some disadvantage as compared with his neighbor, the successful lawyer or physician, when it comes to that distribution of confidence with responsibility which usually exists in any well ordered community, although the latter may possess but a fraction of the intellectual power and sound judgment which he can command. To his credit it may be said that he is usually considered to be a harmless creature, and to render him assistance and encouragement is generally regarded as a virtue. The fact of his knowing much about things which do not greatly concern the general public, is accepted as proof that he knows little of matters which seriously affect the public welfare.

It is true, that when the public is driven to extremities it sometimes voluntarily calls upon the man of science, and in this emergency it is often unpleasantly confronted with the fact that it does not know where to find him. The scientific *dilettante*, or worse, the charlatan, is often much nearer the public than the genuine man of science, and the inability to discriminate, sometimes results in disaster in which both science and the public suffer.

In venturing to suggest some possible remedies for this condition of things, it will be logical, if not important, to roughly define the two classes under consideration, the scientific and the non-scientific. One is the great majority, the general public, including in the United States over sixty millions of people in all conditions, cultured and uncultured, educated and uneducated, but in average intelligence, we are proud to say, superior to the people of any nation in the world. Out of these it is not easy to sift by definition, the small minority properly known as men of science. Only a rough approximation may be reached by an examination of the membership of scientific societies.

The American Association for the Advancement of Science, includes in its membership about two thousand persons. It is well known, however, that many of these are not actually engaged in scientific pursuits, either professionally or otherwise; indeed it is one of the important functions of the society to gather into its fold as many of this class as possible. The fellowship of the association is limited however, by its constitution, to such members as are professionally engaged in science, or have by their labors aided in advancing science. They number about seven hundred, but in this case it is equally well known that the list falls far short of including all Americans, who by their labors in science, are justly entitled to a place in any roll of scientific men. On the whole, it would not, perhaps, be a gross exaggeration to say, that not more than one in fifty thousand of our population could be properly placed upon the list, even with a liberal interpretation of terms.

In this estimate it is not intended, of course, to include that large class of active workers whose energies are devoted to the advancement of applied science. Although their methods are often the result of scientific training, and while the solution of their problems requires much knowledge of science, the real advancement of science at their hands is rather incidental than otherwise. In certain particulars they may be likened to the class known as "middle men" in commercial transactions, the connecting link between producer and consumer. It is in no way to their discredit that they usually excel both of these, in vigilance and circumspection and in their quick perception of utility. By them the discoveries of science are prepared for and placed upon the market, and it is difficult to overestimate their usefulness in this capacity. It is true that the lion's share of the profit in the transaction is generally theirs, and that they are often negligent in the matter of giving the philosopher the credit to which he is entitled, but for the latter, at least, it is believed that the philosopher is himself often responsible.

If this statement of the relative numbers of the scientific and the non-scientific is reasonably correct, the scientific man may at least congratulate himself on wielding an influence in affairs vastly greater than the census, alone, would justify, and this fact encourages the belief that if there is anything "out of joint" in his relations with the general public, the remedy is in his own hands. Let our first inquiry be, then, in what particulars does he fail in the full discharge of his duties as a man of science, and especially as an exponent of science among his fellows?

Without attempting to arrange the answers which suggest themselves in logical order, or, indeed, to select those of the first importance, I submit, to begin with, his inability or unwillingness, common but by no means universal, to present the results of his labors in a form intelligible to intelligent people. When inability, it is a misfortune, often the outgrowth, however, of negligence or indifference; when unwillingness, it becomes at least an offence, and not one indicative of the true scientific spirit. Unfortunately, we are not yet entirely out of the shadow of the middle ages, when learning was a mystery to all except a select few, or of the centuries a little later, when a scientific treatise must be entombed in a dead language, or a scientific discovery embalmed in a cipher.

Many scientific men of excellent reputation, are to-day guilty of the crime of unnecessary and often premeditated and deliberately planned mystification; in fact almost by common consent, this fault is overlooked in men of distinguished ability, if, indeed, it does not add a lustre to the brilliancy of their attainments. It is usually regarded as a high compliment to say of A that when he read his paper in the mathematical section, no one present was able to understand what it was about; or of B and his book that there are only three men in the world who can read it. We greatly, though silently, admire A and B, while C the unknown, who has not yet won a reputation and who ventures to discuss something we do understand, (after his clear and logical presentation of the subject) must go content with the patronizing admonition that there is really nothing new about this, and that if he will consult the pages of a certain journal of a few years ago, he will find the same idea, not developed, it is true, but hinted at and put aside for future consideration, or, that he will find that Newton or Darwin declared what is essentially the same principle, many years before. No one can deny that there is great reason and good judgment displayed in all this, but the ordinary layman is likely to inquire whether it is distributed and apportioned with nice discrimination; and it is the standpoint o' the layman which we are occupying at the present moment.

All will admit that there are many men whose power in original thinking and profound research is far greater than their facility of expression, just as on the other hand, there are many more men whose linguistic fluency is unembarrassed by intellectual activity, and representatives of both classes may be found among those usually counted as men of science. It is with the first only, that we are concerned at the present moment, and it is sufficient to remark, that their fault is relatively unimportant and easily overlooked. Among them is often found that highly prized but imperfectly defined individual known as the "genius," for whose existence we are always thankful, even though his interpretation is difficult and laborious.

Concerning those who, although able, are unwilling to take the trouble to write for their readers or speak for their hearers, a somewhat more extended comment may be desirable. It is always difficult to make a just analysis of motives, but there can be little doubt, that some of these are influenced by a desire to imitate the rare genius, whose intellectual advances are so rapid and so powerful, as to forbid all efforts to secure a clear and simple presentation of results. The king is lame and the courtier must limp. With others there is a strange and unwholesome prejudice against making science intelligible for fear that science may become popular. It is forgotten, that clear and accurate thinking is generally accompanied by the power of clear, concise and accurate expression, and that as a matter of fact the two are *almost* inseparable. The apparent success before the people of the *dilettante* and the charlatan, has resulted, in the case of many good and able men, in a positive aversion to popular approval. It should never be forgotten that the judgment and taste of the public in matters relating to science, are just as susceptible of cultivation as in music and the fine arts, and that scientific men owe it to themselves to see that opportunity for this culture is not withheld. A just appreciation by the people of real merit in art has resulted in the production of great painters, sculptors, musicians and composers, and there is every reason to believe that the best interests of science would be fostered by similar treatment. Even the great masters in science, then, can well afford to do what is in their power to popularize their work and that of their colleagues, so that through closer relations with a more appreciative public their opportunities may be enlarged and their numbers increased.

Another error into which the man of science is liable to fall, is that of assuming superior wisdom as regards subjects outside of his own specialty. It may seem a little hard to accuse him of this, but nevertheless, it is a mistake into which he is easily and often unconsciously led. That this is the day of specialization and specialists, every student of science learns at the very threshold of his career; but that one man can be expected to be good authority on not more than one or two subjects, is not generally understood by the public. It thus frequently happens that the man of science is consulted on all matters of a scientific nature, and he is induced to give opinions on subjects only remotely, if at all, related to that branch of science in which he is justly recognized as an authority. Although going well for a time, these opinions often prove to be erroneous in the end, resulting in a diminution of that confidence which the public is, on the whole, inclined to place in the dictum of science.

Examples of this condition of things are by no means wanting, and they are not confined, as might at first be assumed, to the lower ranks of science. A distinguished botanist is consulted, and advises concerning the location of the natural gas field; a mathematician advises a company in which he is a stockholder in regard to the best locality for boring for oil, and a celebrated biologist examines and makes public report upon a much-talked-of invention in which the principles of physics and engineering are alone involved.

In these and many other instances which might be related, the motives of those concerned, at least on one side of the transaction, cannot be questioned, but certainly their judgment is open to criticism, and the outcome of it all, is that the confidence of the people in scientific methods and results is weakened. Fifty years ago, or a hundred years ago, there was good reason for much of this sort of thing. Specialization was neither as possible nor as necessary as now; the sparseness of the population of the country, the absence of centres of learning and scientific research, the obstacles in the way of easy and rapid communication between different parts of the country, all these and other circumstances contributed to the possibility of a Franklin, who wrote and wrote well upon nearly all subjects of human thought; whose advice was sought and given in matters relating to all departments of science, literature and art. Combining in an extraordinary degree the power of profound research with a singularly simple and clear style in composition, together with a modesty which is nearly always characteristic of the genuine student of nature, he wisely ventured further than most men would dare to-day, in the range of topics concerning which he spoke with authority.

But at the present time and under existing conditions there is little excuse for unsupported assumption of knowledge by men of science, and, fortunately, the danger of humiliating exposure is correspondingly great. The specialist is everywhere within easy reach, and the expression of opinions concerning things of which one knows but little, is equally prejudicial to the interests of science and society.

The scientific man should also be at least reasonably free from egotism in matters relating to his own specialty, and particularly in reference to his own authority and attainments therein. In controversy he has the advantage over most disputants in that he can usually call to his support an unerring and incontrovertible witness. A well conducted experiment or an exhaustive investigation, carried out with scrupulous honesty, deservedly carries great weight, but it must not be forgotten that it does not, in a very great degree, depend upon the personality of him who directs the experiment or plans the investigation. One must not confound himself and his work, to the extent of assuming that upon him ought to be bestowed the praise and admiration to which his work is, perhaps, justly entitled. This blunder is analogous to that of the mechanic in whom the first symptom of insanity appeared as a conviction that he was as strong as the engine which he had built, evidence of which he unpleasantly thrust upon any who might deny the truth of his assertion. "By your works shall ye be judged" may be especially affirmed of men of science, not only as regards the judgment of the public, but particularly that of their colleagues and fellow-workers. Least of all should title, degree, membership in learned societies or the possession of medals or other awards of distinction and honor, be paraded unduly, or offered by himself, in evidence of his own fitness. In general these are honorable rewards which are justly prized by scientific men, but some of them have been so indiscriminately bestowed and, in some instances, falsely assumed that the general public, not yet properly educated in this direction, does not attach great value to them as an index of real scientific merit. Where real merit actually exists, nothing is usually gained, and much is likely to be lost by boastful announcements of high standing or of accumulated honor. A distinguished man of science at the end of a controversy into which he had been called as such, complained that he had not been recognized as a Fellow of the Royal Society. "You gave us no reason to suspect your membership," quietly, but severely, replied a man of the world.

As another element of weakness in the scientific man I venture to suggest that he is often less of a utilitarian than he should be. This is a sin, if it be such, which seems especially attached to those who, unconsciously or otherwise, are imitators of men of science of the highest type. The latter are so entirely absorbed in profound investigation and their horizon is necessarily so limited by the very nature of the operations in which they are engaged, that they are altogether unlikely to consider questions of utility nor, indeed, is it desirable that they should. The evolution of processes and methods by means of which the complex existence of the present day is maintained, is largely the result of specialization or the division of labor. In such a scheme there is room for those who never demand more of a fact than that it be a fact; of truth that it be truth. But even among scientific men the number of such is small and as a class they can never be very closely in touch with the people.

Strong to imitate, even in those characteristics which are akin to weakness, many persons of lesser note affect a contempt for the useful and practical which does not tend to exalt the scientific man in the opinion of the public. Even the great leaders in science have been misrepresented in this matter. Because they wisely determined in many instances to leave to others the task of developing the practical applications of their discoveries, it has often been represented that they held such applications as unworthy a true man of science. As illustrating the injustice of such an opinion one may cite the case of the most brilliant philosopher of his time, Michael Faraday, who in the matter of his connection with the Trinity House alone, gave many of the best years of his life to the service of his fellow-men. The intensely "practical" nature of this service is shown by the fact that it included the ventilation of light-houses, the arrangement of their lightning conductors, reports upon various propositions regarding lights, the examination of their optical apparatus and testing samples of cotton, oils and paints. A precisely similar illustration is to be found in the life of our own great physicist, Joseph Henry, who sacrificed a career as a scientific man, already of exceptional brilliancy, yet promising a future of still greater splendor, for a life of unselfish usefulness to science and to his countrymen as Secretary of the Smithsonian Institution, as a member of the Light House Board, and in other capacities for which he was especially fitted by nature as well as by his scientific training.

There is an unfortunate, and perhaps a growing tendency among scientific men to despise the useful and the practical in science, and it finds expression in the by no means uncommon feeling of offended dignity when an innocent layman asks what is the use of some new discovery?

Referring to the theoretically extremely interesting spar prism of Bertrand, which under certain conditions may be used to detect traces of polarization of light, a recent writer remarks, "But for this application the prism would possess, in the eyes of the true votary of science, the inestimable value of being of no practical utility whatever."

Much is said, everywhere and at all times, about the pursuit of science for the sake of science, and on every hand it is sought to convey the impression that no one who has any other object in view in interrogating Nature than the mere pleasure of listening to her replies, is unworthy of a high place among men of science. So old, so universally accepted, so orthodox, is this proposition, that it is with much hesitation that its truth is questioned in this presence. In so far as it means that one cannot do anything well unless it is done *con amore*, that pecuniary reward alone will never develop genius, that no great philosopher, or poet, or artist will ever be other than unselfishly devoted to and in love with his work, just so far it is true, although it does not, as is often assumed, furnish a motive of the highest order. It is a trite saying, but perhaps it cannot be too often repeated, that he who lives and labors in the interest of his fellows, that their lives may be brightened, that their burdens may be lessened, is above all others worthy of the highest praise. By this standard, the value of a discovery must at last be fixed, bearing in mind, of course, that the physical comfort of man is not alone to be considered. Judged by this standard, the work of Newton, of Watt, of Franklin, Rumford, Faraday, Henry and a host of others, is truly great. There should be, and there usually is, no controversy as to relative merit between the discoverer of a gem and the artist who polishes and sets it. In science, the genius of the former is unquestionably rarer and of a higher order, but his work will always be incomplete and in a great degree useless until supplemented by that of the latter.

Another demand which the public may justly make upon the man of science is that his interest in public affairs should not be less than that of other men. Through his failure in this particular, science has long suffered, and is suffering in an increasing degree. This criticism is especially applicable in this country, where in theory every man is supposed to bear his share of the public burden, and to take his part in the performance of public duties. Unfortunately, the attitude of the scientific man is too often one of criticism and complaint concerning matters in the disposition of which he persistently declines to interfere, It cannot be denied, I think, that men well trained i.. the logic and methods of scientific research, ought to be exceptionally well equipped for the performance of certain public duties constantly arising out of local, state or national legislation; yet the impression is well-nigh universal, that the scientific man has no genius for "affairs." Indeed it has been more than once affirmed that he is utterly devoid of administrative or executive ability, and even that he cannot be trusted with the direction of operations which are almost wholly scientific in their nature. That there are many examples which seem to justify this belief is too true. but that there are other instances in which administrative and scientific ability have been combined is also true. Little search is required to reveal cases in which men of science have so ignored all ordinary rules and maxims of business procedure as to merit severe criticism, in which, unfortunately, the public does not discriminate between the individual and the class which he represents. It seems astonishing that one who is capable of successfully planning and executing an elaborate research, in which all contingencies are provided for, the unexpected anticipated and, all weak points guarded and protected may utterly break down in the management of some much less complicated business affair, such as the erection of a laboratory, or the planning of an expedition, and I am unwilling to believe that such failures are due to anything other than culpable negligence on the part of the individual.

It is generally recognized that, aside from all questions of a partisan, political nature. this country is to-day confronted by several problems of the utmost importance to its welfare. to the proper solution of which the highest intellectual powers of the nation should be given. The computation of the trajectory of a planet is a far easier task than forecasting the true policy of a great republic, but those qualities of the human intellect which have made the first possible, should not be allowed to remain idle while an intelligent public is striving to attain the last. That men of science have not, thus far, made their full contribution to the solution of some of these great problems, is due to the fact that many have exhibited an inexcusable apathy toward everything relating to the public welfare, while others have not approached the subject with that breadth of preparation in the close study of human affairs which is necessary to establish the authenticity of their equations of condition.

As already intimated, we do not seem to be getting on in this direction. Our own early history and the history of other nations is full of examples of eminent scientific men who were no less distinguished as publicists and statesmen. The name of Franklin is imperishable alike in the history of science and of politics. On many questions relating to exact science, the Adamses spoke with confidence; Thomas Jefferson was a philosopher, and on assuming the duties of the highest office in the gift of the people, counted his opportunities for association with men of science as one of its chiefest rewards. Other illustrations might be selected from the pages of the history of our own country, while in Europe, where science has long been cultivated and under more favorable conditions, they are much more common. This is notably so in France, whose roll of scientific men, who have distinguished themselves and their country during the past century, includes many names prominent alike for the importance of their performance in her various crises of peace and war. The present president of the French Republic, himself an engineer, bears a name made famous in the history of science by the rich contributions of his ancestors, one of whom voted for the execution of Louis XVI, and was a member of the committee of Public Safety. It would be difficult to overestimate the value to science as well as to the public, of the presence in the halls of legislation of even a very small number of men who might stand as exponents of the methods of science and as competent authorities on the results of their application. Our national congress, especially, is almost constantly dealing with questions of great moment to the people, which can only be thoroughly understood and wisely dealt with by scientific men, and the presence of one or two such in each branch of that body would be of decided advantage to the whole country. In the nature of things, opportunities for such representation will be rare, but when they occur they must not be suffered to escape.

Finally, if the conclusions reached in the foregoing should be thought wise, and should any young man at the threshold of his scientific career determine to be guided by them in establishing his relations with the general public, he will find splendid examples among the distinguished leaders of all departments of science. Should he desire to present the results of his labors in such a way that they may be understood by intelligent people, he may imitate Franklin, whose literary style, as to simplicity and clearness, commanded the highest praise from literary men; or Faraday, who was able to give expression to the most involved conceptions in simple English; or Tyndall, the appearance of whose "Heat considered as a Mode of Motion," was an epoch in the history of Physical Science, in its relation to an intelligent constituency, without which it cannot thrive. He will learn that there is no discredit in "popularizing" science; that popularizing what is not science is the thing that is to be shunned and prevented. The arrogance of genius is not less disagreeable than that of riches, although it is less common.

Should he wish to cultivate modesty in estimating his own attainments, he need only follow Newton, Darwin, and, in fact, the whole list of distinguished men of science down to the present time, with a few rare and unexplainable exceptions, the existence of which serves, like a whistling buoy, to point out what should be avoided.

Should he aspire to be of some use to the world and to leave it better because of his life, he will be encouraged by the fact, already considered, that in the long run those discoveries are most highly esteemed, and justly so, which are the most potent in their influence upon civilization and society by ameliorating the condition of the people, or by enlarging their opportunities, and that all really great men of science have not lost sight of this fact: that "science for the sake of science" does not represent the highest ideal, nor can the "almighty dollar" ever be bartered for the "Divine Afflatus."

All of these questions will serve to enlarge his interest in public affairs, because he will come to recognize that he is himself but a part of the public. He will remember the delight of Faraday, when near the end of his life he saw a huge dynamo illuminating the tower of a light-house. That which he had given to the world as an infant, in his splendid discovery of induction, had, through the fostering care of others, grown to a brilliant manhood, and he experienced exquisite pleasure in the reflection that it might be the means of saving the lives of his fellow-men. The ideal of duty which ought to be present in the mind of every man of science may well be higher than that growing out of mere selfish pleasure in the acquisition and possession of knowlenge.

Perhaps it is hardly becoming in me, at this time and in some sense representing this large body of scientific men, to make even a simple remark in criticism of the general public, the party of the second part of the question which we have considered to-night. I venture to suggest, however, that whenever the public is disposed to consider its obligations to science and her votaries, there are some things which must not be forgotten;—things so important and so numerous, indeed, that many volumes would be inadequate to their enumeration. Prove this by comparing the world *with* science with the world *without* science. Take as an illustration that which less than two hundred years ago was but a spark, a faint spark, exhibited on rare occasions by the scientific man of the time. With this spark, thanks to science, the whole world is now aflame. Time and space are practically annihilated; night is turned into day; social life is almost revolutionized, and scores of things which only a few years ago would have been pronounced impossible, are being accomplished daily. Many millions of dollars of capital, and many thousands of men, are engaged in the development of this agent, so purely a creation of science, that the Supreme Court of the land has already decided that it has no material existence. Surely science, which has brought us all these blessings, together with thousands besides, is worthy of every care and consideration at the hands of a generous and appreciative public.

THE BLOOD AND BLOOD-VESSELS IN HEALTH AND DISEASE.[1]

By WESLEY MILLS, M.A., M.D.

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Our knowledge of any subject may perhaps be regarded as a perception of relations. As these, however, are innumerable, the great question becomes, What relations are of the most importance? From what point of view shall we look at a subject? Necessarily, this must vary with the progress of all knowledge and with that of the department under consideration.

When the period of derision and skepticism that followed at once the announcement of the discovery of the circulation of the blood by Harvey had passed away, and a body of practitioners, less prejudiced than the great man's own contemporaries, considered the subject, a reaction took place. Undue attention was given the blood in all discussion on the ætiology of disease.

In comparatively recent times the investigations of blood-pressure and kindred problems by Ludwig and his school, diverted attention unduly to that subject, and the influence of this is evident in almost every text-book on physiology at present extant. Believing, myself, that physiology has been confined within extremely narrow limits, that it must in consequence suffer from the intellectual myopia of its cultivators, I have within the past year endeavoured to present to the student of this science a work[2] on a new plan; and it is my purpose this evening to ask your consideration to its advantages, which I shall endeavour to present in so far as they apply to the subject of this

[1] An address delivered before the Ottawa Medical Society, May 1890. Reprinted from the *New York Medical Journal* for September 13. 1890.

[2] *A Text-book of Animal Physiology.* D. Appleton & Co., New York, October, 1890.

address, and leave you to judge for yourselves whether this method of viewing the subject gives a wider and truer view of physiological truths than the older plan or not.

We all recognize the fact that any individual can be but indifferently understood apart from his antecedents; hence the importance we attach to biographical sketches of those persons that interest us. It is really an acknowledgment of the influence of the environment on the organism, both during its own life-time and that of its ancestors.

Why, then, is not the consideration of every function of the body preceded by an account of the development of the structures involved, as well as by ordinary anatomical or histological details?

No advanced morphologist hopes to clear up the relations of any animal group without taking its embryology into consideration. Up to the present, this method has been almost wholly ignored by physiologists. Allow me to suggest in this connection a few considerations which seem to put the student in the possession of a clew to otherwise very obscure relations.

All are agreed that the blood-cells, whatever their later history, arise in the embryonic mesoblast at the same time as the heart and blood-vessels themselves. To consider, therefore, the heart, blood-vessels, and blood wholly separately, or without a perception of their unity, is a mistake that has practical as well as theoretical consequences. When we bear this relation in mind, it is possible to understand that there may be cases in which the whole vascular system, including the contained blood, may be imperfectly developed, and with all the consequences of recurrent anæmia. There can be no doubt that any crop of blood-cells must bear relations to the preceding one, and if the original ancestors are defective, their descendants are likely to be similarly weak, apart from any unfavorable circumstances in the environment.

Until recently, the functions of the white corpuscles, if considered at all in works on physiology, were dismissed in a very few lines. When we remember that the leucocytes of the blood correspond to the original undifferentiated embryonic cells, which alone have made up the entire embryo, and are preserved as floating organisms with a latent capacity for further development, much light is thrown upon both physiological and pathological processes. Whatever the view that finally prevails as to their relations to invading micro-organisms, there can be no doubt that as scavengers, porters, or phagocytes their function is of great importance; yet, apart from a consideration of their origin, this can be but indifferently understood. It is well known that the undifferentiated cells of the embryo are more or less amœboid organisms; hence, it is perfectly natural that their descendants should, under suitable circumstances, exhibit those qualities which recent investigators are showing more and more that they possess. The great part they play in inflammation is also more readily comprehended. In this condition there is a profound alteration in the environment, as will be shown later.

At present our positive and clear knowledge of the red cells of the blood is confined to their oxygen-carrying function; but I feel satisfied that this does not include all their work and that we must look for a very considerable enlargement of our knowledge of the range of their duties. Indeed, it would seem that we are in great danger now of going to an extreme the opposite of that of our ancestors, and attributing too little to the blood, especially its cells. It is not to be forgotten that the blood as a whole is to be regarded as a tissue, and there is no more reason why this tissue should be devoid of functions than any other.

Most of our works on physiology so present the subject to the student that he has no clear ideas as to *how* the blood does minister to the tissues, though everyone is ready to say at once that the function of the blood is "to nourish the tissues." In truth, some very remarkable doctrines have been taught in regard to the relations of the blood and blood-vessels. As a rule, students have the most misty notions of the relations and importance of the lymph. They know that it flows in "the lymphatics," that it gets into the blood-stream finally, that it is in some way derived from the blood, etc. But there is no clear perception of these relations, and it is impossible that there should be with the teachings that are prevalent.

The books represent the lymph as passing through the capillaries; but, if any explanation of this process is given at all, it is represented as a filtration—very much of the character of that "filtration" of urine through the capillaries of the Malpighian capsules, which has been so commonly taught up to the present as dependent almost solely on blood pressure.

This doctrine has seemed to me so utterly at variance with all sound biological laws, that for three or four years I have been accustomed to teach in my lectures, and have recently published in my text-book, a theory which I must present to you with brevity, but which I am sure you will see places the physiologist, the pathologist, and the practitioner of medicine on an eminence from which they can view the events of the body in an entirely new light. It is simply this: *The capillaries of the body are glands.* They are glands not only in the glomeruli of the kidney, but everywhere else. So far as I know, I have been the first to teach this doctrine; I must therefore give you, at least in a general way, the reasons for my conviction.

In the first place, I should be prejudiced against any biological doctrine that would represent a living structure as acting as a mere filter, or as teaching that osmosis played any considerable part or, in the strict sense, any part at all when living structures, "membranes" or other, were concerned. There seem to be no facts that can not be better explained without such an assumption; and, even if this were not the case, it is better not to construct a theory at all, but simply confess ignorance and wait, than one which like this is radically opposed to all sound conceptions of living structure.

To believe that the lymph which bathes the various tissues is everywhere identical in composition, is to overlook the relations of the blood and blood-vessels to the tissues among which they have been developed. But the lesson Nature everywhere teaches is that things do work in relation to each other.

What a crude conception of life processes to suppose that the capillaries pour out a fluid around the cells of the tissues whose composition is not specially related to the needs or peculiarities of each one!

But the facts we do know are opposed to such a view.

All exudations or transudations are not alike in chemical composition; nor are passive exudations identical with inflammatory ones. Can osmosis explain this? Can it explain why an inflammatory exudation does not correspond with the normal tissue-lymph? Can it give a reason why there are coagulable proteids in lymph, or any of the fluids that are derived from the blood at all? While the facts cannot be explained by osmosis, they are all simple enough when we view the capillaries as glands—*i.e.*, as passing from the blood to the tissues, and the reverse, an elaborated fluid which varies with the condition of the cells composing the capillary and the tissue-cells that surround it. That the condition of the blood can modify the capillaries, the latter the blood and the tissues both, is to my mind clear enough. To put it otherwise: The tissue-cells around a capillary, the capillary cells themselves, and the blood are always in a sort of balanced relation. They understand each other, so to speak, and act in harmony. One cannot be disturbed without affecting the other.

When a great derangement occurs, what we call inflammation arises, and, sooner or later, all the parts of this inseparable trio become involved. In inflammation we have changes in the blood-cells, changes in the vessel-walls, and changes in the surrounding tissue-cells. The embryological history should have led us to expect all this.

When this relation of the capillaries as secreting mechanisms is understood, many of the difficulties that surround "digestion" and "absorption" will be removed. Time will not allow of my developing this part of the subject at length now. In my opinion, there is no sharp line to be drawn between digestion and absorption. They are parts of one great series of processes. Not only so, but the term absorption is misleading, as it suggests purely physical processes, which latter must always be dealt with very cautiously by physiologists.

If, for example, we regard the capillaries of the alimentary tract as glands, it will no longer be impossible to understand that the peptones of digestion are not represented by peptones in the blood, the great stumbling-block of physiologists for long enough.

Intracellular digestion is not confined to invertebrates. The cells of the digestive tract, those of the capillaries included, have not wholly forgotten the amœboid habits of their embryonic ancestors. They are specialized, it is true, but not wholly altered. To suppose that digestion, or the physical and chemical alteration of food ends within the cavity of the alimentary tract, is to overlook a large part of the truth. Food is changed there by virtue of the digestive secretions, but all is not thus done. In fact, what is commonly termed digestion is only the beginning of a long series of processes which go on in the cells of the structures of the tract, the capillaries included, in the blood itself to some extent, and which continue under the name of metabolism in the tissues themselves. But it is the separation and isolation in the mental conception of the student, of what must be linked in one long chain, that is to be especially dreaded in the modern teaching of physiology.

A student may throw a great part of the facts of his physiology overboard after his examination, but the influence of his teaching must last for good or evil in all his thinkings as a practitioner. That a sounder view of the processes of digestion, etc., would greatly modify practice, and especially would explain present failures and successes, is clear to myself. Any attempt, however, to make this evident to others must be left for another occasion.

It may, without exaggeration, be said that the application of the principles of evolution to morphology has revolutionized the teaching of that subject. But, strangely enough, its great doctrines have thus far made very little impression on physiology, especially the teaching of the subject; and my own text-book is the first and only one in which an attempt has been made to light up the student's path with this theory; and you will be glad to hear that this effort has been rewarded by increased interest in physiology on the part of my own classes during the four years of trial of the new methods of presenting the subject.

But if this is good for students that are undergraduates, may it not also prove helpful to practitioners to regard disease in the light of evolution?

Physicians have given but little attention to the subject. To this statement, however, there are at least two notable exceptions: the late brilliant Milner Fothergill, and that profound thinker, of whom we are so proud the world over, Hughlings Jackson.

Turning to the vascular system in the wider sense (the blood and blood-vessels). by the help of evolution and embryology not only are many anomalies of vessels understood, but also of the blood itself.

Does not a case of extreme multiplication of leucocytes in the blood indicate a condition at once embryonic and ancestral? In other words, is not this an example of physiological or pathological reversion? In the early embryo, leucocytes are very abundant everywhere, and in invertebrates, almost without exception, they or their equivalents, are alone found, while in the lower vertebrates they are both numerous and of very much more pronounced amœboid character than in the higher. Is not this tendency, then, on the part of the higher mammals and man, under certain circumstances, to an excess of leucocytes in the blood better understood than without the explanation of evolution? Why this particular form of derangement, and not some other, if higher forms are not related by descent to the lower?

Again, in the various forms of anæmia we find red cells that are nucleated, cells smaller or larger than normal, distorted cells, corpuscles resembling the genetic marrow-cells, etc.

All these forms occur in the embryo, apparently normally; some of them are certainly transition forms. They also bear a resemblance to the red cells of lower vertebrates. Are these not clear cases of reversion to an earlier condition, both embryonic and ancestral? Even that form of anæmia in which the cells are fairly normal, excepting a deficiency in hæmoglobin, points to the lower vertebrate and invertebrate blood, which is, relatively to the higher groups of animals, poor in hæmoglobin.

Inflammation itself, both as regards the vascular system and the tissues, becomes clearer from the standpoint of evolution. The increased amœboid activity of the leucocytes, the alterations in the latter and the vessel walls permitting of the ready "wandering" of the colorless blood-cells, point to a condition of things common in lower vertebrates. Inflammation is clearly a reversion.

Reference might be made to the resemblance between the condition of things in the young mammal—in which, after birth the usual changes that fit it to its altered environment do not take place—and the permanent state of the heart and vessels in lower vertebrates, as reptiles. However, the illustrations employed may suffice to show that evolution does concern the physiologist, the pathologist, and the physician; and, did time permit, I think I could demonstrate that such views may be made to have a bearing on the treatment of disease by the most enlightened methods. The subject has been dealt with further in its relations to medicine elsewhere.[1]

I shall not pursue this line of thought further at present, but leave you to judge for yourselves whether the time has come when students and practitioners should be provided with text-books of physiology in which attention is paid to general biology, comparative embryology, and evolution, with a view of giving a wider and truer grasp of the functions of those organisms with which the great art of medicine is concerned.

[1] Physiological and Pathological Reversion. *Canada Med. and Surg. Journal,* April, 1888.

On Canadian Spessartite and Mountain Cork

By B. J. Harrington, McGill College.

Read before the Natural History Society, March 31st, 1890.

1.—Spessartite.

The Villeneuve Mica Mine, on the thirtieth lot of Range 1, Villeneuve, Ottawa County, P.Q., is already known to many on account of the interesting minerals which it has afforded. The vein, which was at one time worked for mica, is a coarse granite, traversing grey garnetiferous gneiss, and consisting of quartz, muscovite, orthoclase and albite, with occasionally black tourmaline and garnet It has also yielded the rare minerals uraninite and monazite.[1] The garnet occurs imbedded in both the feldspar and the muscovite, and crystals of that found in the latter have recently been analysed by the writer. The crystals are much distorted and more or less flattened in the direction of the cleavage planes of the mica. They range, in the few specimens examined, from one up to about ten mm. in greatest diameter, and are of a beautiful red colour. They are rather brittle, but possibly some might be obtained which would stand being cut as gems. The specific gravity was found to be 4·117 and analysis of carefully selected material gave the following percentage composition :—

Silica	36·30
Alumina	19·20
Ferrous Oxide	10·66
Manganous Oxide	30·06
Lime	3·07
Magnesia	0·43
Loss on ignition	0.31
	100.03

[1] G. C. Hoffmann, Ann. Rep. Geol. Can. 1886, p. 11 T., and F. A. Genth, Am. Jour. Sci., 1889, p. 203.

The atomic and quantivalent ratios deduced from the above figures are:—

	Atomic.			Quantivalent.		
Si ...	605 × 4	= 2420		2420	2420	1
Al ...	378 × 3	= 1134		1134	2408	1
Fe″ ..	148 × 2	= 296	1274			
Mn ..	423 × 2	= 846				
Ca ..	55 × 2	= 110				
Mg...	11 × 2	= 22				

The analysis shows that the mineral is a manganese garnet, approaching very nearly in composition to the original spessartite, but containing more lime. The iron was proved to be all in the ferrous state. The figures given as loss on ignition indicate the loss on heating for about fifteen minutes. Further heating caused a gain in weight, owing to oxidation of the iron.

2.—Mountain Cork.

In 1877, the writer found on the dump at the "Grant Phosphate Mine," in the township of Buckingham (south ½ of lot 18, Range 12), specimens consisting of mountain cork and mountain leather. Under the latter name they were referred to in his "Report on the Minerals of some of the Apatite-bearing Veins of Ottawa County," but were not then analysed quantitatively. During the past few years, in the Emerald Mine, on the same lot as the above, similar material has been obtained in masses of considerable size, one specimen presented to the Peter Redpath Museum by Mr. F. W. Warwick, containing about half a cubic foot.

It consists mainly of mountain cork, though on the surface it is in places slightly foliated or leather like. Some portions contain irregular grains of quartz and minute crystals of copper pyrites[1]; but fragments were selected for

[1] The crystals are mostly 1 to 2 mm. in diameter and many of them black superficially. When freshly fractured they have the colour of copper pyrites, with which they also agree in blowpipe characters. To the eye the crystals look like regular octahedrons but may be tetragonal. They require further examination.

examination which were apparently free from intermixed impurities. They were creamy-white in colour, and were found to have a specific gravity of 3·05.[1] An analysis made in the college laboratory by Mr. Sidney Calvert, gave the following results:—

Silica	53·99
Alumina	0·55
Ferric Oxide	1·00
Ferrous Oxide	10·99
Manganous Oxide	2·19
Lime	12·53
Magnesia	16·25
Loss on ignition	2·56
	100·06

The atomic and quantivalent ratios deduced from the above analysis are given below, and it will be seen that the mineral is a true bisilicate.

	Atomic.				Quantivalent.		
Si	899	× 4	=	3596	3596	2
Al	10	× 3	=	30		
Fe'''	12	× 3	=	36		
Fe''	152	× 2	=	304	1692	1
Mn	31	× 2	=	62		
Ca	224	× 2	=	448		
Mg	406	× 2	=	812		

It is interesting on account of the large proportion of ferrous and manganous oxides which it contains, and differs considerably in composition from the mountain cork of Zillerthal, examined by Scheerer. His analysis gave:—

Silica	57·20
Ferrous Oxide	4·37
Lime	13·39
Magnesia	22 85
Loss on ignition	2·43
	100·24

[1] Dry fragments float upon water for a time, owing to the air which they contain. In determining the specific gravity, the air was got rid of by soaking under water in vacuo.

Pyroxene crystals converted into asbestus have been found at the same locality as the mountain cork in Buckingham, and this suggests that the latter may also be a secondary mineral derived from pyroxene, one of the most constant constituents of the apatite-bearing veins.

Soil Temperatures.

By C. H. McLeod, Ma. E., and D. P. Penhallow, B. Sc.

During the past two years, observations of soil temperature have been taken daily, at the McGill College Observatory; the primary object being to establish somewhat more definitely, the relation of such temperatures to vegetation. An important part of this work relates to the changes attending the penetration of frost in autumn; the influence of snow as a protective covering; and the changes incident to the opening of the ground in spring. For this reason the period of observation embraces the entire year, instead of covering only the spring and summer months as is customary. It may also be stated in this connection, that observations are being made on root penetration and the movement of sap in trees, in order to complete the necessary data. These will be published as soon as circumstances will permit.

This work, which it is expected will be carried on continuously for some years, is conducted under the auspices of the Natural History Society of Montreal. The expense attending the construction of the necessary instruments, was met by a grant from the Elizabeth Thompson Science Fund. Reference may be made to the Annual Reports of the University, for further information concerning the inauguration of this work. The following is a brief description of the instrument used :—Couples of copper and iron are placed in the ground at the required depths. A wire passes from each couple to a switch-board in the observing room, and there is a return wire common to all the couples, which, in the observing room passes through a delicate galvanometer and a couple similar to those in the ground, to make connection with the other wires at the switch-board. The galvanometer is made to read zero on the circle when the circuit is open, If now the circuit be closed at the switch-board the needle will be found to deflect, but may be brought back by bringing the inside couple to the same temperature as that in the ground. For this purpose the inside couple is immersed in water, or in winter, in a mixture of snow and water. When the balance is established, the temperature of the water is the same as that of the ground at the depth of the outside couple.

In this the first report upon the work of the committee, it is proposed simply to place on record the results thus far obtained, leaving to the future, such deductions as it may be possible to draw. The temperatures in degrees centigrade—as given—are averages of ten-day periods, while the figures for snow and rainfall express the total precipitation for the same periods. The accompanying chart of curves will exhibit the relations thus far established.

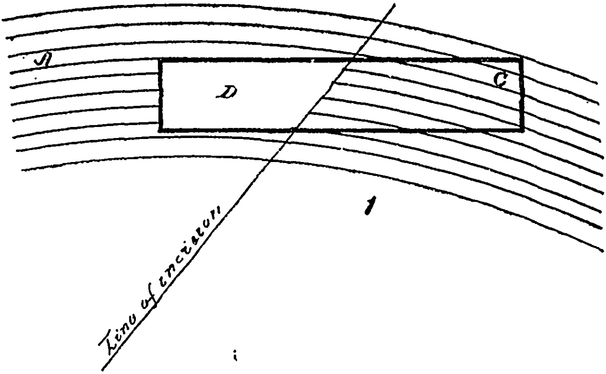
The soil terminals of the thermometer are located at a distance of about fifty feet from the air terminal, and about twenty feet from the observatory. The depths thus far operated upon are one, two, three and four feet from the surface, a limitation imposed by the formation of the locality—which is at present, the only one available within working limits of the instrument.

The soil in which the instrument is placed, is a well-drained and rather gravelly loam for a depth of four feet three inches, at which point the bed rock is reached. It will, therefore, be observed that the lowest point of observation is only about three inches from the rock. Grass has been allowed to grow freely about the instrument, though kept rather short, thus establishing the conditions of land in sod.

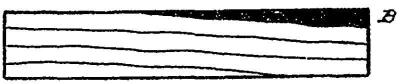
The observations recorded below have been taken by Mr. E. H. Hamilton, B.A.Sc., assistant in the McGill College Observatory.

Date.	Temperatures in Degrees Centigrade.					Total Precipitation.		Estimated depth of snow on the ground
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	Air.	Rain.	Snow.	
1888.								
Nov. 11...	6.3	6.9	8.0	9.3	6.0	3 83	0.5	......
21...	2.3	4.2	6.8	10.1	− 2.0	0.41	3.1	1.4
Dec. 1...	0.4	2.4	5.4	8.5	− 4.5	0.76	7.4	4.5
11...	0.9	2.3	4.7	7.8	− 2.5	0.01	2.20	3.6
21...	0.8	2.6	4.6	7.5	−10.2	0.81	10.90	3.6
31...	0.4	1.4	4.0	6.6	− 3.1	0.75	3.80	4.7
1889.								
Jan. 10...	0.5	2.2	3.7	5·6	− 2.5	1.62	6.30	2.5
20...	0.6	2.1	3.5	5.5	− 5.7	0.23	2.40	4.0
30...	0.2	1.4	3.0	4.7	− 9.2	0.03	29.40	19.0
Feb. 9...	0.2	0.9	2.8	3.0	−14.5	0.00	22.00	28.6
19...	−0.4	0.7	2.2	4.1	− 8.3	0.30	10.20	35.5
Mch. 1...	−0.1	0.9	2.2	3.5	−11.5	0.00	2.40	31.0
11...	−0.3	0.6	2.2	3.5	− 2.2	0.34	11.10	29.0
21...	−0.2	0.9	2.4	3.3	− 1.4	0 08	3.10	26.7
31...	−0.5	0.4	1.8	2.8	− 1.8	0.20	1.10	21.0
Aprl. 10...	−0.5	0.2	1.5	2.7	1.9	0.00	0.10	12.0
20...	3.7	1.0	0.2	0.0	8.8	0.15	.....	2.6
30...	6.4	7.0	4.7	2.4	8.6	2.04	.....	......
May 10...	12.7	9.5	6.4	3.3	14.8	0.14	.....	......
20...	15.3	12.9	9.6	4.3	16.3	1.36	.....	......
30...	14.7	13.3	12.6	7.7	10.9	1.55	.....	......
June 9...	15.5	13.1	11.3	7.9	14.9	2.35	.....	......
19...	18.8	16.5	13.6	8.9	17.5	0.93	.....	......
29...	19.2	16.9	14.6	9.8	18.4	1.47	.....	......
July 9...	21.1	19.9	17.1	11.1	21.7	1.39	.....	......
19...	20.4	18.8	16.9	12.6	19.1	1.56	.....	......
29...	21.5	19.1	17.8	13.6	19.3	4.17	.....	..
Aug. 8...	21.2	19.4	17.9	14.3	19.2	1.12	.....	......
18...	18.7	17.5	17.4	14.6	16.6	1.50	.....	......
28...	18.9	17.3	16.8	14.2	18.5	0.25	.....	......
Sept. 7...	19.6	17.6	16.8	14.1	19.9	0.12	.....	......
17...	18.4	17.7	17.2	14.5	19.1	1.59	.....	......
27....	13.6	14.3	15.9	15.7	11.5	2 68	. ...	.....
Oct. 7...	11.0	12.2	14.0	14.7	8.6	2.46	.....	......,
17...	7.1	8.1	10.4	12.9	5.7	0.12	.....	......
27...	5.0	6.3	8.7	11.1	3.1	0.47	.....	......
Nov. 6...	4.7	5.7	7.9	10.7	4.3	1.11	0.80	......
16...	4.3	5.4	7 3	9.8	2.1	0.29	0.06	......
26...	3.0	4.4	6 7	9.3	1.7	1.39	.....	......
Dec. 6...	1.2	3.5	6.0	9 1	− 7.1	0.00	17.50	13.00
16...	1.0	2.7	4.9	7.9	− 3.6	1.39	2.00	9.00
26...	0.9	2.2	4.2	6.5	− 1.1	1.55	8.50	5.00

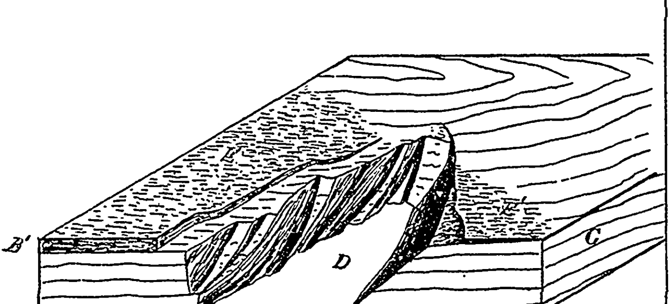
Date.	Temperature in Degrees Centigrade.					Total Precipitation.		Estimated depth of snow on the ground
	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	Rain.	Snow.	
1890.								
Jan. 5...	1.3	2.7	4.4	6.6	− 6.1	0.70	7.00	5.00
15...	1.9	2.3	3.9	5.7	−11.9	1.00	11.40	10.00
25...	1.4	1.8	3.2	5.0	−11.9	0.18	12.80	19.00
Feb. 4...	1.1	1.6	3.3	5.1	− 6.6	0 41	0.60	17.00
14...	0.8	1.6	3.2	4.8	− 8.1	1.29	13.20	20.00
24...	0.8	1.5	2 8	4.1	−11.7	0.20	13.90	30.00
Mch. 6...	1.0	1.6	3.0	4.1	− 5.1	0.96	0.00	28.00
16...	0.7	1.5	2.7	3.7	− 2.6	0.30	0.00	20.00
26...	0.4	0.9	2.3	2.9	− 1.6	0.18	1.40	11.0
Aprl. 5...	0.5	1.1	2.3	2.8	− 0.4	0.65	10.30	11.0
15...	0.6	0.2	0.9	1.1	4.7	0.25	0.20	6.0
25...	5.3	2.8	2.0	1.5	5.3	0.12	.....	1.0
May 5...	7.4	5.2	4.5	2.6	6.7	1 75	2.80	......
15...	9.1	7.1	5.9	3.6	9.2	1.47	.....	......
25...	11.7	10.0	8.2	4.9	11.8	1.72	.....	.....
June 4...	15 0	12.1	9.6	5.9	15.1	1.58	.....	......
14...	15.5	13.5	11.7	7.8	15.3	0.90	.....	......
24...	17.6	14.7	12.4	8.2	19.4	0.92	.....	......
July 4...	21.1	17.8	14.8	9.8	21.7	0.65	.....	......
14...	20.7	18.3	16.1	11.5	19.4	0.20	.....	......
24....	20.7	18.3	16.5	12.1	18.5	1.02	.....	......
Aug. 3...	21.7	18.8	16.6	12.2	22.8	1.07	.....	......
13....	21.9	19.9	17.8	13.3	20.8	1.56	.....	......
23...	18.7	17.5	17.0	14.5	15.7	2.71	.....	......
Sept. 2...	16.5	15.3	15.4	14.5	15.5	3.65	.....	......
12...	17.2	15.7	15.4	13.9	17.0	2.29	.....	......
22...	14.9	14.6	15.1	14.1	14.3	0.98	.....	......
Oct. 2...	11.1	12 0	13.5	13.8	14.1	0.30	.....	......
12...	10.1	11.1	12.9	13.5	8.7	0.80	.....	......
22...	8.8	8.0	10.8	12.3	7.7	1.64	.....	......
Nov. 1...	6.8	7.6	9.7	11.7	4.6	0.30	.....	... ..



1



2



3

Note on a Peculiar Growth in Black Walnut.

By D. P. Penhallow.

The specimen herewith described, was handed to me by the Hon. Senator Murphy, it having been sent to him by the Huntingdon Organ Company, who purchased the lumber from which it was cut, in the United States. The block is one-half inch thick by three by four inches. As the board to which it originally belonged was being cut up, a portion, occupying the space D^1 (Fig. 3), fell out, disclosing a cleft made by an axe, evidently the result of an abandoned effort to cut the tree down many years before that event actually occurred.

Upon examination it appears that the block occupying the space D^1 was originally continuous with the shaded areas E, E^1, from which it became separated by the action of the saw—the line of fracture appearing as shown in the figure. This block also completely filled the space D^1, and evidently extended—in the entire tree—much above and below the limits of thickness in the specimen. The entire surface of the intruded mass, where brought in contact with the surfaces of the cleft, is covered with a thin layer of carbonized material, showing the effects of decay in the first formed tissues, under exclusion of air—a result always to be observed in similar cases; while the grain is found to run at various angles—chiefly right angles—to that of the surrounding parts.

The intruded mass is the result of growth following injury, and an effort on the part of the plant to repair it—a result commonly observed, as in the obliteration of surveyors blazes, and as illustrated in the case of a remarkable blaze described a few years since.[1] This case offers nothing new, but presents some features of interest as showing the extent to which an injury may be repaired under the ordinary conditions of growth. This will be more obvious from

[1] *Science*, iii, 354.

an examination of the relation between the specimen and the original tree.

From the curvature of the growth rings it would appear that the tree— at the time of injury—had a diameter of about eighteen inches. The relationship of parts is shown in figure 1, where C represents an end view of the specimen (Fig. 3 C^1), in relation to the growth rings of the tree: D shows the intruded mass as exposed on a line of section passing through the center of D^1 (Fig. 3). The slope of the cleft shows the line of incision to have had the direction given by the line in figure 1, from which it is evident that the incision was a somewhat deep one, and that our specimen came from one end of it. It is also obvious that this injury must have been inflicted in the winter, or at least before the growth for the season began, since the intruded mass is part of the ring formed at A (Fig. 1), and B, B^1 (Figs. 2 and 3). In Fig. 3, the left-hand side of the incision represents the basal portion of the cut. Whether the original cleft was filled throughout by the new growth, or whether this was only partial, cannot be determined from the specimen before us.

"On Burrows and Tracks of Invertebrate Animals and other Markings in Palæozoic Rocks."[1]

By Sir J. William Dawson, LL.D., F.R.S., F.G.S.

This paper, which is illustrated by photographs and drawings, indicates some new facts in connection with the markings produced by the burrows and tracks of animals, and other causes. *Rusichnites* and *Cruziana* are regarded, like *Climactichnites* and *Protichnites*, as representing probable burrows or tracts of Crustaceans and Chætopod worms, *Scolithus canadensis* is shown to be a cylindrical burrow, with accumulations of earthy castings at its mouth. The relation of these burrows to the forms known as *Scotolithus*,

[1] From Proceedings of London Geological Society.

Asterophycus, *Monocraterion* and *Astrapolithon* is pointed out.

Under the new generic name of *Sabellarites*, the Author describes certain tubes, composed of shelly and other fragments cemented by organic matter, f und in the Trenton Black-river Limestone. They resemble the burrows or tubes formerly described by the Author from the Hastings and Quebec Groups, and appear to be the tubes of worms allied to the recent *Sabellariæ*; but they are liable to be mistaken for Algæ of the genera *Palæophycus* ıd *Buthotrephis*.

Some large cylindrical bodies from the Potsdam Sandstone, are described as having been supposed to be trunks of trees; but the Author regards them as probably concretions formed around slender stems, like some now forming in the alluvial mud of the St. Lawrence, (and described in a recent number of this Journal.)

Some curious combinations of worm-tracks with ripple-marks and shrinkage-tracks, are described; as also branching or radiating worm-trails which present some resemblance to branching Fucoids. Finally, the Author describes the formation of rill-marks on the mud-banks of the tidal estuaries of the Bay of Fundy, and indicates their identity with some impressions in slabs of rock, which have been described as Fucoids under several generic names.

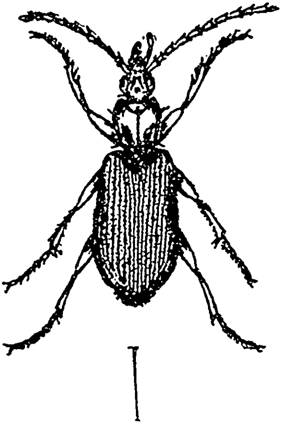
The paper will probably be published in full, with illustrations, in the November number of the Journal of the Geological Society.

A New Canadian Platynus.

By J. T. Hausen.

PLATYNUS HORNII sp. nov.

Piceus, subviridiæneus, non nitidus, subtus fuscus vel rufofuscus, elytris obscure vividibus, satis strialis, striis impunctatis, interstitiis paullum complanatis, rugulose punctulatis, costa tertia quinque foveolata; capite viridi, bisulcato; antennis nigris, scapo, palpis, mandibulis, pedisbusque rufes centibus. prothorace latitudine paullo longiori, subcordato, canaliculato, valde basi foveis oblongis impressis, margine laterali postice reflexo. Long. .375in.



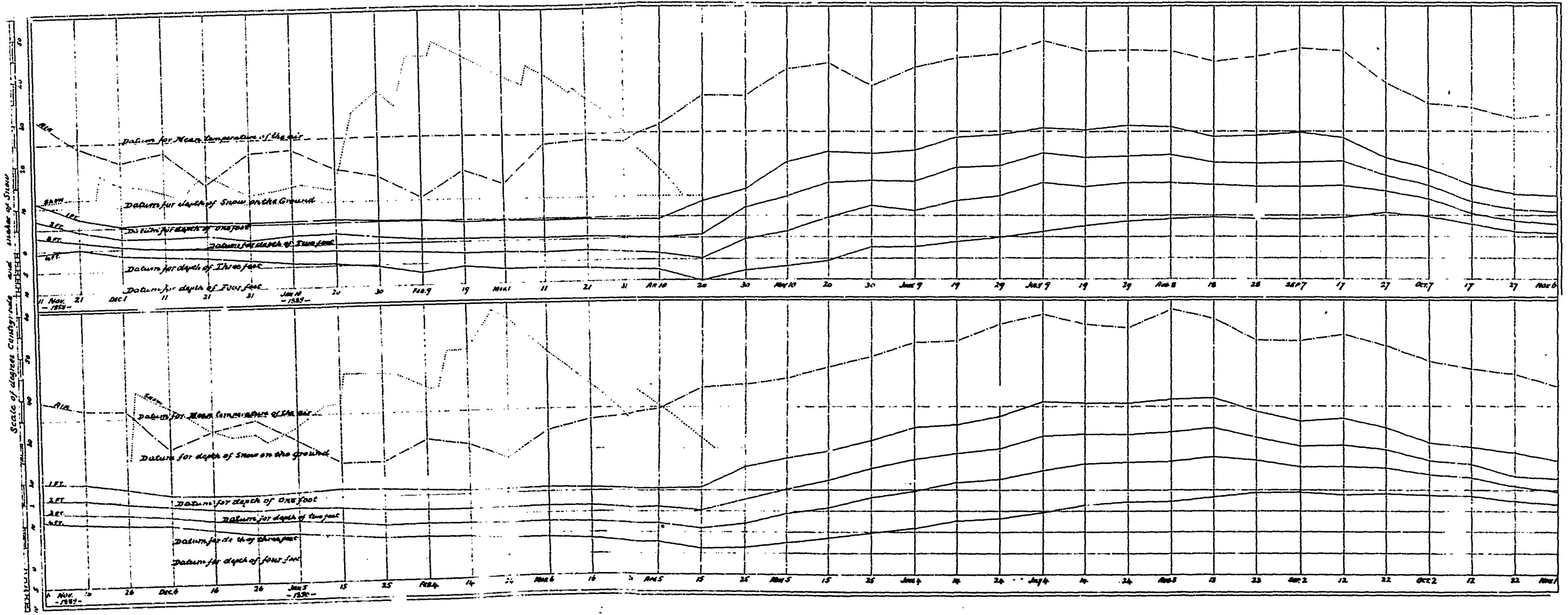
Dark with a greenish tint, not shining, beneath reddish *brown passing into dirty yellow on the prosternum and* gula; first joint of antennæ, mouth-parts and legs testaceo-rufous; prothorax obcordate, scarcely sinuate in front of posterior angles, which are obliquely cut off and slightly rounded, finely channelled at middle, with the anterior angular impression almost obsolete. Head dark bronzy green, sometimes with a small punchform impression at the middle above the frontal impressions. Elytra moderately convex, furrows well-marked, not punctate, interspaces punctulate.

Var. *α*. Prothorax brown, lighter than head and wing covers.

Var. *β*. Head and thorax black, underside dark brown.

On being shown a specimen. Dr. Horn declared he doubted the American origin of this species, but as I have individuals from Ste. Rose and Ile Perrot, P.Q., both rather out-of-the-way places and somewhat distant from each other, I venture to describe it as new.

I wish to dedicate it to Geo. H. Horn, M.D., of Phila., the distinguished American coleopterist, who well deserves such an honor.


Scale of degrees Centigrade and inches of snow
AIR
SNOW
1 FT.
2 FT.
3 FT.
4 FT.
Datum for Mean temperature of the air
Datum for depth of Snow on the Ground
Datum for depth of One foot
Datum for depth of Two feet
Datum for depth of Three feet
Datum for depth of Four feet
11 Nov. 1888
21
Dec 1
11
21
31
Jan 10 1889
20
30
Feb 9
19
Mar 1
11
21
31
Apr 10
20
30
May 10
20
30
June 9
19
29
July 9
19
29
Aug 8
18
28
Sep 7
17
27
Oct 7
17
27
Nov 6
Datum for depth of One foot
Datum for depth of Two feet
Datum for depth of Four feet
Nov. 1889
Dec 6
16
26
Jan 5 1890
15
25
Feb 4
14
Mar 6
16
Apr 5
15
25
May 5
15
25
June 4
14
24
July 4
14
24
Aug 3
13
23
Sep 2
12
22
Oct 2
12
22
Nov 1

ABSTRACT FOR THE MONTH OF JULY, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	76.45	87.1	65.2	21.9	29.8762	29.931	29.813	.118	.5095	57.2	59.5	S.E.	9.1	5.2	10	0	91	....	....	....	1
2	71.63	77.0	68.5	8.5	29.7503	29.810	29.693	.117	.5508	71.3	61.7	S.	17.2	10.0	10	10	15	0.02	....	....	2
3	71.37	81.0	64.1	16.9	29.6422	29.672	29.606	.066	.6138	81.7	64.8	S.W.	10.7	8.8	10	4	42	0.63	....	....	3
4	70.25	77.0	66.3	10.7	29.7062	29.733	29.685	.048	.6025	81.8	64.3	S.W.	14.5	7.5	10	0	28	Inapp.	....	....	4
5	63.98	71.2	56.5	14.7	29.9153	30.004	29.748	.256	.4358	73.5	55.2	S.W.	17.7	2.3	10	0	60	....	....	....	5
SUNDAY........ 6	.....	77.2	57.3	19.9	....	......	......	....	.....	....	....	S.W.	14.0	....	..	..	67	0.01	....	....	6 .... SUNDAY
7	68.32	77.0	62.3	14.7	29.9522	30.047	29.858	.189	.5235	76.3	60.2	S.	7.0	9.0	10	6	25	0.06	....	...	7
8	74.78	88.6	65.3	23.3	29.6177	29.747	29.501	.246	.6338	74.2	65.5	S.W.	22.9	9.5	10	4	40	0.10	....	....	8
9	59.67	72.0	53.5	18.5	29.7915	29.962	29.519	.443	.3220	61.7	46.0	W.	20.2	4.2	10	0	76	0.03	....	....	9
10	58.52	67.2	49.4	17.8	30.0682	30.148	30.011	.137	.3225	65.5	46.8	W.	9.8	5.8	10	0	58	....	....	....	10
11	62.72	71.3	52.3	19.0	30.1852	30.259	30.128	.131	.3368	60.2	48.0	E.	5.2	0.8	8	0	92	....	....	....	11
12	69.82	81.0	55.0	26.0	30.0410	30.146	29.953	.193	.4295	60.2	54.7	S.W.	5.4	3.8	10	0	100	....	....	....	12
SUNDAY..... 13	.....	82.5	62.4	20.1	....	......	......	....	.....	....	....	S.	10.1	....	..	..	97	....	....	....	13 .... SUNDAY
14	72.67	82.5	60.4	22.1	29.9307	29.976	29.880	.096	.5692	71.3	62.7	S.	10.8	6.5	10	0	79	....	....	....	14
15	76.28	86.5	68.2	18.3	29.8795	29.919	29.842	.077	.6222	69.7	64.8	S.W.	13.3	3.7	10	0	80	0.54	....	....	15
16	73.52	81.9	65.9	16.0	30.0023	30.025	29.977	.048	.4825	62.2	57.8	W.	9.7	2.8	10	0	95	....	....	....	16
17	63.62	72.0	57.0	15.0	29.8748	29.980	29.773	.207	.4545	77.2	56.2	S.W.	10.7	10.0	10	10	02	0.13	......	....	17
18	61.83	71.0	52.9	18.1	29.9345	29.977	29.868	.109	.3118	57.7	46.0	W.	13.5	3.5	10	0	99	Inapp.	....	....	18
19	57.20	65.1	52.9	12.2	29.9302	30.047	29.849	.198	.3480	74.8	48.8	N.	11.2	7.7	10	0	24	0.33	....	....	19
SUNDAY........20	.....	67.6	49.8	17.8	.....	......	......	....	.....		....	N.W.	10.1	....	..	..	48	Inapp.	....	....	20 .... SUNDAY
21	62.17	70.8	54.0	16.8	30.2078	30.254	30.179	.075	.3402	61.3	48.5	W.	5.4	4.8	10	0	69	....	....	....	21
22	65.85	75.7	54.4	21.3	30.1445	30.223	30.078	.145	.3838	62.0	51.5	S.	7.3	3.8	10	0	94	....	....	....	22
23	67.62	79.7	56.5	23.2	30.0432	30.081	30.004	.077	.4123	62.3	53.7	S.	12.7	8.3	10	6	20	....	....	....	23
24	66.58	75.0	60.3	14.7	30.0315	30.059	30.002	.057	.4715	72.7	57.2	S.E.	15.2	10.0	10	10	18	0.02	....	....	24
25	66.35	69.1	62.3	6.8	29.9245	30.001	29.831	.170	.5702	88.0	62.8	S.E.	11.9	8.7	10	2	00	0.28	....	....	25
26	72.37	82.0	65.3	16.7	29.7762	29.832	29.700	.132	.6157	78.3	64.7	S.W.	14.8	6.5	10	0	19?	0.01	....	....	26
SUNDAY........27	.....	80.0	61.2	18.8	....	......	......	....	.....	....	....	S.W.	14.7	....	.	..	100	....	....	....	27 .... SUNDAY
28	74.45	84.1	66.1	18.0	30.1027	30.122	30.085	.037	.5693	68.3	62.5	S.W.	16.3	1.3	7	0	76	....	....	....	28
29	74.92	87.0	64.8	22.2	30.0583	30.139	29.980	.159	.5848	67.5	63.2	S.W.	11.2	2.5	9	0	89	....	....	....	29
30	75.45	86.8	66.7	20.1	29.8853	29.964	29.811	.153	.6177	71.3	64.8	S.W.	20.3	6.3	10	0	66	0.04	....	....	30
31	72.87	80.9	67.9	13.0	29.7110	29.840	29.653	.187	.6362	78.3	65.7	S.W.	19.0	7.0	10	1	40	0.58	....	....	31
....Means	68.57	77.67	60.15	17.52	29.9253	......	......	.143	.4915	69.9	57.7	....	12.6	5.94	..	..	¶58.4	2.78	....	.. .	Sums ....
16 yrs. means for & including this mo.	68.99	77.36	60.96	16.40	29.8841	. ....	......	.140	.5005	70.8	...	....	....	5.45	..	..	59.1	4.16	....	....	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	376	87	....	985	1748	4490	1145	575	....
Duration in hrs..	30	17	....	86	151	303	92	60	5
Mean velocity...	12.5	5.1	....	11.5	11.6	14.8	12.4	9.6	

Greatest mileage in one hour was 32 on the 31st.
Resultant mileage, 6,210.
Resultant direction, S. 39° W.
Total mileage, 9,406.

Average mileage, 12.64.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 88.6 on the 8th; the greatest cold was 49.4 on the 10th, giving a range of temperature of 39.2 degrees. Warmest day was the 1st. Coldest day was the 19th. Highest barometer reading was 30.259 on the 11th; lowest barometer was 29.501 on the 8th, giving a range of 0.758 inches. Maximum relative humidity was 97 on the 3rd. Minimum relative humidity was 37 on the 1st.

Rain fell on 17 days.

An Aurora was observed on 1 night.

Lunar halo on 1 night.

Thunderstorms on 5 days, and lightning without thunder on 2 days.

ABSTRACT FOR THE MONTH OF AUGUST, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	Max.	Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	71.90	80.3	60.3	20.0	29.9948	30.061	29.900	.161	.4248	54.7	54.5	W.	6.8	0.0	0	0	100	....	....	....	1
2	75.15	84.9	61.5	23.4	30.0883	30.135	30.051	.084	.5250	61.3	60.3	S.	8.4	2.5	7	0	98	....	....	...	2
SUNDAY........ 3	.....	86.8	66.3	20.5	....	......	......	....	.....	...	....	S.	15.8	....	..	..	60	0.16	.. .	....	3 .... SUNDAY
4	75.85	88.8	71.5	17.3	29.9250	29.969	29.878	.091	.7980	81.8	72.3	S.W.	10.6	7.2	10	0	59	0.37	...	....	4
5	75.05	85.0	69.1	15.9	29.9200	29.974	29.852	.122	.7023	80.2	68.5	S.	12.7	8.3	10	3	50	0.60	....	....	5
6	68.18	75.0	62.0	13.0	29.9632	30.011	29.933	.078	.4947	72.2	58.7	S.W.	18.7	4.7	9	0	88	0.30	....	....	6
7	68.55	79.0	61.6	17.4	30.0782	30.110	30 019	.091	.4668	67.7	57.0	W.	10.4	2.8	10	0	66	....	....	...	7
8	69.40	79.0	60.2	18.8	30.0335	30.114	29.936	.178	.5112	72.2	59 7	S.	6.6	1.7	10	0	71	....	.. .	....	8
9	72.75	82.7	64.1	18.6	29.77:8	29.905	29.671	.234	.5768	73.3	63.0	S.	13.8	6.2	10	2	79	0.28	....	....	9
SUNDAY........10	.....	72.8	56.2	16.6	....	......	......	....	.....	....	....	S.W.	16.6	....	..	..	63	0.01	....	....	10 ....SUNDAY
11	64.23	75.1	55.1	20.0	29.8980	30.051	29.761	.290	.3610	61.5	50.0	N.	14.5	2.2	10	0	70	Inapp.	...	....	11
12	66.17	75.9	56.0	19.9	30.1552	30.183	30.134	.049	.3645	58.5	50.0	N.E.	10.3	0.0	0	0	97	....	....	....	12
13	70.25	81.1	57.2	23.9	30.1022	30.198	29.999	.199	.4770	66.0	57.5	N.E.	2.5	4.7	10	0	84	....	....	....	13
14	70.13	79.8	61.3	18.5	29.8650	29.954	29.814	.140	.4682	64.5	57.0	**W.**	8.8	7.0	10	0	46	0.02	....	....	14
15	62.32	68.8	54.4	14.4	30.0292	30.167	29.858	.309	.3222	57.0	46.5	**N.W.**	15.0	1.2	5	0	90	....	....	....	15
16	59.18	67.0	48.3	18.7	30.1818	30.261	30.069	.192	.2727	54.5	42.2	**N.W.**	7.0	4.0	10	0	84	....	....	....	16
SUNDAY........17	.....	69.9	57.7	12.2	....	......	......	....	.....	....	....	**W.**	14.9	....	..	..	00	0.42	......	....	17 ....SUNDAY
18	58.90	67.8	51.4	16.4	30.1725	30.200	30.098	.102	.2932	59.7	44.2	**N.W.**	8.2	0.0	0	0	100	....	....	....	18
19	57.53	64.7	52.4	12.3	30.0775	30.198	29.960	.238	.3853	81.5	51.8	**N.E.**	8.7	8.7	10	2	01	0.57	....	....	19
20	60.10	68.9	53.0	15.9	30.0882	30.130	30.015	.115	.3805	73.5	51.5	**N.W.**	7.2	3.7	8	0	84	0.04	....	....	20
21	62.22	72.5	51.5	21.0	29.8297	30.112	29.533	.579	.4622	82.0	56.3	**W.**	18.6	6.7	10	0	39	0.32	....	....	21
22	59.92	68.1	53.4	14.7	29.8733	30.031	29.760	.271	.3828	74.3	51.2	W.	15.8	6.2	10	0	82	....	....	....	22
23	48.57	53.5	47 4	6.1	30.1035	30.133	30.056	.077	.2912	85.2	44.3	N.	17.6	10.0	10	10	00	1.34	....	....	23
SUNDAY........24	.....	55.9	48.3	7 6	....	......	......	....	....	....	....	N.	11.2	....	..	..	00	0.83	....	....	24 ....SUNDAY
25	58.95	68.5	49.3	19.2	29.9287	29.973	29.901	.072	.3616	73.0	50.0	S.W.	14.3	4.5	10	0	62	....	....	....	25
26	65.17	73.5	52 9	20.6	29.8833	29.999	29.769	.230	.4180	67.7	53.7	S.	5.7	6.7	10	0	69	Inapp.	....	....	26
27	61.98	66.1	58.4	7.7	29.6215	29.686	29.589	.097	.5262	94.7	60.2	N. W.	5.2	10 0	10	10	13	1.61	....	....	27
28	63.42	70.9	58.3	12.6	29.8148	29.931	29.680	.251	.4262	73.0	54.0	W.	13.2	6.0	10	0	71	0 20	....	....	28
29	60 07	66.8	50.9	15.9	29.8740	29.964	29.718	.246	.3305	64.0	47.7	E.	6.7	7.7	10	0	36	Inapp.	....	....	29
30	59.38	67.9	55.4	12.5	29.6735	29.746	29.625	.121	.4423	87.5	55.7	S.W.	10.8	9.3	10	7	38	0 87	....	....	30
SUNDAY........31	.....	61.2	53.3	7.9	.... .	.....	......	....	.....	...	..	N.W.	11.6	....	..	..	00	0.14	....	....	31 ....SUNDAY
....Means.	64.82	72 84	56.73	16.11	29 9595	......	......	.178	.4409	70.8	54.5	....	11.26	5 08	..	..	58.1	8.08	....	....	Sums ....
16 yrs. means for & including this mo.	66.96	75.22	58.82	16.40	29.9409	. ....	......	.323	.4813	72.37	...	....	....	5.24	..	..	¶60.1	3.15	....	....	16 yrs. means for and including this month.

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles............	1308	380	182	367	1171	1964	1839	1169	....
Duration in hrs..	119	45	28	47	111	137	139	112	6
Mean velocity...	11.0	8.4	6.5	7.8	10.5	14.3	13.2	10.4	

Greatest mileage in one hour was 33 on the 21st.

Greatest velocity in gusts, 60 miles per hour on the 21st.

Resultant mileage, 3,370.

Resultant direction, S. 83° W.

Total mileage, 8,380.

Average mileage, 11.26.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.

§ Observed.

† Pressure of vapour in inches of mercury.

‡ Humidity relative, saturation being 100.

¶ Nine years only.

The greatest heat was 88.8 on the 4th; the greatest cold was 47.4 on the 23rd, giving a range of temperature of 41.4 degrees. Warmest day was the 4th. Coldest day was the 23rd. Highest barometer reading was 30.261 on the 16th; lowest barometer was 29.533 on the 21st, giving a range of 0.728 inches. Maximum relative humidity was 99 on the 27th and 31st. Minimum relative humidity was 34 on the 12th.

Rain fell on 20 days.

An aurora was observed on one night.

Solar halos on two days.

Fog on two days.

Thunderstorms on five days.

NOTE.—The wind directions in broad-faced type are from the City Hall record.

ABSTRACT FOR THE MONTH OF SEPTEMBER, 1890.

Meteorological Observations, McGill College Observatory, Montreal, Canada, Height above sea level, 187 feet. C. H. McLEOD, *Superintendent.*

DAY.	THERMOMETER. Mean.	Max.	Min.	Range.	*BAROMETER. Mean.	§Max.	§Min.	Range.	† Mean pressure of vapour.	‡ Mean relative humidity.	Dew point.	WIND. General direction.	Mean velocity in miles per hour	SKY CLOUDED IN TENTHS. Mean.	Max.	Min.	Per cent of possible bright sunshine.	Rainfall in inches.	Snowfall in inches.	Rain and snow melted.	DAY.
1	61.82	68.7	53.8	14.9	30.1640	30.198	30.120	.078	.3807	69.5	51.7	S.W.	15.3	3.7	10	0	99	....	....	....	1
2	59.90	65.9	55.4	10.5	30.1853	30.211	30.160	.051	.4380	84.7	55.3	S.W.	15.2	8.5	10	1	03	.	....	...	2
3	57.07	66.0	48.0	18.0	30.2427	30.293	30.211	.082	.3120	68.0	46.0	N.E.	7.8	0.5	3	0	97	....	....	....	3
4	61.72	72.9	48.4	24.5	30.1040	30.215	29.978	.237	.4402	79.0	54.5	S.E.	9.2	7.2	10	3	47	....	..	....	4
5	70.10	77.0	63.0	14.0	29.9870	30.012	29.962	.050	.5458	74.3	61.0	S.W.	15.0	6.3	10	0	50	0.02	....	....	5
6	64.02	71.0	58.3	12.7	30.0402	30.076	30.012	.064	.4737	79.3	57.3	N.E.	5.1	6.3	10	0	22	....	....	....	6
SUNDAY 7	.....	77.7	56.5	21.2	....	......	......	....	.....		....	S.	6.8	....	..	..	47	....	....	...	7 ....SUNDAY
8	69.37	80.0	61.3	18.7	30.0107	30.124	29.935	.189	.6080	83.8	64.2	S.	13.6	7.2	10	0	51	0.26	....	....	8
9	60.12	67.0	54.4	12.6	30.2457	30.292	30.164	.128	.3595	70.0	49.8	N.E.	9.9	8.2	10	0	59	....	....	....	9
10	58.57	64.5	54.5	10.0	30.3445	30.367	30.313	.054	.3795	77.3	51.3	E.	6.0	9.2	10	5	9	...	....	....	10
11	56.18	60.7	52.6	8.1	30.3118	30.381	30.220	.161	.3783	83.7	51.3	S.E.	10.1	10.0	10	10	00	0.27	...	....	11
12	61.65	67.2	55.0	12.2	30.0050	30.153	29.871	.282	.5435	98.0	61.0	S.	10.8	10.0	10	10	00	1.74	....	....	12
13	67.95	76.8	58.4	18.4	29.7580	29.885	29.666	.219	.5975	85.3	63.0	S.W.	15.7	7.5	10	2	27	0.62	....	....	13
SUNDAY 14	.....	62.8	48.3	14.5	......	......	......	....	.....	....	....	S.W.	11.5	....	..	..	91	....	....	....	14 .... SUNDAY
15	57.80	65.9	49.7	16.2	30.0518	30.106	29.978	.128	.3937	82.8	52.3	S.E.	5.3	8.0	10	3	32	....	....	....	15
16	58.07	62.1	54.3	7.8	29.9637	[illegible]	29.929	.053	.4633	95.8	56.8	N.	5.3	10.0	10	10	00	0.26	....	....	16
17	58.70	64.6	54.3	10.3	29.9842	30.047	29.942	.105	.4008	81.7	52.8	N.	19.7	4.7	10	0	35	....	......	....	17
18	61.60	69.9	53.6	16.3	29.9723	30.002	29.953	.049	.3683	67.8	50.5	W.	12.5	0.0	0	0	99	....	....	....	18
19	62.42	71.1	52.1	19.0	29.9217	30.020	29.792	.228	.4002	71.8	52.7	S.	14.6	0.5	2	1	96	..	....	....	19
20	54.87	65.1	44.8	18.3	29.9822	30.183	29.819	.364	.3238	73.3	46.3	S.W.	17.8	5.5	10	0	35	0.10	....	....	20
SUNDAY 21	.....	53.8	39.5	14.3	.....	......	......	....	.....	....	....	S.W.	6.9	....	..	..	98	...	....	....	21 ....SUNDAY
22	52.95	59.6	44.0	15.6	29.9422	30.094	29.808	.286	.3187	79.5	46.3	S.W.	7.5	9.0	10	4	48	Inapp.	....	....	22
23	52.33	59.6	46.0	13.6	29.8165	29.971	29.743	.228	.3137	79.3	45.7	W.	16.3	9.2	10	2	39	0.03	....	....	23
24	45.97	51.8	40.6	11.2	30.2100	30.295	30.058	.237	.1920	62.2	33.2	N.W.	13.5	2.3	10	0	81	....	....	....	24
25	49.27	56.9	40.8	16.1	30.1422	30.314	30.006	.308	.2360	69.0	38.7	S.W.	15.1	0.2	1	0	99	....	....	....	25
26	50.57	58.0	43.1	14.9	29.9518	30.004	29.926	.078	.3200	86.3	46.5	S.W.	10.4	8.3	10	0	07	0.19	....	....	26
27	45.42	51.8	41.5	10.3	30.1408	30.280	29.990	.290	.2405	79.2	39.2	N.	10.0	6.7	10	0	00	0.08	....	....	27
SUNDAY 28	.....	52.0	38.6	13.4	....	......	......	....	....	....	....	N.	5.8	....	..	..	85	....	....	....	28 .... SUNDAY
29	47.00	55.0	38.1	16.9	30.3598	30.450	30.279	.171	.2348	73.3	38.5	S.W.	6.2	0.3	2	0	97	....	....	....	29
30	57.10	65.3	46.0	19.3	30.2083	30.230	30.179	.051	.3360	71.3	47.7	S.W.	19.0	0.2	1	0	96	....	....	....	30
....Means	57.79	64.62	49.83	14.79	30.0786	......	......	.160	.3846	77.9	50.5	....	11.3	5.75	..	.	51.6	3.57	....	....	Sums ....
16 yrs. means for & including this mo.	58.51	66.47	50.77	15.71	30.0110	. ....	......	.178	.3807	75.1	...	... .	....	5.69	.	..	¶5.41	3.34	....	....	16 yrs. means for and including this month

ANALYSIS OF WIND RECORD.

Direction........	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Miles..............	792	602	150	709	1070	3262	917	620	....
Duration in hrs..	77	65	27	83	99	231	72	61	5
Mean velocity...	12.9	9.3	5.6	8.5	10.8	14.1	12.7	10.2	

Greatest mileage in one hour was 38 on the 30th.
Greatest velocity in gusts, 42 miles per hour on the 30th.
Resultant mileage, 3410.

Resultant direction, S. 49° W.
Total mileage, 8,122.
Average mileage, 11.3.

*Barometer readings reduced to sea-level and temperature of 32° Fahr.
§ Observed.
† Pressure of vapour in inches of mercury.
‡ Humidity relative, saturation being 100
¶ Nine years only.

The greatest heat was 80.0 on the 8th; the greatest cold was 38.1 on the 29th, giving a range of temperature of 41.9 degrees. Warmest day was the 5th. Coldest day was the 28th. Highest barometer reading was 30.450 on the 29th; lowest barometer was 29.666 on the 13th, giving a range of 0.784 inches. Maximum relative humidity was 100 on the 12th and 13th. Minimum relative humidity was 48 on the 24th.

Rain fell on 11 days.
Aurora were observed on four nights.
Hoar frost on four days.
Fog on four days.
Slight earthquake at three minutes past three on the morning of the 26th.