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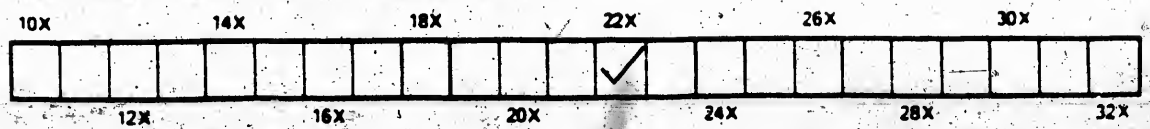

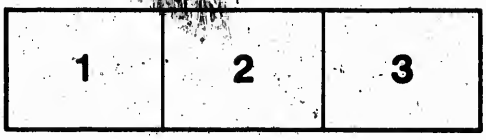

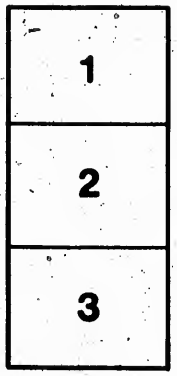

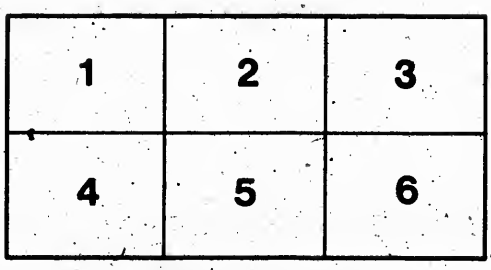

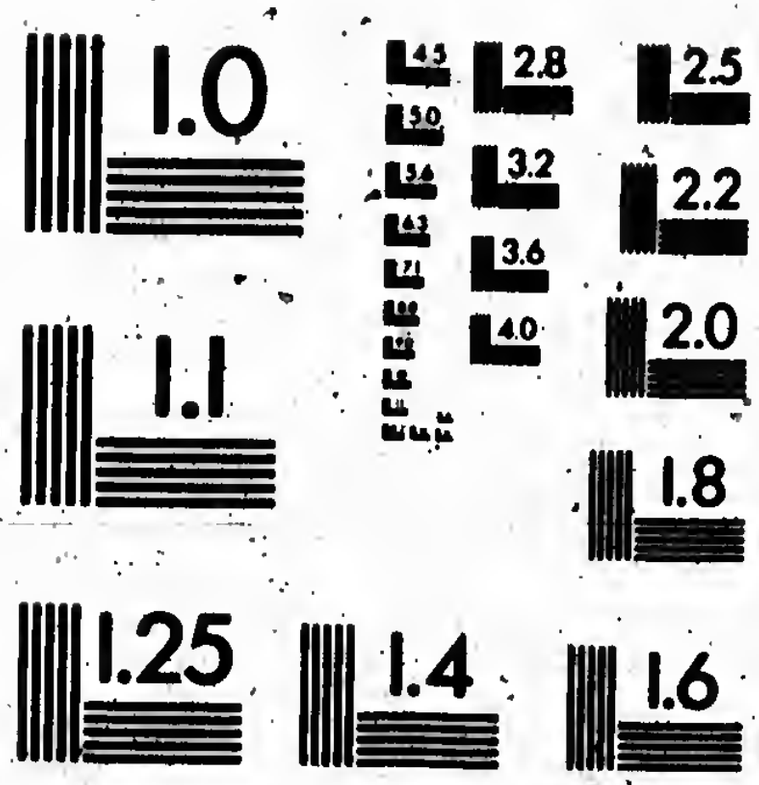

HAMILTON ASSOCIATION.

The regular meeting of the Hamilton Association was held at the Court House, on Friday Evening, the 6th December, 1872. The following paper was read by H. B. Witton, Esq., M. P.

A NIGHT'S WORK WITH THE MICROSCOPE ON SOME OF THE MINUTE FORMS OF LIFE FOUND IN BURLINGTON BAY, WITH SOME GOSSIP CONCERNING THEIR HISTORY AND DISTRIBUTION.

NOTE—All measurements in this paper are expressed thus: One Inch, 1"; One Tenth of an Inch, 1-10", &c.

On a previous occasion when I had the pleasure to submit to the members of this Association an account of some of the lower forms of life so abundant in our Bay, our attention was confined to the more prominent characteristics of some of the *Algæ*, and more especially to the modes of development common to some of the *Desmidiaceæ* and *Diatomaceæ*. Then, none of our objects of study carried us beyond the limits of the vegetable kingdom. To-night, however, I will endeavour to serve as a gossiping guide, to an examination of a few of the lower forms of life, generally regarded as distinct animals. All the minute objects, to which I solicit your attention, are common; indeed any student who, with but ordinary industry, devotes his leisure for a single season to the study of the organisms which may be easily found in our Bay, will find himself tolerably familiar with many members of the families of Animalcula, from which we select the objects of our gossip.

I assume we have our microscope in readiness, and our gathering made for our evening's work; so arranging our 4-10" object glass, and carefully scanning the field of our animalcula cage, our attention is arrested by what looks like a tiny, flattened lump of almost colourless translucent jelly. It is not at all a prominent object, partly from lack of colour, and partly from having almost the same power of refraction as water. Indeed by an untrained eye, it would be apt to be altogether overlooked. This little spec, which marks the zero of animal life, is an *Amœba*; so called by Ehrenberg from its failing to retain any one particular shape. Muller, the celebrated Danish naturalist, who with all his marvellous industry, strange to say, had seen but two specimens of this organism, had years before called it *Proteus*, after the changeful sea-god of the old mythology. The use of this name, however, it was found, had been forestalled by Laurenti, by whom it had been applied to a remarkable genus of reptiles; whence the adoption of the later name, since become common.

The substance of this organism shows no trace of fibrous or cellular tissue; but is found, on close examination, to be homogeneous, contractile and elastic; a substance called by Dujardin *sarcode*, and found by him to be common to most of the Infusoria. Scattered through the sarcode, are two or three kinds of granules, which, in their action under chemical reagents, differ from each other, and also from the sarcode itself. These granules, a few clear globules called vacuoles, which in the same form vary both in size and number; a larger globule which alternately contracts and expands almost rhythmically, sometimes called the contractile vesicle, and a nucleus and nucleolus, are all the traces of organization our highest magnifying power under the most favorable circumstances will be able to give. Indeed we may not be able to find either nucleus or contractile vesicle, for in some of these forms careful observers have failed to find either. Whether any of the *Amœba* have an investing membrane is difficult to determine. Aurbach confidently asserts that a delicate integument may be found in all the members of the group, but other observers do not sustain his assertion. The size of the *Amœba* varies considerably according to age, species, and conditions of growth. Careful measurements show a variation in different forms, from the 1-70" to the 1-2800". The specimen I have figured measures the 1-140".

What in these forms of life most strikingly arrests the attention, and never fails to interest no matter how often seen, is their peculiar mode of locomotion. This is difficult to describe, and must be seen to fully realize its peculiarity. First there is a gradual bulging out of the sarcode at some particular part, which part is gradually extended till in the species we are watching, it forms a foot-like protrusion equalling in length the entire mass of the body, and having a diameter of about one-fourth its length. Into this protruded part, which becomes gradually distended, the whole mass of the sarcode follows, and the animalculum has thus advanced, a distance equal to the length, the process was thrown out. This singular mode of advancement by protruding a portion of

the body, and then forcing the rest into it, goes on continuously; all parts of the sarcode alike, having power to send out these "variable processes." From their use as organs of locomotion these processes, thus singularly, and regularly thrust forward, are called *pseudopodia*. In the general economy of this class of animals these protruded parts are also used as prehensile organs for grasping their food, and thus may be said to discharge the two-fold duties of hands and arms, as well as feet. These *pseudopodia* in size, number and length, widely vary in the several groups of organisms kindred to the *Amœba*. This odd faculty of projecting from the mass of the body these processes, is found in a large number of otherwise widely differing forms of life; and has been seized on by Siebold as the distinguishing characteristic of one of the two classes into which, under the name of *Rhizopoda*, he divides the sub-kingdom of the *Protozoa*. This name, Siebold took from the properties of the pseudopodia, which in many of the class are as the name implies root-like feet.

The modes of reproduction known to occur in the *Amœba* are at least threefold. That by fission which may be seen often, commences by the thrusting forward of a somewhat larger process than usual. Instead of the mass of the sarcode flowing into this large process in the accustomed way, if we watch closely we may see a gradual constriction formed near the body, which becomes deeper and deeper until the process is entirely detached, and rendered free to continue its existence as an independent organism. Prof. Carpenter has detected in some groups of this class a mode of increase, known as "gemmation," which is the development of a new, distinct individual from a bud which the parent throws out. To this mode of increase so common to many of the Infusoria, we may in our gossip recur. Another mode of reproduction is near akin to that seen in the *Algæ*, and called conjugation, a process referred to in our previous gossip.

The *Amœba* has been seen to take an encysted state; a stage of being through which many of the Infusoria pass. This singular phase of Infusorial life, which is a literal withdrawal from the world, and falling back, on the part of the animalculum on itself, is interesting to study. The ordinary form of an animalculum gradually changes as the process of encysting goes on, until at length it has become globular, and the little being has surrounded itself with an investing integument for protection, and almost or entirely ceased to move. The Infusoria encyst for protection against drought, against cold, forming in this manner a convenient kind of winter quarters, and also for purposes of reproduction. From what many observers have seen, it is thought that it is for the latter purpose the Amœba generally encyst.

More than twenty species of Amœba are figured in the text books. But, as these distinctions are founded upon mere diversities of color, size, length of pseudopodia, and minor differences of a similar kind, it is questionable whether such trivialities are worthy of much attention. On the other hand there are naturalists who are disposed to accord a status amongst distinct species, to but very few members of the group. By such they are regarded as transient forms, common to several different organisms in the various stages of their development. The evidence that various observers have been able to adduce is unequivocal, that many organizations during some stage of their existence, take an amœboid form. The changes undergone by the Infusoria are perhaps no greater than those common to many living beings; and will appear to us less astonishing as our knowledge of their life history becomes more perfect. The difficulty of correctly tracing and understanding these changes must, however, always be great, from the diminutive size of the little atomies in which they occur.

Many forms of life wide apart in the scale of being are now known, which produce successive generations, so widely different in appearance from each other, that it would be impossible for one not cognizant of their history, to suspect any relationship at all between them. These peculiarities are in no class of animals so marked as in the Infusoria; and it is thus that as our knowledge of their whole life becomes more exact, our number of species is continually diminishing. The early microscopists naturally enough thought every new form of animalculum they saw, was a distinct species, while in some cases subsequent observation, has shown three or four of their species to be merely the harlequim changes taken by one specific form during different stages of its development. These whole broods which may be met with so unlike their progenitors, are now by many regarded as products of asexual generation; that is—young, springing from gemmæ or buds, and from fission. Moreover it is said, if these proles so unlike their parents be followed up, that even though they change through several generations, and though each new brood in its turn should be found more unlike the parental type than its predecessor, yet, as soon as the species is found to be produced again sexually, that is by the union of a sperm cell with a germ cell—as it will be sooner or later—so soon will there be a reversion to the parental type from which these intermediate forms varied. This curious course of change which has of late years been watched by many naturalists with much interest, was seen as far back as 1819, by Chamisso, who witnessed its occurrence in some of the *salpæ*. In these mulluscs he found two dissimilar kinds, which came one after the other in suc-

ternate generations." This discovery deservedly stamps the clever author of the shadowless man, as one of the few, in whom rare powers of observation have been cultivated simultaneously with the graces of fancy.

The believers in the possibility of Heterogenesis, who contend that the diversities of succeeding generations may go on indefinitely without any necessary recurrence to an ancestral type, have not been slow to argue that these changes seen in the *amœba* and in many of the Infusoria, tend to confirm their views. Carefully prepared drawings were given in the journal of the Royal Microscopical Society, about a year ago, of transformations of a *pin point monad*, which had been seen by an English observer of some note. This monad which under the highest powers is a mere spec, he had seen gradually become an *amœba*, and pass on through two intermediate forms to a fully developed ciliated infusorium. Prof. Edwards, of New York, has given a detailed account of similar changes, which by watching for two days he had seen in an *amœba*. Similar observations to these have been published during the last few years, resulting in much discussion, and the spread of a wider interest in every thing pertaining to the development of infusorial life. Those best competent to judge, are however, found with these who are most strongly protesting against drawing from imperfect observations, conclusions which the most extended knowledge of animal life can support by no analogy. Perhaps nothing having life is known, the sight of which more strongly tends to excite curiosity in an observer than an *amœba*. There was an early member of the Royal Society, whom Butler the poet was not slow to satirize, who believed that the special organs of one sense might be made to do the duty of another, and who instanced in support of his views, a Spaniard who "heard with his eyes and could see words." Our *Amœba*, though far smaller, is more than a match for Sir Kenelm Digby's Spaniard, for it discharges the duties of many organs in blissful ignorance of organs altogether. As to special provisions for discharging the functions of life, it is actually "sans everything." Yet it moves without muscles, feeds and nourishes itself without mouth, stomach, or any special arrangements for absorption and assimilation, in short, performs all its vital actions with an independence of special structural provisions, to which no other living being, high or low, can make any pretensions. A mere tiny lump of jelly, nothing can be imagined to live, with less differentiation of parts.

Although the *Amœba* is oftener met with in gatherings from our Bay than any other *Rhizopod*, we may sometimes find some of its near relations. One of these, the Sun Animalcule, *Actinophrys Sol*, is remarkable for being surrounded by fine radiating pseudopodia, which make it the miniature resemblance of those rayed figures used from time immemorial to represent the sun.

Another form, a species of *Arcella*, sometimes to be seen amongst the duckweed, closely resembles in structure the *Amœba*, but has the addition of a tiny, delicate shell.

The *Rhizopods*, the class to which these organisms so remarkable for their simplicity of structure, belong, have existing representative forms scattered all over the world. Their fossils, too, shew they had an existence in ages of the world so remote, that there is nothing which now lives, and nothing which to our present knowledge ever has lived, but must yield to their claims to be regarded as the earth's earliest settlers. Some groups kindred to these furnished by our gathering, deserve, from their importance as prominent members of this class, a few words of our gossip. One of these groups which has taken, and still takes an active part in the changes to which the earth itself is constantly subjected, by its innumerable inhabitants, is called, from the minute pores with which the shells of all the members of the group are perforated, *Foraminifera*. These shells are calcareous, and the substance of the bodies which occupy them has been shewn by Dujardin to be Sarcode. This sarcode is thrown into fine pseudopodia, similar to these found on our sun animalculum, and which are protruded like threads through the minute pores of the shells. Soundings in the deeper parts of the Gulf of the St. Lawrence, and in the Atlantic show their presence in the ooze in vast numbers and many varieties. Soundings for the Atlantic cable showed the ooze in places to contain ninety five per cent of one species, the *Globigerina*. So numerous are they in some places that a single ounce of sand from the Antilles has been estimated to contain four millions. In the chalk too their fossils are abundant, and they were undoubtedly active agents during the period of its deposition. Some of their species are almost cosmopolitan, and are found in the marls and calcareous rocks of the Tertiary, wherever these rocks have been defined. Charleston, South Carolina, stands on a deposit of marl more than 200 feet thick, in which, according to Bailey, *Foraminifera* are entombed in myriads. The stone commonly used in Paris for building, and that of which the Egyptian Pyramids are built, have *Foraminiferous* fossils for their chief ingredients. These insignificant forms of life are thus alike associated with man's most recent and artistic, and with his oldest, and most durable work.

The members of another group of this class, the *Polycystina*, have minute siliceous shells, which for beauty, the Diatoms themselves cannot surpass. The substance of the bodies of this group is similar to that of the *Foraminifera*, and as in them the pseudopodia

are protruded through the pores of their shells. Indeed the *Polycystina* closely resemble in many particulars the *Foraminifera* and differ from them, merely in being smaller, of a different shape, and in having a siliceous in lieu of a calcareous shell. Like their congeners, they too are found in the lower S. Lawrence, and in many places off the Atlantic coast. Their fossils have been traced from the shores of the North Sea to the Antarctic ocean. But for abundance and variety of forms, the deposit in Barbadoes excels any other deposit yet known. Here Ehrenberg found a rock extending through a considerable district, which contained no less than three hundred and sixty-one different fossil forms, of which number three hundred were before unknown. Some of these have a quaint grotesqueness of shape, and all of them have a marked beauty of outline, and delicacy of sculpturing, which make them once seen not readily forgotten.

We must not either, omit from our gossip another organism belonging to this class, the *Eozoon Canadense*; which is one invested with a unique interest. For this creature having so close an affinity in point of structure to these Amœboid forms of which we are gossiping; flourished in an era so far removed from our own, that the intervening ages, no mortal can guess. It is down in the Limestones towards the base of our Laurentian system that these fossils are found, thousands of feet lower than the lowest fossiliferous rock before known, and far beyond the limits of that "primordial zone," beyond which geologists had in error conjectured all was death. Our President, in his inaugural address, rightly called attention to the fact that the animal nature of this fossil has been disputed. But when we remember that Prof. Dawson, and other disinterested experts, who have made it the subject of special microscopical study, have no doubt whatever concerning its *foraminiferous* nature; and that moreover their decisions have, after the most painstaking examination, been unequivocally confirmed by Prof. Carpenter, whose special knowledge of these organisms is confessedly unrivalled; it is difficult to suppose that we have erred concerning its nature; or that our geologists will have to relegate it to a place amongst the more mineral objects in their collections.

Our collecting bottle furnishes us with a larger piece of a gelatinous substance than any of these to which we before turned our attention. Examination shows it to consist of a vast number of globules, which when set free assume an amœba-like form. We find also in addition to these a delicate net-work of fibres, and some yellowish seed-like bodies, which are more numerous the farther we carry our examination from the surface. A higher magnifying power, will show considerable complexity in the structure of these bodies. This bit of jelly which may be easily resolved into the above named constituents, is the fragment of a fresh water sponge, the *Spongilla Lacustris*. Specimens may be often found adhering to the piles on the sides of the Desjardin's Canal, where, under favorable circumstances they attain a size of from five to eight inches.

The group of organisms to which this *Spongilla* belongs, have been handled about from place to place in the zoological scale, by one after another of our naturalists, all of whom until recently failed to recognize their true nature. Thanks however to modern microscopical research, the sponges are now regarded as true animals, having close structural resemblances to the *Rhizopoda*, near which they must be placed in any natural system of classification. Bowerbank, Lieberkuhn and Carter, shew them to be compound organisms, made up of innumerable amœba-like forms. The seed-like bodies before mentioned, a higher power shews, contain a number of spicula, each of which resembles two little toothed wheels joined by an axle. When the amœboid mass of the sponge dies, as it does in the winter, it turns out that these little spicula are winter spores, which will remain encysted and unharmed during the cold, and grow into Spongillæ in the Spring. There is also a Summer process of reproduction which has been observed, and which is regarded by some as a true sexual process, the result of the contact of spermatozoon with ova.

Although these simple organisms at which we have taken this bird's-eye glance, are but little known, and still less cared about, I do not consider it necessary to offer to this Association any apology for allowing creatures so generally thought uninteresting, to monopolise our gossip to the exclusion of their more advanced congeners. For, to the true student of life, none of its infinite variety of manifestations—nothing that lives—is common or unclean." And even these lowest of the lowly things that live, are they not the first link in that marvellous chain of life of which man himself is but the last? In complexity of structure, how wide the difference between the amœba and the higher animals. Yet in all the essentials which distinguish a living being from an inert mass, how close the resemblance! Are not all animated beings moved by the same wondrous impulse which eludes all detection and defies all analysis.

And should any one anent these studies whisper *cui bono*, I answer, in the words of Stillingfleet, which, though uttered more than two centuries ago, are worth pondering still—"we may be sure of one thing, that if we study and follow nature, whatever path we are led into, we shall at last arrive at something valuable to ourselves and others, but of what kind we must be content to remain ignorant."