Address delivered before The Royal Microscopical Society, at the anniversary meeting, Feb. 9, 1870 / by J.B. Reade.

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DELIVERED BEFORE

The Royal Microscopical Society,

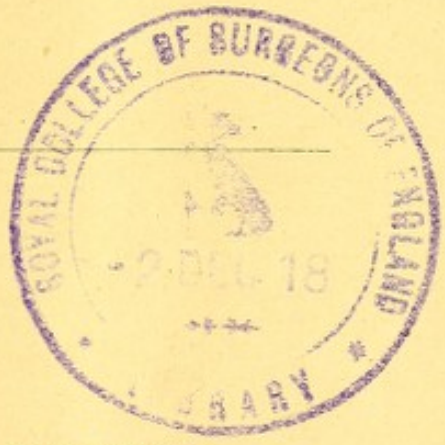
AT THE

ANNIVERSARY MEETING, FEB. 9, 1870.

BY

THE REV. J. B. READE, M.A., F.R.S.,

PRESIDENT.



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THE PRESIDENT'S ADDRESS.

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(*Delivered before the* Royal Microscopical Society, *February* 9, 1870.)

Gentlemen,

A statutable generation has nearly passed away since the first felt want of organization among microscopists issued in the formation of the Society over which I have now the honour to preside. To me, therefore, it seems natural to look back upon the past, and I will gladly carry my hearers along with me while I turn my sail up the stream of life under the cheerful gale of pleasant memories. It is now more than thirty years since the honoured father of our Society, Dr. Bowerbank, assembled what he called a "band of brothers" for the weekly investigation of microscopic objects, with special reference to structure, functions, and laws of formation. The animal, the vegetable, and the mineral kingdom were brought under review by pioneers of science, and the early fruits of their discoveries promised an abundant harvest. The cherished names of Lindley, Mantell, Lister, Henslow, Ward, Quekett, Bell, and of other leading investigators in the branches of physical science, where the microscope is an indispensable instrument for research, will be a guarantee, not for vague speculations, but for the establishment of new facts and the extension of positive knowledge. Could it be possible to collect within moderate compass an account of the weekly labours of Dr. Bowerbank and his zealous collaborateurs, not only would there be a present testimony to the value of their early work, but it would be at once apparent that the philosopher's *sanctum* within which so many were assembled was too limited in dimension, and that the law of cell-formation must perforce be called into requisition. Accordingly, after a large and most interesting meeting, specially assembled to greet our Honorary Fellow, Ehrenberg, Dr. Bowerbank said to me with a warmth of feeling I shall never forget, "God bless the microscope; let us have a Society." A hearty response was given on my part when Dr. Bowerbank added, we will call the Society the Microscopic Society. I suggested *Microscopical* instead of *Microscopic*, as being more in accordance with the analogy of nomenclature, and

preventing the possibility of ourselves being mistaken for microscopic objects. This was admitted, and hence our name. An arangement was made in due course for drawing up suitable rules and laws, and after a few preliminary meetings at Messrs. Bowerbank's, Quekett's, and Ward's, the "Microscopical Society of London" had both a local habitation and a name, under the presidency of Professor Owen, on the 29th of January, 1840.* From this date the appointed monthly meetings of the Society were regularly held, but the Monday evening meetings at Islington and Highbury were not yet interrupted. There the net was still spread, and the bait, too tempting to be refused, seldom failed to prove the skill of the angler in adding new members to our body. The varied treasures of well-arranged cabinets were always open for inspection, so that those—and they were many—who brought new objects of interest, received an ample equivalent in the knowledge they carried away. Many fields of microscopical research, now indeed well trodden, were then only just ventured upon by a few; and it will always be a pleasant recollection to Dr. Bowerbank that he was able to offer efficient assistance to the authors of valuable works, which tended in no small degree to advance microscopical investigation. Many of the objects figured by Mantell in his 'Wonders of Geology' and 'Medals of Creation,' were first of all exhibited to Dr. Bowerbank and his friends; and Professor Owen derived no small assistance both from Dr. Bowerbank's microscope and my own, in the exquisite drawings by Lens Aldous

* Extract from the first Historical Document in the Archives of the R. M. S.

"At a meeting held at the house of E. J. Quekett, Esq., Wellclose Square, September 3rd, 1839, to take into consideration the propriety of forming a Society for the promotion of Microscopical investigation, and for the introduction and improvement of the Microscope as a scientific instrument,

"Present, the following gentlemen:—

Rev. J. T. Bean,
Mr. J. S. Bowerbank,
Dr. F. Farre,
Mr. Francis,
„ Greening,
„ Jackson,
„ Lister,
„ G. Loddiges,
„ C. Loddiges,
Mr. E. J. Quekett,
Rev. J. B. Reade,
Mr. Rippingham,
„ Ross,
„ R. H. Solly,
„ C. Varley,
„ N. B. Ward,
„ A. White,

"It was resolved, that such a Society should be formed, that a provisional committee be appointed to carry the resolution into effect, and that the said committee do consist of the undermentioned gentlemen, *viz.*:—

Messrs. Bowerbank, Lister, Loddiges, Quekett, Reade, Solly, and Ward.

"The provisional committee having held several meetings, it was resolved, that the following Rules and Regulations be recommended for adoption:—

"1st. That the Society be designated 'The Microscopical Society of London.'"

Then follow twenty Rules, which were adopted at the first public meeting, under the presidency of Professor Owen.

of the sections of teeth which embellish his 'Odontography.' Of three of these sections I made enlarged photographs in 1839, for the artist's guidance, by means of the solar microscope, under such an arrangement of lenses that no danger could ensue from the heat-giving rays; and presentation copies of proofs of many of the plates, and also of Professor Owen's work on the Kangaroo will always be valued by me as a memento of those early days. Many papers also on the minute structure of fossil and recent plants owed their origin to these weekly meetings, and it will suffice to add that the elaborate work on Sponges, which even now is adding to the honour of our good friend's honoured name, is the fruit of the good seed sown thirty years ago. And happily the author is still with us and at work. The *cruda viridisque senectus*—his good and green old age—is still devoted with almost youthful ardour to his early love; while his ripe experience enables him to recognize more devoutly the hand of the Great Master, and to bid "God speed" to the Society which specially investigates His works. The few, alas! the very few of our original members who still remain on our list, will, with myself, refer with mixed feelings to this our early history, while the younger Fellows will be glad to find these few historical particulars for the first time officially recorded.

I have stated that Dr. Bowerbank is the father of the Microscopical Society. Perhaps I may be looked upon as a godfather and sponsor, inasmuch as I named the child; and now that it has arrived at maturity, it is my duty to see that in ripeness of age it may attain to perfectness of knowledge. To perform this my duty efficiently, and to give some proof of my abiding interest in the present and future welfare of the Society, it is my intention to place in its Library my own copy of the 'Philosophical Transactions.' In the perusal of this great work your minds will be filled with thoughts of other men; and after due meditation and study, they will be also replenished with your own. The unavoidable result will be a large accession of valuable papers at our meetings on topics peculiarly ours.

My first seventeen volumes of the 'Transactions,' from the commencement in 1665 to 1694, representing as it were the *Eocene period* of microscopical investigation, are *in extenso* as originally printed. Then follow ten volumes containing the 'Transactions abridged.' The first five volumes are by Lowthorp and Jones, under the *imprimatur* of Sir Isaac Newton as President. The remaining five are by Reid, Gray, and Martyn. In these volumes the papers are disposed under general heads, and the Latin papers are translated into English. This 'Abridgment' contains the 'Transactions' from the commencement to 1750. From this date the publication of the 'Transactions' was placed under the special direction of the Society itself, and not left, as heretofore, in the

hands of the respective secretaries, and my own copy is complete from 1751 to the present year 1870.* There is also an Index, both of authors and subjects, from the commencement to 1770, with *references* to the 'Transactions at large' and to the 'Abridgment;' and to complete our means of reference, not only to the 'Transactions,' but to many other philosophical works, both English and foreign, published during the present century, the Royal Society has generously added to our Library its 'Catalogue of Scientific Papers' now in course of publication.

I wish also to present to you my copy of the 'History of the Royal Society,' by Dr. Sprat. This learned Bishop of Rochester informs us in his preface that, owing to the objections and cavils of detractors, he writes not altogether in the way of a plain *history*, but sometimes of an *apology;* and it may be said of the Bishop, in the language of an author of the period,—"Taking to task that insulting question, *What have they done?* he gives an answer to it, which doubtless will satisfy discreet and sober men. And as for those that would have them give the *Great Elixir*, the *Perpetual Motion*, the way to make *Glass Malleable*, and *Man Immortal*, &c., or they will object *they have done nothing;* for such, *he saith*, their impertinent taunts are no more to be regarded than the *chat of idiots* and *children*."

But the Bishop had not only to meet detractors like these; he had also to vindicate the design of the Royal Society from the imputation of being prejudicial to the Church of England. And he finds it easy to point out the agreement there is between the design of the Royal Society and that of our Church in its beginning. "They both," says his Lordship, "may lay equal claim to the word *Reformation;* the one having compassed it in *Religion*, the other purposing it in *Philosophy*." And how this purpose has been carried out we ourselves are witnesses. Many reverent and master-minds, from Newton to the present day, have received in their study of the Book of Nature an illumination from the Great Author of Nature no less specific and manifest than that divine illumination which enabled Prophets and Apostles to indite the Book of Revelation. Hence, an enlightened philosopher can now point out, in terms unknown to the Early Church, *How* "the heavens declare the glory of God, and the firmament showeth His handy work,"—while, under an unerring inspiration, it is announced to us that "the law of the Lord is perfect, converting the soul."

I almost shrink from giving any historical account of the many portions of the 'Transactions,' specially interesting to ourselves, as I would rather avoid the *Scylla* of a mere index of authors, and the *Charybdis* of a too extended account of their works. Suffice it to say that our lamented President, Professor Quekett, has given us,

* A few parts now in the *limbo* of borrowed books will be replaced.

in his 'History of the Microscope,' copious extracts from these volumes, which literally teem with improvements in the construction of this instrument, from the very first published paper—*viz.* 'An Account of the Improvement of Optic Glasses by Campani'—to the recorded discovery of Mr. Lister, who raised the compound microscope from its primitive and almost useless condition to that of being the most important instrument ever yet bestowed by art upon the investigator of Nature. I would rather commend for your frequent and profitable perusal the whole 'Transactions of the Royal Society,' extending over more than 200 years. They are a mine of intellectual wealth; and the zeal and determined labour of those who drill and bore the solid earth for that gold for the body which perisheth, may be held up for the imitation of those who desire more anxiously gold for the mind. With these few observations I offer you this great commentary on universal nature, while, as a Fellow of your Society, I still retain the virtual possession of a gift now absolutely your own.

I connect at once the present with the past in addressing you now as "Fellows of the Royal Microscopical Society." The change in our designation and the charter which led to it were alluded to as simple facts by my predecessor in the chair, and that with a modesty which I am not bound to imitate, inasmuch as it concealed his own claim to the honour of procuring these privileges. Five years ago, at the official meeting of the Council, my predecessor strongly urged that my name should be placed first in the selected list of officers for the following year; but I knew myself, and I knew my friend; and it will be admitted by all that I exercised a wise discretion in then refusing the proffered honour, and in joining heartily with the Council in securing for our Society the untiring energy and practical knowledge of business which have enabled our late Chief Officer to leave behind him in uneffaceable characters the marks of Royal favour in the title "Royal" which Her Most Gracious Majesty conferred, and in the distinguished honour of receiving H.R.H. the Prince of Wales as our Patron. It is therefore but a just debt of gratitude, after his doubly biennial occupation of the chair—*viz.* during the last two years under our first condition and the first two years under the higher standing of our Society—that I should now offer to Mr. Glaisher, in the name and on behalf of the Society, our cordial acknowledgment of his faithful services, and our hearty good wishes for his future welfare.

The three oldest members of your Society, who were mainly instrumental in its formation, and who therefore had the honour of applying for a Royal Charter of Incorporation, were Dr. Bowerbank, Mr. Ward, and myself. The last address from the chair announced the death of our dear and valued fellow-worker and first treasurer,

Mr. Ward; and it is now my painful duty to record the loss of another of the associated founders of our Society, and to add to our obituary the name of Joseph Jackson Lister. Full of years and full of honour he rests from his labours; and it is the consoling testimony of the friends who witnessed the perfect calmness of his departure that he enjoyed that peace of which it is enough to say that it "passeth all understanding."

During the past year we have lost four Fellows by death, *viz.*:— Mr. Joseph Jackson Lister, F.R.S., Z.S.; Mr. Henry Hall; Mr. George Western, and Captain John Gould Noble; also one Honorary Fellow, Professor Purkinje, of Prague. We have lost six Fellows by resignation. The number of Honorary Fellows has been increased by two, and of Ordinary Fellows by twelve. At the present time our total number is greater than in any preceding year, being now 458.

In a long letter received from Professor Lister to-day I am furnished with important particulars regarding his late dear and honoured father. This obituary notice, through the medium of our Journal, will be placed in the hands of all our Fellows.

The points of special interest to our Society are naturally connected with the improvements Mr. Lister effected in the microscope; and owing to the admirable arrangement of his original MSS. and letters, we have here, in his own words, a detailed history of his experiments and discoveries from 1824 to 1837. When he saw his principles of construction practically carried out, he devoted his leisure to various investigations by aid of the instrument he had so greatly improved; and his well-known observations "On the Structure and Functions of Tubular and Cellular Polypi and Ascidiæ," beautifully illustrated by sketches from life under the camera lucida, form a classical paper in the 'Philosophical Transactions' for 1834.

Some important papers of Mr. Lister's, still unpublished, will, we may hope, be given to the world.

Our list of Honorary Fellows commenced with the names of Professor Ehrenberg and the late Professor Purkinje. These distinguished philosophers were elected at the first anniversary meeting of our Society in 1841. Professor Purkinje, of Prague, unlike his illustrious compeer of Berlin, was not a contributor to our 'Transactions;' but his valuable physiological researches, continued throughout a long and active life, place him among the most celebrated observers of modern times. He died on the 28th of July last, in the eighty-second year of his age.

Mr. Hall, Mr. Western, and Captain Noble, whose loss we also deplore, took great interest in microscopical literature; and Mr. Hall will be especially remembered among the circle of his friends as having zealously promoted microscopical investigation at Hackney.

A few words *in memoriam* respecting the late Mr. Holland, who, though not officially *of us*, uniformly worked with us, will be received, as a due tribute to the zeal of one of our oldest friends.

Mr. Holland commenced life as a clerk to a ship broker, and afterwards started in business, first as a partner, and then alone as a wine merchant on Tower Hill.

He was always ardently attached to science, and every moment he could spare was devoted to some pursuit connected therewith. As early as 1822 both the telescope and microscope seem to have been passions with him. For a long time his best microscope was a small compound one by Cary. To this instrument he added the first rectangular movable stage. Afterwards he began to construct and use very perfect globules of glass as objectives in a single microscope made on a plan of his own, and having caused some of these to be ground plano-convex, his continued study and experiments resulted in the manufacture of some excellent Wollaston *Doublets*, and afterwards in the *Triplet* with which his own name has since been connected. The Triplet carried the single microscope to its highest point of excellence, and for its discovery the Society of Arts awarded him its Silver Medal.

At the time Mr. Barton made the beautiful specimens of fine lines which are seen in the buttons now bearing his name, he ruled, at the request of Mr. Holland, some exceedingly fine micrometers, which bear comparison with any recent productions.

In September, 1833, he opened an exhibition of a gas microscope, at 106, New Bond Street, which continued till July, 1834. This instrument greatly surpassed the first arrangement exhibited by Cary and Cooper in the previous year, inasmuch as the error of spherical aberration was neutralized by mounting the objects on curved glasses.

In his collection of apparatus there is a rectangular prism and a separate raised stage for sub-stage oblique illumination, and among his papers we find a careful series of observations by this arrangement on the *striæ* of various species of diatoms.

An ingenious speciality was the construction of polarizing "Floral Devices" for the microscope, some of which were made up of as many as 192 pieces stamped out of various polarizing films by a graduated series of minute punches, the connecting stems being formed of the hairs from the back of a child's hand, adult hairs being too coarse. One of these is most kindly presented to our Society by Mr. J. Lyon Field, the present possessor of Mr. Holland's microscope and objects.

His latest investigations were on the specific microscopic characters of the virus of the cattle plague, illustrated by mounted specimens and careful drawings.

For the last thirty years he was in the counting-house of

Messrs. Field, of Lambeth, and his probity, methodical habits, and untiring attention to business, secured for him the personal respect and friendship of every member of the firm. His naturally vigorous constitution was at last undermined by chronic bronchitis, and he passed away in his sleep on the 15th day of November, 1869, and in the 77th year of his age.

At the eight monthly meetings held during the past session twenty-one papers have been communicated, *viz.* seven by friends of our Fellows, and fourteen by Fellows themselves.

The first paper in March, by the well-known and accurate observer, Dr. Gulliver, points out the unique character of the fibres of the crystalline lens of the lamprey, which appear to be smooth and not serrated. This departure from the general law of structure is very remarkable.

The exhaustive and elaborately illustrated paper by Mr. Suffolk, "On the Structure of the Proboscis of the Blow-fly," and the paper by Mr. Lowne "On the Rectal Papillæ of the Fly," are admirable specimens of patient investigation and manipulative skill.

Valuable communications in reference to minute anatomy and animal and vegetable physiology, by Messrs. Sanders, Kent, McIntyre, Carruthers, Wake, and Dr. Macintosh, have supplied us with new and useful information, and led to enlivening and interesting discussions.

In bringing before us the forms of gigantic *Lycopodiaceæ* belonging to the Carboniferous period, Mr. Carruthers set forth, in a very able *vivâ voce* exposition, the several points of agreement and difference between the immense stems of ancient cryptogamic forests and the stems of existing plants. During my own residence in Halifax, in 1829 and two following years, I had frequent opportunities of examining the *Lepidodendron selaginoides*, figured and described by Mr. Carruthers, and I can corroborate his statement that the fossil-bearing nodules, known locally as "*baum-pots*," occur over a space of many acres. One of these *baum-pots*, now in the Halifax Museum, has entrapped, in the Coal-measures, about 12 inches of the skeleton and tail of an 8 or 10 lb. fish.* It was during my residence in Halifax that the British Association, of which I am now what is popularly known as "an old life member," assembled for the first time at York under the presidency of the Earl Fitzwilliam, and from that time to this our indebtedness, as microscopists, to a goodly company of members of the Association, will be acknowledged by us all. It is also gratifying to find that our own labours have been recognized by the Association, and we

* A plaster of Paris cast of this remarkable baum-pot fossil was sent to the meeting by Mr. Waterhouse, of Halifax. The fish is probably a fine specimen of the *Cœlacanthus Phillipsii*, described by Agassiz, having a cartilaginous vertebral column with bony *hollow appendages* (hence its name) and beautifully sculptured scales.

may hope that the lapse of twelve years gives additional force to the following words of our own first President in his *Address* at the Leeds meeting of the British Association :—" The microscope is an indispensable instrument in embryological and histological researches, as also in reference to that vast swarm of animalcules which are too minute for ordinary vision. I can here do little more than allude to the systematic direction now given to the application of the microscope to particular tissues and particular classes, chiefly due in this country to the counsels and example of the Microscopical Society of London."

At our meeting in April, Dr. Beale, treading on the very confines of the limit of human knowledge, brought a question before us which may very easily be answered on the ground of speculation, yet all but unanswerable on the basis of truth. What is *Protoplasm?* and, What is *Life?* In consequence of the penumbra of diametrically opposite definitions, Dr. Beale rejects the word *Protoplasm*, so much in favour with metaphysical physicists, and he enables us to look on at the battle of the giants vigorously destroying each other's theories but failing to establish their own. In propounding his own views concerning the *matter* of living beings, Dr. Beale restricts himself to the simple and expressive terms, *germinal matter* and *formed matter*. The former is possessed of *vital properties*, and the latter of *material properties* only. The rather striking difference between dead and living matter seems to justify the rejection of a term which is indiscriminately applied to masses of living things and dead things, and to warrant the use of other terms which are free from the mysteriousness of *protoplasm*, and which properly indicate matter existing in two very different states, *living* and *formed*.

Then, as to the question, What is Life? This much we know, on the highest authority, that Life is the direct gift of the Creator to the living creatures of His hands, and for perfect knowledge we must wait for the perfect day, when " we shall know even as also we are known." Meanwhile, the conscientious observer is amply justified in investigating the Law of Life as well as the Law of Gravitation, telling us, as it may seem to him, what it is and how it acts ; and if he advance no farther than a plausible hypothesis, he may thereby direct us *Truth-ward* though he reach not the goal himself. We can place no limit to legitimate inquiry, nor refuse a hearty reception of well-established facts. At the same time let us bear this in mind, *Humanum est errare*, and it may be that universal error is received as practical truth,—but truth is not error for all that.

In the discussion of an allied subject, Mr. Staniland Wake strongly supports the view that the connection between the initial phases of animal and vegetable life is more fundamental than has

hitherto been supposed,—that it is, in point of fact, a mere matter of chance, a mere question of conditions, whether a particular germ shall finally be exhibited as a true animal or a true vegetable. But this speculation on the most minute forms of existence ought to be supported by evidence which substantiates the hypothesis. Otherwise, in spite of the novelty which may be attractive to younger philosophers, the old faith will maintain its ground, that animal or vegetable life is in no case produced except from germs of individuals of the same species.

At our December meeting Professor Rymer Jones favoured us with a short *extempore* account of deep-sea dredging. This laborious operation is now carried on with equal assiduity and success. Ehrenberg, as Professor Owen states, had discovered that the substance of the greensands in stratified deposits, from the Silurian to the Tertiary periods inclusive, is composed of the casts of the interior of the microscopic shells of *Polycystineæ* and *Foraminifera*. But many soundings now brought up from various parts of the deep sea consist chiefly of similar microscopic polythalamous shells, mingled with a greensand composed of casts of *Foraminifera*. Therefore the mode in which a deposit was made at the bottom of the deep primeval ocean of the Silurian period is illustrated by that which the microscope has demonstrated to take place under similar conditions at the present day.

Thanks to the *monthly publication* of our 'Proceedings,' I am spared the regret of my predecessor, who naturally complained that in preparing his address he had not the advantage of perusing the papers communicated at the two preceding meetings. The papers are now posted up to the day, and the Journal for this month contains the four papers read in abstract at the meeting in January. The last of these is a long and most instructive monograph by Mr. Kent, "On the Calcareous Spicula of Gorgonaceæ, their Modification of Form, and the Importance of their Characters as a Basis for Generic and Specific Diagnosis." It is only very recently that naturalists have availed themselves of this new basis for a natural system of classification, and it is cheering to an old observer to see the tact with which a young microscopist exhibits Nature's modifications under Nature's law. Mr. Kent's paper, with nearly 100 charming illustrations of his subject, most of them heretofore unfigured, is a boon to microscopists, and stamps something far beyond a mere money value on the 'Monthly Microscopical Journal' for February.

Our thanks are due to Mr. Browning for two papers on the Spectroscope, and to our Hon. Secretary, Mr. Hogg, for his results of spectrum analysis. In the reported discussion on Mr. Hogg's paper, I should be glad to place *absorption bands* on a few expressions used by Mr. Ray Lankester, as their absence would add force

to some of his criticisms. It is true, for instance, that alcohol alone is not the best menstruum for the chlorophyll of plants. A previous aqueous solution is desirable. Of this I have just had a striking example when examining the spectrum of the Japan honeysuckle. The dark purple skin of the fruit yields a purple solution to water, and its spectrum is marked by the obliteration of the red, with the exception of a curiously thin bright band untouched in the middle of the red,—the obliteration of the yellow and blue, and the exaltation of the green. The subsequent alcoholic solution of the portion first acted on by water gives a green solution of chlorophyll, and its spectrum is now characterized by a magnificent black band near the commencement of the red, over the line B,—a pale band in the green, and the cutting off of nearly all the blue. Whereas the spectrum of a primary alcoholic solution is a curious mixture of these two spectra.

Another striking example of the accuracy of spectroscope work was lately supplied by Mr. Sorby, to whom I forwarded the dichroic fluid exhibited at our last Soirée. Mr. Sorby clearly proves that a very different spectrum is produced by the addition of albumen to the confervoid mass, and hereby he establishes Mr. Sheppard's conclusions, and disestablishes Mr. Ray Lankester's assertions.

Mr. Browning's micro-spectroscope was lately added to our Ross-microscope. The spectroscope leads us into a new field of research, and the wonders revealed by this marvellous instrument are only dawning upon us. Already it converts the telescope into a celestial microscope, and in the hands of our distinguished Fellow, Mr. Huggins, now on the Council of the Royal Society, it enables him to deal with the constituents of some of the mighty spheres of the universe as if they were merely elements of the *Volvox globator*. Mr. Browning has recently improved the series of prisms, and also, in order to secure a reliable measurement of absorption bands, he has converted the instrument into a *micrometer-spectroscope;* and I have the pleasure of stating that Mr. Browning will put new and more powerful prisms to our own instrument, and will also add "the new measuring apparatus" as a present to the Society. Mr. Browning's communication on this subject was read at our last meeting, and we learn from it, in few words, that the micrometer-spectroscope determines the position of absorption bands by their accurately measured distance from Fraünhofer's fixed lines of the spectrum, while the ordinary micro-spectroscope determines their position by their distance from one of Mr. Sorby's 12 interference lines produced by a thin plate of quartz between two Nicol's prisms. Mr. Sorby's ingenious artificial scale is thus superseded by an unalterable natural scale.

With respect to the attempts brought before us to improve the microscope itself as an instrument of scientific research, I must

refer to Dr. Royston-Pigott's paper "On High Power Definition," and to my own paper "On the Equilateral Prism." Considering a perfect microscope as consisting of two parts, a magnifying apparatus and an illuminating apparatus, Dr. Pigott proposes to weed out, as it were, an effective portion of the small residuary spherical aberration of the best objectives, and I have ventured to propose a principle of illumination which has not hitherto been avowedly advocated. When Dr. Wollaston recommended for an illuminating lens one of three-fourths of an inch in focal length, in which the microscopic object was placed in a vortex of foci, where the rays crossed in a thousand points both before and after they fell upon the object, he failed to realize the true method of illumination. Spherical and chromatic aberration are equally injurious in either of the essential parts of a microscope. The equilateral prism used as a condenser and the hemispherical lens used as a prism, are free from both these errors. They supply, the one a condensed, the other a simple, single beam of parallel light; and a microscopic object, under such illumination, has virtually the advantage of being illuminated as by the sun. Natural light and shade are secured, and objects, like the valves of the Diatomaceæ, which hitherto have been shrouded in a haze of interpretations, are truthfully presented to the observer. I therefore look upon the prism as a kind of "*Zaphnath-paaneah,*" a revealer of secrets.

Dr. Pigott's work is more arduous, and it certainly met in the first instance with an encouraging amount of opposition,—encouraging, I mean, to one who knew—and was prepared to defend—the right. For my own part, I must honestly say, and I am not alone in my opinion, that I did not believe a word of it. In point of fact, I was sure that Dr. Pigott's "beaded scale" was not the true *test scale.* True, we were all taken by surprise and uttered our criticisms freely, yet, in my own defence, I must be allowed to say that I do not concur in the personal comments reported in our 'Proceedings' and now willingly cancelled. I felt, however, that I had sat too long at the feet of my old friend, Andrew Ross, to admit the possibility of his good work being vitiated by this newly-announced error, and what I did not look for I did not find,—but only because I did not look for it, not because it did not exist. There is undoubtedly in our best objectives a residuary spherical aberration,—small, I admit,—but it is unnecessary to say to a microscopist that its injurious effect upon the magnified image of an object varies directly as the square of the power of the eye-piece. It would be beyond the scope of a President's Address to point out how this small but injurious amount of error may be detected and diminished. This must remain as a fundamental problem in the *Optician's Euclid.* It is enough to record *the fact of improvement* as one of the salient points of the year. I will therefore

only add that those who, like myself, have seen Dr. Pigott's exhibition of the beaded scales of *Lepidocyrtus curvicollis* and *Degeeria domestica*, can only sincerely thank him for taking the trouble to compel us to believe that a successful raid upon the existing trace of spherical aberration is not a myth.

The immersion lens, the "hydro-objective," has probably an advantage in "the battle of the glasses" over the "pneumo-objective," as pointed out by Dr. Pigott; and Mr. Ross has laid us under further obligation by kindly adding immersion-fronts to his $\frac{1}{8}$th and $\frac{1}{12}$th in our possession. The high praise, however, which is given to the immersion system will perhaps be received with caution until more extended observations have been made upon its powers. Yet all seem, at present, to admit that considerable advantages are gained by its use. The light is more abundant, the colouring of natural objects more brilliant, the definition keener: inferior glasses are frequently improved by its application: illumination can be more effectively employed with a less complex machinery of stops, diaphragms, and condensers: above all, facility of construction seems to be indicated by the offer of the highest powers at the lowest prices. This intimation comes from the Continent,—*A* $\frac{1}{12}$*th for fifty shillings!* Is such work possible at home? Still we have yet to learn, notwithstanding these acknowledged advantages, whether there are any considerable drawbacks looming in the microscopic future which may in some measure counterbalance the employment of water refractions. Of one thing we may be sure, that absolute perfection is unattainable. The ghost of aberration will never be entirely exorcised even by cold water. It is there —do our best—and after all our compensations for figure, as for colour, there ever must be a little ghost of an error in all probability. At the same time, I believe it to be reduced to the *minimum visibile* when the *colour test* so strongly advocated by Dr. Pigott is fairly exhibited on the stage. Thus the natural colours, for instance, of the upper and lower rows of beads on the scale of *Degeeria plumbea* seem, for the first time, to be brought out by Dr. Pigott's more accurate balance of positive and negative aberrations. But this part of the subject is extensive, and must be left for further research and observations.

It is proper to remark that Colonel Woodward has resolved the 19th band of Nobert's lines with a Powell and Lealand's $\frac{1}{16}$th immersion. He is the only observer who has succeeded in resolving 112688 lines to the inch, with a power of 1000 linear. But these lines present the same appearance as lines drawn about 112 to the inch would afford at a distance of 10 inches, to the ordinary sight,—which are evidently exceedingly close for numeration. No other powers in Colonel Woodward's possession could resolve this 19th band, and this is a strong fact in favour of the immersion system. But even

here diffraction lines are multiplied, and the visibility of the lines is a function of the breadth of the groove ploughed in the glass,—the depth to which it is cut,—the sectional shape of the groove itself,—and the direction and character of the illumination employed. All these variable conditions in some measure detract from the fixed value of this test. It ought to depend upon the uniformity of standard conditions. The *Acus*, as shown by Mr. Powell, is a sharper and safer test.

A valuable series of papers by Mr. Wenham, "On the Construction of Object-glasses for the Microscope," will be found in the 'Monthly Microscopical Journal' for 1869. These papers were considered by the author to be communications to our Society; but, owing to their nature and arrangement, the formal reading of them was, at his request, dispensed with. It is acknowledged by all opticians that Mr. Lister's introduction of the *triple-back*, *i. e.* the innermost of the three combinations, has proved "the grandest step" towards the perfection of the compound objective. Mr. Wenham was no doubt the first to connect with this new back a lens nearly hemispherical, instead of the cemented triple front. Mr. Wray, following closely but independently in his wake, used what he calls "the kettledrum system for front" so early as 1851. It gives confidence to observers when they find that able men are driven by the necessities of the case to work by almost the same rules. Accordingly I received with pleasure a note from Mr. Wray, in which he says, "Judge of my surprise when I read Mr. Wenham's first paper, and found he was using a form very nearly similar to my own." Mr. Wenham points out very forcibly that the single front has the advantage of facility of construction, and also gives command over any required extent both of aperture and power. When we find the diameter of a single front to be only the $\frac{1}{70}$th of an inch, Mr. Wenham may well say, "The difficulty if not impossibility of constructing a *triple* of such almost invisible atoms of glass may be imagined."

Despairing of taking up the subject again practically, Mr. Wenham leaves, as a legacy to opticians, an improvement even on the single front, and proposes to construct the higher powers with two single lenses in front, of equal radius. If these are set in contact, the magnifying power will be nearly as their sum; they may therefore be made of double the radius, and consequently nearly twice the diameter, which, of course, would lessen the practical difficulty of working a $\frac{1}{50}$th, and enable us to go even beyond this power. A partial experiment with a $\frac{1}{4}$th, having this "doublet" front, has proved that perfect correction for colour is the result. Our leading opticians will no doubt thankfully avail themselves of these suggestions of an amateur labourer whose masterly knowledge of the subject and almost unrivalled practical skill fit him to speak *ex*

cathedrâ. The Society also will learn with regret that Mr. Wenham is now unable to take his place amongst us and to add, as heretofore, to the interest of our discussions.

Among the many valuable presents received during the past year, the Amici reflecting microscope, presented by Dr. Millar, requires a special notice. As Holland's *Triplet* was the culminating point of the single microscope, so the *Amici Reflector* was a stand-point in the history of the compound microscope. It is not too much to say that the compound microscope had been in what we may term an embryo state for a period of nearly 200 years. Griendelius in 1687 published in his work on the Microscope a diagram and an account of a compound microscope, the compound positive eye-piece consisting of two pairs of plano-convex lenses placed with the convex surfaces towards each other, an arrangement superior perhaps to Ramsden's, and, what is very remarkable, the object-glass of that early microscope is compound also, consisting of two plano-convex lenses of short focal length, as in Wollaston's celebrated *doublet*, the convex surfaces being hyperbolic curves. Spherical aberration, however, would necessarily confine such a construction within the limit of low powers, and the achromatic objective had not yet become a matter even of mathematical speculation. Errors from curvature and colour seemed for a long time to be looked upon by opticians as a *sine quâ non*, and to be accepted as an inherent and irremovable blot upon their work. Nor did mathematicians get them out of the scrape until Amici, in our own day, threw the refracting medium overboard, and, after the example of Newton, used a small speculum for high and low powers. In the exterior of the Amician microscope there is indeed a *primâ facie* resemblance to a Newtonian telescope; but, as Dr. Goring justly remarks, "the form of the concave metal and the situation of the radiant point are so totally different as to constitute a new instrument."

The instrument presented to the Society by Dr. Millar was made by Cuthbert. Dr. Goring gives a very minute description of it in his 'MICROGRAPHIA,' speaking of Cuthbert and himself as "the parents of the instrument *in its effective form*." I was fortunately able to complete Dr. Millar's instrument by adding to it the deeper objective metals, and these, in Dr. Goring's opinion, became invaluable when Cuthbert's loss of sight stopped his work. Yet, under my own eyes, this good old man when blind, but owning an inner light, figured to perfection a small speculum for my Gregorian telescope, saying with the blind old poet, "Yet not the more bate I one jot of hope, but hold right on."

As the triplet gave place to the more aplanatic speculum, so the latter was ultimately superseded by the Achromatic objective. Wm. Tulley was the first among English opticians to produce a single uncemented achromatic triple, $\frac{2}{10}$ths of an inch in focal

length. This was effected for Dr. Goring, but only after such an amount of "trial and error" that the cost of labour alone, as Tulley informed me himself, was not less than 90*l.* on the first object-glass. The record of this fact is interesting.

The present prosperous condition of our Society not only in the number of our Fellows but in their working power and its efficient results cannot fail to be a source of satisfaction. It is also gratifying to know that our influence during a period of thirty years has been largely felt by other bodies of scientific men, both in London and the provinces; so that there is hardly a town of importance in the length and breadth of the land without its co-operative Microscopical Association. In the large centres of commercial enterprise and industry our own labours find a parallel in theirs, and our once infant Society is now surrounded by a host of kindred institutions, joining with ourselves in the minute and accurate investigation of Nature's laws and works. But in looking at the extent to which the leaven of our influence has operated, it is impossible to omit a tribute of admiration to the "State Microscopical Society of Illinois," for which a charter was procured at the last Spring session of the legislature, and published *in extenso* in the 'Chicago Times' on the 12th of April last. Your President and Mr. Durham, as the President of the Quekett Club, were invited to be present last May at the first great gathering of this new Society, when an address of no ordinary interest and power was read from the chair. This address commenced with a condensed account of microscopy as to its antiquity and its progress in modern times, and then more fully described the status of the Royal Microscopical Society of London, and its influence upon science, literature, and optical art. After alluding to the increasing number of scientific journals ably edited and abundantly supported, and also to our own and other 'Transactions' admirably printed and illustrated, the President observed that "the influence of such a tidal wave on the interests of science must be at once apparent. Nor," says he, "did the usefulness of the parent Society (for such the London Society may justly be called) end here. From its formation it has given such an impetus to the optician's art as to have produced a keen but friendly competition, which has resulted in a degree of perfection deemed impossible a few years ago,—a competition which is, year by year, producing the most marked benefits to science, and, therefore, to the world."

The President then alluded to the past and present condition of Chicago, and to the marvellous change both in the face of the country and its population, which seems to us, on this side the Atlantic, more like a new creation than the following out of any natural law. He writes as follows:—"The time-honoured saying of good Bishop Berkeley, 'Westward the star of empire takes its

way,' is as true in science as in material things, Thirty years ago, when the founders of the London Society met together, the city in which we live was little better than a swamp. Ten years later, when the writer first saw it, it was despised even by the cranes. The only decent tavern where the traveller could find 'native rye' with a strong smack of 'fusil,' was the old Sherman House, opposite which, in a wooden erection, 10 by 12, presided the Hon. Hugh J. Dickey, as Judge of the Circuit Court of Cook County, surrounded by such *an aborigines bar* as would lead the more civilized spectator to doubt whether they were the exponents or the examples of the criminal code of the State. But the old times have fled; and now, in a well-ordered city with its 300,000 inhabitants, on this 30th day of May, 1869, we are able to note that just thirty years from the foundation of the first Microscopical Society of which we can find any record, we have with us, in all the pride and pomp of circumstance, THE STATE MICROSCOPICAL SOCIETY OF ILLINOIS."

The proposed cultivation of microscopy by this young but far-seeing Society contains useful hints to those who have been longer at work. Already special committees have been appointed for the systematic investigation of floral structures, cryptogamous plants, vegetable and animal histology and pathology, vegetable and animal parasites, infusoria, crystallography, and kindred branches. Besides which it is desired to make the Society useful in social and commercial interests, by detecting adulteration in food and fraud in fabrics, and to exhibit from time to time, so far as may be possible, to such of the citizens as may appreciate it, the minute handiwork of the Creator, as it can be seen in no other way than through the almost infinite vision of the microscope. Such, then, is the vigorous impulse which our parent Society is admitted to have given during the past year to microscopy, in the great commercial centre of the State of Illinois.

In accordance with an intimation made to you at our last anniversary, your President and Council, in the early part of our present session, were permitted to lay before the Chief Commissioner of Public Works and Buildings their formal application for apartments in some building appropriated by Government for the use of learned societies.

It was stated to the Chief Commissioner that the Royal Microscopical Society, from the date of its foundation in 1839, has efficiently contributed to the advancement of the various branches of science which the microscope is capable of elucidating, and that the very high degree of perfection obtained by English opticians in the construction of microscopes, and apparatus pertaining thereto, has mainly resulted from the labours of Fellows of the said Society, in devising plans, supplying formulæ, and generally stimulating

a demand both for first-class instruments, and, what is of equal importance, for those of an educational character.

That the Society, now numbering more than 450 members, has for many years published, and continues to publish, records of its Transactions and Proceedings, and has accumulated a valuable Library of Microscopical and Philosophical works, and a large collection of objects, preparations and instruments.

That many of the researches promoted by the Society have a direct bearing upon questions of public health, the propagation and prevention of disease, the adulteration of food and medicine, and the detection of frauds upon the excise, and that the assistance and counsel of Fellows of the Society have been sought by official persons in departments of the public service where the microscope is in frequent use.

That the Society is under the special patronage of His Royal Highness the Prince of Wales, and has received in the title conferred upon it a distinguished mark of Her Most Gracious Majesty's royal favour.

The Chief Commissioner of Works, acknowledging his own personal interest in the advancement of Microscopical Science, very kindly submitted for the inspection of the deputation a plan of the new buildings at Burlington House, and he expressed his regret that all but one set of apartments at the top of the building had been appropriated to the larger wants of other Societies by the former Government. He also pointed out certain alterations which might be made in the plan for the more convenient arrangement of our library and instruments, and intimated his wish that application should be made to the Linnean Society for the occasional use of their own meeting-room. At the same time, while expressing a decided opinion as to the propriety of our application, the Chief Commissioner of Works distinctly stated that the uncertainty which hung over the whole business—the contract even had not been signed—prevented him from formally committing himself to a definite promise of the apartments, and he hoped we should be satisfied with the statement he had made.

Your Council cannot but feel that the sincere regret expressed by the late Chief Commissioner at not being able to make a definite promise, and the recollection of his very courteous and friendly reception of the deputation, form the best ground for hope that the present Chief Commissioner of Public Works, at the proper time, will kindly gratify the Society by a grant of the apartments in question.

The historical character of my Address suggests a few remarks on the publication of our 'Transactions.' 'The Microscopic Journal,' edited by David Cooper, in 1840 contained the first brief record of the 'Proceedings' of our Society. In the first volume we find the important statement that the papers read at the several monthly

meetings had all been presented to the Society by the respective authors, together with a portion of the drawings, diagrams, and specimens by which they had been illustrated. These papers, with others which have since been read, but never published, are duly deposited in the archives of the Society, and a catalogue of such communications and illustrations will be forthwith prepared. In the first annual address from the chair, Professor Owen reviewed at considerable length the previous monthly contributions to microscopic science in reference to minute anatomy, animal and vegetable physiology, zoology, and palæontology; but beyond short abstracts of some of these papers in the 'Microscopic Journal,' the only reference to them is contained in the President's address. An official catalogue of our MSS. is therefore a desideratum.

'The Transactions of the Microscopical Society of London,' published by Van Voorst in three volumes, and issued to members gratis, contained a selection of the papers read before the Society during the first thirteen years of its existence. The nine parts of this work contained on an average about six papers and five plates for each year; but such was the tardiness of publication, that the first part of vol. iii., published in 1850, contained two papers read in 1847, and three read in 1848. This quiescent period was closed in 1852 by the publication of the Quarterly Journal. With reference to this publication it may be stated, as a matter of history, that Mr. Samuel Highley, then associated with his father, observing that the 'Transactions' of our Society appeared with great irregularity and at increasingly long intervals, thought that a journal devoted to microscopy, published regularly every quarter, would be welcomed by the increasing number of persons interested in the microscope, whether as an instrument of rational amusement or of earnest research. He felt convinced, however, that the elements of success depended upon leavening purely scientific matter with a sufficiency of popular articles and memoranda to enlist the support of a large number of histological amateurs, without whose aid the existence of a scientific periodical would be impossible. Dr. Lankester and Mr. George Busk were then invited by the proprietors to become the editors of the projected journal. The prospect of a more speedy publication of our papers secured the co-operation of our Society, and the first number of 'The Quarterly Journal of Microscopical Science' was launched in October, 1852, with the promise of contributions from very many microscopists of note in the United Kingdom. In the first instance the 'Transactions' of the Society, as published in the Journal, were issued gratis to the members as heretofore, and 1*s.* per quarter was charged to those who received the additional matter also. This arrangement was the sole cause of the *separate paging* of the two distinct portions of the Journal.

In the following year the Society agreed to take 200 copies of the Quarterly, and to deliver the whole free of charge to all the members. This better arrangement had a marked influence on the success of our Society, for within a few months our muster-roll was satisfactorily increased by sixty-seven additional names. Nor is this to be wondered at when we recollect that every member received an admirably illustrated Journal, worth 16*s*., as well as the other advantages of membership, for the small subscription of one guinea.

Too high a charge was demanded, however, by the subsequent publishers for extra numbers of the Journal, since it appears by a reference to our Journal account, that while the cost of the Journal was 84*l*. in 1856 to meet the requirements of 241 members, it was more than 184*l*. in 1862, though in this interval our members had increased by seventy-six only. This losing game put such a strain upon our finances that, in spite of a small improvement effected in subsequent years, your Council eventually gave legal notice to terminate the agreement for the publication of our 'Proceedings' and 'Transactions' in the Quarterly Journal; and in conformity with their resolution the connection of the Society with that Journal ceased with the publication of the October number in 1868. An arrangement was then made with Mr. Robert Hardwicke for the issue of a *Monthly Journal*, to commence on the 1st January, 1869, to be edited by Professor Lawson, M.D., and to contain, in addition to the matter furnished by the Society, an ample digest of British and foreign histological research and microscopical intelligence. The cost to the Society for 450 copies is 20*l*. per month, additional copies being charged 1*s*. each. Hence, while the cost of the Quarterly Journal, worth 16*s*. per annum, was 186*l*. in 1862, to meet the wants of 317 members, the Monthly Journal, worth 18*s*. per annum, was supplied for 240*l*. to 450 Fellows during the past year. A charge of 2*s*. per annum is now made for the postage of this Monthly Journal to subscribers of one guinea per annum; nor will this charge be deemed unreasonable when we bear in mind that the subscription, if diminished by the cost price and postage of the Journal, would leave but a very small remainder to meet the large annual expenses of the Society. It is also necessary to add that we receive about twice as much matter in the course of the year as was supplied under the late arrangements, and we have the very important additional advantage of a *monthly record* of valuable notices of foreign publications, as well as of the 'Proceedings' of many kindred societies at home and abroad. This *story of the Journal* cannot but be gratifying, and your Council feel that our thanks are due to the Editor and the Publisher for their ready conformity with all the Society's stipulations.

One remaining proposal I will venture to submit to you. It

has received the unanimous approbation of the Council; and the personal support which several of its members offer, will, I hope, be appreciated and copied by other Fellows of our Society. I will state then, in few words, that the increased advantages which the Society is now able to offer as compared with earlier years induce me to hope that many Fellows will voluntarily raise their subscription. The guinea subscription is so nearly balanced by the copy of the Society's 'Transactions and Proceedings,' the expenses of the soirée, the rent and cost of circulars, &c., as to leave only a mere trifle for other purposes.

It would obviously be unfair to make any unexpected demand upon gentlemen to whom the low terms of subscription offered a chief inducement to join the Society, or in any way to press *them* for an advance; but now that the library, daily open for consultation, has been largely augmented by purchases and donations—the latter including a complete set of the 'Philosophical Transactions'—and when valuable and larger collections of instruments, apparatus, and objects are likewise accessible, it is believed that many Fellows who entered at 1*l.* 1*s.*, but who can well afford the outlay, will not grudge a further annual payment or donation, to be appropriated to the advancement of microscopical science.

It is felt that this appeal may be made to our original compounders as well as to our annual subscribers at the lower rate, and it is needless to add that a kind reception of this proposal would materially contribute to the well-being of our parent Society.

Such then, in conclusion, is our position and our work. We have gone on year after year, both gaining knowledge ourselves and communicating knowledge to others. Let us still be up and doing while the Great Architect of the Universe permits us to investigate His works, and "all His works praise Him." Let us never rest upon our oars, whilst, in the language of the immortal Newton, "the great ocean of truth lies all undiscovered before us."

Conspectus of the Present State of the Society :—

	Royal Patron.	Honorary and Foreign.	Associates.	Compounders.	£1. 1*s.* yearly.	£2. 2*s.* yearly.	Total.
Anniversary, 1869 ..	1	5	2	94	329	24	455
Since elected	..	+ 2	..	+ 1	..	+ 11	+ 14
Since deceased	..	− 1	..	..	− 4	..	− 5
Since resigned	..	..	..	..	− 5	− 1	− 6
Anniversary, 1870 ..	1	6	2	95	320	34	458

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