TRANSACTIONS

OF

THE TORONTO ASTRONOMICAL SOCIETY

FOR THE YEAR 1901

INCLUDING TWELFTH ANNUAL REPORT.

ARTHUR HARVEY, F.R.S.C., EDITOR.

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The Toronto Astronomical Society

FIRST MEETING.

1901, January 10th. This eleventh annual meeting of the Society was held in the Library of the Canadian Institute. The President, Mr. G. E. Lumsden, F.R.A.S., occupied the chair during the business part of the meeting, when the following were elected Associates of the Society :

Dr. P. H. Bryce, M.A., Bracondale and Toronto,

Mr. R. W. King, 503 Markham Street, Toronto.

A letter was received from one of the Past Presidents, Dr. Larratt W. Smith, K.C., which, after expressing the learned doctor's regret that the growing infirmities of age, especially deafness, would prevent his attending the Society's meetings, contained the following sentence : " If you will substitute for my presence my large telescope, I shall with pleasure present it to the Society, as an indication that my interest in your Society has not flagged, but still continues, and will do so to the end."

The Society's satisfaction with the promise of such a generous donation, the telescope being an exceedingly fine three-inch refractor, was naturally offset by regrets that such a valued member was suffering from the attacks of Time.

Mr. Lumsden then yielded the chair to First Vice-President R. F. Stupart, F.R.S.C., and delivered the Annual Address, as follows :

THE THRESHOLD OF A NEW CENTURY.

It is related that upon a certain occasion a traveller was wrecked on the coast of an unknown country and that after long buffeting with the waves he reached the shore at nightfall, utterly spent by swimming and by hunger and exposure, when, failing to find a human habitation, he flung himself upon the grass and sank into slumber so sound and prolonged that before he wakened, the Lilliputian inhabitants who had found him in the morning were able to pin and tie him fast to the ground, where he lay at their mercy. The veracious narrative, however, goes on to explain that once the traveller became alive to his position he bent his physical strength and mental powers to the task of securing his release, and having finally gained his freedom he rose from his sleep a giant among the pygmies who had imprisoned him, and who, as they came to perceive his ability to serve them, were ready to accept his friendship and appoint him their champion, rallying behind him gladly when their land was attacked and lending him all the assistance in their power.

May not the incident be used as an illustration of the mental condition of Europe during many centuries prior to the revival of Learning ? Utterly exhausted by long struggles and overwhelmed by disasters, independence of spirit was so crushed out of the human breast that the intellect of man sank into a lethargy profound and long enough to allow it to become bound down to the very earth. A day of awakening did arrive, truly, but the evidences of consciousness were the merest glimmerings of returning intelligence—glimmerings which were sought to be concealed rather than revealed. However, the old spirit gradually revived, and the sagacious exercise of restored mental powers enabled it to shake off its shackles one by one until at last, only after several centuries, the human intellect was free. Once itself again, it grew to gigantic proportions in the same ratio as the old hostile influences lost their ascendency, and presently those very influ-

ences were glad to accept an unfettered intellect as their best friend and champion. The pulse that was scarcely discernable at the close of the XVth Century and still feeble at the close of the XVIth, had undergone a marked change at the close of the XVIIth, and by the end of the XVIIIth had become quite strong. At the close of the XIXth its beats were regular and full and indicated prime health and vigor. To-day Knowledge is untrammelled, and as Tennyson sings :

> Who loves not Knowledge? who shall rail
> Against her beauty? may she mix
> With men and prosper! who shall fix
> Her pillars? let her work prevail.

My subject seems to demand a brief review of the development during the XIXth Century of that great branch of general science popularly spoken of as "Astronomy," and of its allied branches now known as "Astro-Physics." This is by no means unpleasing, for it must be a story of progress everywhere, at some periods steady, at others by leaps and bounds. Results were almost invariably substantial ; occasionally brilliant, as if the patient workers had caught some inspiration, or as if the very hand of Providence had in the interest of the human race suggested the means or pointed out the lines along which investigation should succeed.

The XVIIIth Century was progressive too. Art, Science and Letters flourished as they never had before, in spite of, perhaps by reason of presumably untoward conditions, consisting of long and disastrous wars, from the effects of which no country escaped ; wars which overturned thrones, uprooted states, shattered nations, re-drew boundary lines and changed social and economic conditions of men and things. It may be that the often rude awakenings of the time had their influence upon the arts of Peace as much as upon the arts of War. Be that as it may, the scientific men who one hundred years ago had crossed the threshold of a new century could point to a brilliant and useful past and predict a promising future. They could speak of the splendid achievements of men like Newton and Halley, Bradley and Napier, Hooke, the elder

Dollond, the Cassinis, father and son, D'Alembert, Leibnitz, Bianchini, Galvani, and others who had not long passed away, while among those who had made or were to make their mark were such original workers in Great Britain as Brewster, who at 20 had turned aside from the Church, for which he was intended, and while engaged in editing *The Edinburgh Magazine*, had taken up optics as a subject for special research ; Davy, sometime an apprentice to an apothecary, who at 23 had gone up to London to lecture at the Royal Institution, then in its infancy, and, like an infant, weakly and needing fostering care ; Wollaston, who, beaten in a contest for the post of physician in St. George's Hospital, had vowed he would not write another prescription, even for his father, and had become an ardent student of optics and spectroscopy. There were Peter Dollond, who was endeavoring to perfect his father's work in constructing large achromatic object-glasses for telescopes ; and Young, a Quaker doctor, who had begun to practice in London, and to lecture at the Royal Institution ; and Dalton, who had grown famous as an observer and a lecturer at New College ; and Faraday, who had just entered upon his apprenticeship to a bookbinder, and who, by reason of his own poverty and that of his family—his father being a journeyman-blacksmith—could only slake his thirst for knowledge as he best might with such scientific information as he could find among the scraps of printed paper given him to be used as the linings of the books he bound. On the continent, there were Arago, who had recently been appointed secretary to the Paris Observatory, where he was to pass many years and to become famous ; Lagrange, who, a few years before, had drifted into Paris, and, as some reward for his splendid mathematical work, was about to be loaded with honors ; Laplace, the ambitious son of a poor farmer in Normandy, rapidly rising to eminence, having just published the first volumes of the *Mecanique Celeste ;* Daguerre, still a lad in Normandy, interested in Science, but unconscious of the great services he was yet to render her by means of his discoveries in the practical application of photography. There were Bessel, still laboriously working his way to the highest place as an observer and computer ; and Gauss, who

had published his first work on Numbers, but was turning his attention to Astronomy, owing to the general interest being taken in the search for the hypothetical planet between Mars and Jupiter ; and Olbers, who though practising an arduous profession, had become famous for his work as an amateur astronomer ; and Volta, who was still Professor of Philosophy at Padua. And yet no mention has been made of Herschel, who, by virtue of his hunger for knowledge, his fixed resolution to acquire knowledge, his great natural talents, acumen, unwearied application, indomitable will and ability (though a mere amateur) to construct for himself telescopes which were the envy of professional instrument makers, all at once burst upon the astonished gaze of scientific Europe like a splendid meteor, or the great comet of 1843, which suddenly appeared in broad daylight and nearly matched in brilliancy the Sun himself. Such were the men who were leading, or were soon to lead, the van of original workers during the XIXth Century—workers who, in numbers alone, were to become a host.

In venturing to describe some of the scientific achievements of the busiest century the world has ever known, I must, of necessity, pass in silence over a multitude of facts and incidents which must be excluded from a paper to be read in less time than one hour. But if I must exclude these facts and incidents, I may take leave to refer you to the books which have recently been published by astronomers and physicists of the highest rank, including the works of the Astronomer Royal, of Sir Robert Ball, Sir William Huggins, Professor George Darwin, Professor S. P. Langley, Professor Simon Newcomb, Professor E. C. Holden, Reverend T. W. Espin, Messrs. W. F. Denning, F. R. A. S., and J. E. Gore, F. R. A. S., and last, but by no means least, the volumes of Miss Agnes M. Clerke. All of these books are lucid in expression and attractive in style, and most of them combine, in a delightful way, with accuracy of statement, the charm of the best light literature. This Society is happy in the knowledge that all of these distinguished persons are members of it, being either Honorary or Corresponding Fellows, an intended distinction modestly conferred, and as modestly, without a single exception, accepted. The volumes of Miss

Clerke have became classic, three of them being her well known "History of Astronomy during the XIXth Century" to which I gladly confess my own obligations; "The System of the Stars," and "The Herschels." In addition to manuals and numerous articles and papers, this able woman has written a work entitled "Familiar Studies in Homer," and has successfully undertaken to translate into verse some of the finest passages in the Odyssey.

At the end of the XVIIIth Century, there was practically no Science of Astronomical Physics, and theScience of Astronomy itself was limited to the confines of the solar system, though Herschel was raising sidereal astronomy to a higher level, and the stars were becoming something more than mere points of light by which the motions of the sun and planets could be determined. Nothing was known of the composition of the sun, or of the stars, or of nebulae or comets. That was awaiting the development of spectroscopy.

For the purpose of this paper, it is necessary to refer to but two of the closing years of the XVIIIth Century, 1796 and 1800. The first was rendered notable by the enunciation by Laplace of his Nebular Hypothesis, which Miss Clerke calls one of the bequests from the old to the new century. In 1800, a force of astronomers sometimes alluded to as the "Celestial Police" was formed, to search for the planet, which was believed to revolve between the orbits of Mars and Jupiter. But the event of the year was the publication of the *Monatlische Correspondenz*, the first magazine to be devoted to Astronomy, a fact which reminds us that throughout the past century Astronomy had a firm and true friend in the periodical press, which in both hemispheres has become a power for the dissemination of interesting and useful knowledge of all kinds, and to which Science owes a vast debt of gratitude.

The very first day of the new century was made glorious by the discovery at Palermo, by Piazzi, one of the "Celestial Police," of the first of the hundreds of planetoids now known to exist. Three other events may be mentioned, namely, the publication by Lalande of his Celestial History; Herschel's efforts to establish a relationship between sun-spots and the weather, wheat

being found to be dearer during the years when there were few ; and the gift by the Duke of Bavaria to Fraunhofer, a poor boy, of the money which enabled him to buy the books he needed to prepare him to enter upon a scientific career which became one of the most famous of the century. The Duke's present was intended as a charity, he having witnessed an accident which nearly cost Fraunhofer his life, but his gift, small as it may have been, was really one of the finest bequests Science has ever received.

In 1802, in the course of spectroscopical work, Wollaston, by a stroke of genius, substituted a slit for the round hole through which, since Newton's time, it had been the custom to pass the solar rays for the purpose of studying the spectrum. For the first time, dark lines, now familiar enough, were detected by human eyes, but, possibly because he saw seven of them, Wollaston was content to suppose they formed the boundaries between the seven primary colours, and, satisfied with this view, he let the matter drop. Had he been animated by the exacting spirit of Bradley, who took nothing for granted, the world might not have had to wait sixty years for the revelations due, in the first place, to the investigations of Fraunhofer, and, in the second place, to those of Kirchoff.

Herschel, having again addressed himself to the subject, announced in 1805, and for the second time, that the sun has a motion of his own among the stars, and that he is travelling towards a point in Constellation Hercules. From the platform of the last car of a moving train, we shall see converging to a point the rails over which we have been carried, and shall notice that objects we pass on either side gradually close in behind us. So with the sun. Careful measurements of certain stars show that they are gradually converging upon a common centre and that others in the opposite portion of the heavens are widening out. The theory was not Herschel's, but to him must be ascribed the honor of having proved its truth. But Herschel's announcement in 1805 was not better received than in 1783, and it was not admitted as true until Argelander, who based his results on the observation of thirty-nine stars, confirmed Herschel's statement.

The year 1807 is notable because of the delivery by Young of a course of lectures in which he expounded the doctrine of interference, which established the undulatory theory of light and destroyed the corpuscular theory of Newton.

The great comet of 1811 appeared on the 26th of March and remained visible 510 days. Some conception of its grand proportions may be formed from the statements that its head measured 127,000 miles in diameter, and that its tail was 100 millions of miles in length. Naturally, the presence in the sky for so long a period of so magnificent a comet caused many scientific men to turn their attention permanently to astronomy. The period of the comet was calculated by Argelander to be more than 3,000 years. "Thus," says Miss Clerke, "when it last visited our neighborhood, Achilles may have gazed on its imposing train as he lay on the sands all night bewailing the loss of Patroclus; and when it returns it will perhaps be to shine upon the ruins of empires and civilizations still deep buried among the secrets of coming Time."

The year 1812 was remarkable for an incident which, while it does not exactly bear upon the subject of our paper, admonishes us to be careful how we decline to lend a helping hand when in our power to do so. Sir Joseph Banks was by far the most prominent scientific man of his day. He equipped at his own expense an expedition, and went around the world with Captain Cook, to study botany as widely as possible. By means of his wealth and position and work, he had become deservedly famous, and during forty-one years held the Presidency of The Royal Society of London. To him, in his extremity, turned Faraday, who was still working at his trade of bookbinder, but was as ambitious as ever to improve himself, and to be at work as an investigator of electrical phenomena. He wrote to Sir Joseph, stating his desire, and offered to perform the most menial duties in return for any opportunity that might be afforded him for study or experiment, but when he called at the great man's door, the footman told him there was no answer for him. Those of you who have read an account of Faraday's life and know his modest, sensitive nature, may form some idea of his bitter mortification. But, though

discouraged and disheartened, his yearnings for knowledge goaded him on to try again, for in December of the same year he wrote to Davy, some of whose lectures he had heard. Davy at once replied: "It would gratify me to be of any service to you. I wish it may be in my power." When Faraday called, Davy advised him to stick to his trade, and promised to send him books to bind. Davy was so much impressed by the youth, however, that in the following month he gave him some secretarial work, which was so carefully and neatly done that it may be said to have opened the door for a scientific career of the greatest usefulness.

In 1814, Guinand invented the process by which large discs of optical flint-glass are made, but this and the following year are noteworthy because, during their course, Fraunhofer, by means of a slit and telescope, made the momentous discovery that the solar spectrum is crossed, not by seven dark lines only, as Wollaston had been content to suppose, but by thousands of transverse streaks, of which he counted 600 and mapped 324. Fraunhofer examined the light of the moon, planets and brightest stars, and found in the spectra of Pollux, Capella, Betelgeuse and Procyon the solar line D, which, to his astonishment, exactly coincided in position with the yellow beam, itself afterwards indentified with the light of glowing sodium, already found by him to accompany most kinds of combustion. Moreover, the dark solar line and the bright terrestrial D line were displayed as double. This correspondence laid the foundation of solar chemistry, but as Fraunhofer was an optician, and not a physicist, he pursued the subject no further than suited his purposes, and the true significance and the overwhelming importance of these discoveries were not known for nearly half a century.

In 1816, the elder Herschel was knighted, and the younger Herschel, having been won away from the law, to which he had been bred, turned to astronomy and science—determined, with Peacock and Babbage, "to leave the world better than they found it." On the 29th of August, died Schröter, who for 34 years had studied the topography of the moon with a thoroughness never rivalled, and laid the foundation of the comparative study of the lunar surface.

Pons, in 1818, discovered a comet which ultimately became known as that of Encke, who calculated its orbit and predicted its return in three and a quarter years, the second prediction of the kind ever made, which was fulfilled in 1822. During the same year Repsold perfected machinery for the division of hour and declination circles for equatorially mounted telescopes.

In 1821, on Christmas Day, Faraday showed his wife his discovery of electro-magnetic rotation, which brought him international fame, he having succeeded in making a wire, through which an electric current was flowing, move under the influence of the earth's magnetism alone.

In 1823, Faraday succeeded in liquifying chlorine-gas and hoped to liquify oxygen and hydrogen, and in the following year Fraunhofer constructed a fine telescope, having an aperture of nine and a half-inches, which became known throughout the world as the "Great Dorpat Refractor," to which, for the first time in the history of such instruments, a clock-driving appliance was attached.

In 1826, Schwabe, tired of his hereditary business as an apothecary, began his forty years' observation of the sun, which resulted in his being able to prove that there are sun-spot-periods with more or less regular maxima and minima.

In the Autumn of 1831, Faraday discovered the magneto-electric current, the principle upon which all our modern dynamos and transformers are constructed, and the foundation of all the systems of lighting by electricity, and for the transmission of electrical power.

In 1828, at a scientific congress at Berlin, Humboldt, advocated the establishment of a net-work of magnetic-observatories over the world, for the purpose of attacking the complex problem of terrestrial magnetism. In 1836, the practical sympathy of England was gained, so that, by 1841, there had been erected throughout the British Dominions a series of similarly equipped observatories, of which that in Toronto is one. Having mentioned this fact, it may be added that, based upon the results obtained here and at Hobarton, Van Dieman's Land, our antipodes. Sabine, in 1851, found that once in about ten years magnetic

disturbances or storms reached a maximum of violence and frequency, and that a coincidence existed between this result and Schwabe's already announced ten-year period in sun-spot maxima and minima.

On the 6th of August, 1835, the second prediction of the return of Halley's Comet was verified by the discovery at Rome of a misty object which by the middle of September had become a great comet with a tail thirty degrees in length. The nucleus or head had the brilliance and reddish hue of Aldebaran. An outrush of luminous matter, resembling a partly opened fan, issued from the nucleus towards the sun, and, at a certain point, like smoke driven before the wind, was vehemently swept backwards in a prolonged train. Bessel said this fan oscillated like a pendulum across a line joining the sun and the nucleus, and that the repulsive force was twice as great as gravity, thus stating a fact but lately explained by the studies of the ether and of cathode rays made by Deslandres, J. J. Thomson, and Fessenden.* Bessel declared the emission of the tail to be a purely electrical phenomenon. This splendid comet will return in 1911, and I hope you may all see it in the glory with which, at intervals of about seventy-five years, it has during many centuries visited this world.

In 1680, Newton reasoned that the heat of the sun was about 2,000 times that of red-hot iron. In 1837, the younger Herschel, at the Cape of Good Hope, and Pouillet, in France, made observations and computed that the heat received by the earth from the sun in one year is sufficient to melt a layer of ice covering the entire world to a depth of 100 feet, while the heat emitted by the sun would in each minute of time melt on the sun's surface a sheet of ice 35 feet thick. Herschel further calculated that if the ordinary heat from the entire solar surface could be concentrated for one minute, it would have power to melt a column of ice 184 feet in diameter reaching from the sun to α Centauri, the nearest fixed star. Recent investigation shows that the column should have been estimated at 250 feet in thickness, and that it

*Professor Fessenden's claim to priority in this discovery is printed towards the end of this volume. (See INDEX).

would require an ice-rod 45 miles in diameter fed into the sun with the velocity of 286,000 miles a second to exhaust his heat.

In 1837, the inventors who had been working upon telegraphy succeeded in making some practical use of their discoveries, little dreaming of the splendid services they were conferring upon mankind.

In 1839, Daguerre and Niepce made the first really useful application of photography and therefore took the first practical step in a branch of Knowledge which, though apparently in its infancy as yet, has already been of the greatest benefit to Science and Art as a whole.

The year 1840 was remarkable for the first application of photography to celestial objects, Dr. J. W. Draper having succeeded in taking a few moon pictures, but their value was so small that the results were not encouraging.

In 1842, Baily, after years of experiment, announced that the weight of the earth was nearly five times that of a globe of the same bulk of water. This remarkable man, like many others who have made to Science contributions of profound value, was an amateur. His name is inseparably connected with phenomena he had noticed during eclipses and now known as "Baily's Beads." Indeed, his lively description of the phenomena aroused attention to that degree that for the first time great efforts were made to properly observe the very next total solar eclipse, on which occasion the corona and streamers and protuberances were well seen. From this time onward solar appendages were regarded in a new light, for eclipses had been esteemed as little more than tests of accuracy in predicting these phenomena. The year is further notable because Meyer and Joule discovered the equivalence between heat and motion, the corollary of which is the grand idea of the "Conservation of Energy."

In 1843, Mitchell, the eloquent Cincinnati professor of mathematics, delivered, in the United States, that splendid series of lectures on Astronomy which sowed the seed for the 150 observatories which presently sprang up in a country where ten years before his time there had been none. Possibly his eloquence was

helped by the sudden apparition of the magnificent comet of 1843, already mentioned. In this year also, Schwabe announced his theory of a ten-year period in the waxing and waning of sun-spots, but, being an amateur, no one paid any attention to him.

In 1845, Lord Rosse's six-foot telescope was put in place, and the first spiral nebulæ were discovered. In the same year solar daguerreotypes were taken at the Paris Observatory, but the results were not satisfactory, there being too much light to contend with. At Harvard, however, Bond photographed two stars of the first magnitude, viz., Vega and Castor. In October, Adams communicated to the Astronomer Royal the results of his marvellous computations, made in his efforts to find the place in the sky of the unknown body which was causing perturbations of the Planet Uranus, and which, when discovered, was named Neptune. Adams succeeded in pointing out its position within about one breadth of the full moon, but he was an amateur, and the professional astronomers did not take him seriously, and the prize, which should have been his, was snatched away by Leverrier, who had been asked by Arago to look into the matter. Leverrier, nearly a year behind Adams, reached very similar conclusions, which were by him communicated to the German astronomer, Galle, and the planet was picked up, at Berlin, on the 20th of September, 1846.

In 1850, Bond re-discovered the crape-ring of Saturn, found by Galle, in 1838, and, this time, the announcement was accepted, it having on the first occasion been ignored. During the year, Bond successfully daguerreotyped the moon and opened the splendid career of celestial photography.

In 1851, at the total solar eclipse of the year, the true character of the rose-flames was conjectured, and a creditable and useful daguerreotype of the sun, showing the corona, was taken. Humboldt published Schwabe's solar statistics, and the neglected amateur at once became famous. It may be noted that this year Faraday declined to recommend Tyndall as a suitable candidate for a professorship in Toronto University. Had Faraday given the testimonial, would Tyndall have been appointed? and if appointed, what would have been his Canadian career? We can

but conjecture. However, it should be stated that Faraday, as a matter of principle refused to commend any candidate for any position. But was he consistent in this? Would he have liked the rule applied to his own case fifty years before, when he was a struggling lad? That Tyndall harbored no ill-will, however, is shown by the fact that his life of Faraday is, perhaps, the best that has been published.

Fraught as they were with practical results, and really typical of many other years, I must pass over 1852, 1853, 1854, and 1857, in order to speak for a moment of 1859. In the autumn of that year, Kirchoff made the classic discovery that if the light of a sunbeam be thrown across a space occupied by the vapor of sodium, the dark Fraunhofer line *D*, instead of being effaced by flame giving a luminous ray of the same refrangibility, is deepened and thickened by superposition, and that a dark furrow, corresponding in every respect to the solar *D* line, is instantly seen to interrupt the otherwise unbroken radiance of its spectrum. The inference was irresistible that the effect thus produced artificially was brought about naturally in the same way, and that sodium forms an ingredient of the solar atmosphere. Other metals were similarly detected. Curiously enough, almost the same results were arrived at by Brewster in 1833, by Miller in 1845, by Foucault in 1849, and by Stokes a little later. But they stopped short of verification. Here I may pause in my enumeration of discoveries, for the list has been brought down to the time within the memory of many of our members, and besides, the great men that would be mentioned are, in many cases still amongst us. It is, however, a fair presumption that the chief recent scientific events are not unknown to any one here.

As the century grew apace so did investigation and results. The mountain torrent of 1801 has swollen into the broad, steadily flowing river of 1901. In one hundred years the company of scientific students has, in numbers, become an army in Europe alone, and another army has been formed on this continent. Compared with the first quarter of the century, progress during the last quarter moved forward with a resistless rush. Invention

and discovery have gone hand in hand. Nothing has escaped improvement.

In 1801, and perhaps as late as the death, in 1871, of Sir John Herschel, it was possible for one man to become master of all known astronomical and astro-physical knowledge. In 1901, this is no longer possible. To-day, the Science of Astronomy may be likened to a tree having many great branches—some as large as the tree itself was one hundred years ago. Inseparably connected with the recent growth of the tree and its branches are the names of Huggins, Birt, De la Rue, Dawes, Schmidt, Wolf, Henry Draper, Rutherford, Carrington, Secchi, Angström, Balfour Stewart, Lockyer, Dewar, Flammarion, Loewy, Langley, Young, Burnham, Helmholtz, Clerk-Maxwell, Hertz, Lodge, Lords Kelvin and Rayleigh, Pickering, Newcomb, Barnard, and many others.

Amid the flood of light which, to us, appears to be streaming over the landscape, we are apt to boast of the present splendid position of Science, and to be tempted to look back upon the past in a condescending way. But let us ask ourselves whether our sky is brightened by the effulgence of the true noon hour, or, after all, by a dawn only a little more rosy than that of our forefathers. Did not the noon-day of Aristarchus seem to Hipparchus one hundred years later as merely dawn? May not the noon of Hipparchus, in turn, have glimmered but as the dawn as seen by Ptolemy and the philosophers who came after him for 1500 years? The noon of Copernicus, Tycho Brahe, Galileo, Kepler, and Newton, may have been the dawn of 1801, as the noon of 1901 may be only the dawn of 2001, by which year shall have been made discoveries of which we no more dream than did our predecessors dream of the great discoveries of which many have been made within our own time. It would be idle for us even to conjecture what shall be known when our successors have crossed the threshold of another century. The splendid telescopes, spectrocopes, cameras and other apparatus, now our boast and pride, may then be found only in museums, other apparatus of which we have now no conception having taken their places.

Science has been for ages busily engaged in erecting the Temple of Truth. From the earliest times men have been contributing of their labor and materials for this purpose. They have been engaged in digging deeply, so that the foundations might be laid on the living rock, which they did not always reach. The result was, that as centuries rolled away, it became necessary to pull down an arch here or a piece of wall there, and even to take up the very foundations in places, and to dig deeper. Sometimes a whole wing (as, for instance, Astrology) has had to go. But allowances must be made where the workmen are in earnest. We must remember that none of them had even such light as we enjoy, and that they often groped in darkness. To them, the noble outlines, the splendid proportions and the perfect symmetry of the building were not visible as they are to us; and even to us the Great Architect of the Universe has not yet revealed them wholly. But the workmen have grown in numbers, in knowledge, in skill. The foundations are probably complete and well laid. The superstructure is rising rapidly. For the first time in the history of the world a band of Canadians has joined the army of artificers. It may be that for want of skill, or tools, or numbers, the labors of the band may not be, at the moment, of great value, but its members give place to no one in their devotion, in their sincerity and in their resolution to render good service. It is but ten years since this Society came into existence as an incorporated body; but those ten years have been years of preparation; and if our future be worthy of our past, there is hope that this Society will become a really useful adjunct to Science. May the President of the Toronto Astronomical Society who stands in my place one hundred years from to-night be able to speak to his audience of that usefulness, and may he be able to point to some beautiful arch, the keystone of which was cut and put in place by a member of this Society; some noble column which was erected and completed by the Society; some turret, pinnacle or spire that the Temple of Truth shall owe to those who come after us.

But this will all depend upon the accuracy of our plans, the exactness of our knowledge, the soundness of our foundations,

the suitability and adaptability of our materials, and the resolution and skill of our workmen, who must be earnest and true to themselves and their beloved science. As Cowper says :

> None sends his arrow to the mark in view,
> Whose hand is feeble, or his aim untrue ;
> For though, ere yet the shaft is on the wing,
> Or when it first forsakes th'elastic string,
> It err but little from the intended line,
> It falls at last far wide of his design.

And now one word personal to ourselves. As a Society, we have just crossed the threshold of a new century, and we have set our faces towards the threshold of the next. We know that we are studying the most ennobling of all the sciences. We are gathering apparatus and improving our facilities. We have opened our doors to every one. We are endeavoring to dispel the idea that Astronomy is a science reserved for the mathematician, for the learned, for the man with leisure and money ; in other words, for the favored few. We are cultivating, as we think, a general love for Nature in her most glorious form, and, we trust, in such a way that it shall redound to the benefit and advantage of us all.

Mr. J. A. Paterson, M.A;, Mr. Arthur Harvey, F.R.S.C., Mr. A. Elvins and Rev. T. C. Street Macklem, D.D., expressed their high appreciation of the eloquent address, and a vote of thanks was cordially offered to the President, who then terminated his first year of office and entered upon the second.

The Society's lecture room and library (in the same building) were then visited by many of the members and guests, the valuable lunar-photographs made by Messrs Loewy and Puiseux at Meudon, Paris, France, and presented by the Government of France, being on exhibition. In the lecture-room Mr. D. J. Howell shewed on the screen many of the beautiful lantern-slides the Society owns, including some fine slides made from the lunar-plates just mentioned. The Society's new electric projecting lantern was used in public for the first time. And

after partaking of light refreshments an unusually pleasurable annual meeting was dissolved.

SECOND MEETING.

January 22nd ; the President in the chair.

The following were elected as associates.

Mr. John Bertram, Ex-M.P., 9 Walmer Road, Toronto.

Mr. Charles B. Petry, 61 Isabella St., Toronto.

Mr. Garnet H. Meldrum, Prince Arthur Avenue, Montreal.

Regrets having been expressed that the Society had lost the Services as Recorder of Mr. Thomas Lindsay, that feeling found expression in the presentation to him, at this meeting, of a stop-watch. In reply to the congratulations of the President and Mr. Elvins, Mr. Lindsay said he had been largely the gainer by the knowledge obtained while acting for the last ten years as Secretary and Editor.

THE SUN.

Mr. Arthur Harvey, commencing his paper on The Sun, said—Nobody can think seriously about him without a feeling of awe. For the Sun it is which holds together his family of worlds, and through his influence all things live, move and are. From the first blush of the dawn which heralds him to the more garish tints which follow his setting, all the processes of life and thought are ruled by him. His are the dews of evening, the purling of the brooks, the soughing of the forests. He it is who tinges the meadow with verdure and tips the flower with color. He regulates the roar of Niagaras, summons the tornado and lets slip the lightning. No astronomer can write of the sun without what seems like rhapsody, and as for the physicist, hear Nikola Tesla :

" We see the ocean rise and fall, the rivers flow, the wind, rain, hail and snow beat on our windows, the trains and steamers come and go ; we hear