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ROYAL SOCIETY OF VICTORIA.

President's Anniversary Address

FOR 1864.

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*Delivered by PROFESSOR MCCOY, President, to the Members
of the Royal Society of Victoria, at the Anniversary
Dinner held on the 25th April, 1864.*

YOUR EXCELLENCY AND GENTLEMEN,

In accordance with the annual custom of our Society, it now becomes my duty, as President for the year, to address you on the subject of the progress made by the Royal Society during the past year, and also—following the usual custom in such cases at home—on the progress in the Colony of all the chief branches of knowledge embraced by this Society.

And first, I must refer to the great loss our Society has sustained during the past year in the departure from the Colony of his Excellency Sir Henry Barkly, our President for so many years, and who, by the great interest he took in the Society, the frequency of his presence at our Meetings, the eloquent and able addresses which he delivered as President at our Annual Dinners and Conversaciones, and by the singularly varied and exact knowledge of many branches of knowledge which he brought to bear on the discussions of the various points of scientific interest which were brought forward from time to time, exerted a most powerful and beneficial influence not only upon the Royal Society, but upon the progress of learning and research in the Colony generally. Science and art have lost in him a consistent and enlightened friend, ever ready to sacrifice his personal convenience, and to freely use his purse, and his position, for their advancement.



Owing to the strain on the energies of the members of the Society, produced by the harassing details of the Exploration affairs, the number of papers read at our meetings last year was not so large as in some former ones, but several of great interest were read, and interesting discussions followed.

At our first ordinary Meeting, which took place in June, a highly suggestive paper was read by Mr. R. Brough Smyth, "On the Advisableness of Collecting and Exhibiting in Europe the Mineral and other Products of the Colony," and in it the probable good effect of such exhibitions of a permanent kind in England and on the Continent in promoting emigration of persons skilled in developing or using such materials, as well as by attracting the attention of capitalists and manufacturers to our products, were dwelt on with much force.

At the same meeting, Dr. Macadam read a paper on "Dalton's Views on the Atomic Theory," which gave rise to a lengthened discussion on the modern theories on the subject, in the course of which some new lines of investigation were suggested by other Members.

At the October meeting following, Mr. Daintree read a paper entitled, "Geological Notes made during a Three Months' Leave of Absence on the Upper Burdekin, Queensland," in which he made known a belt of Silurian (he believed Upper Silurian) rocks extending from Brisbane to near Broad Sound; the strike of the beds was nearly parallel with the sea coast, and the general dip, at a high angle, was to the North East. The Maryborough and Rockhampton beds were considered to be on about one geological level, but the goldfields of Canoona were supposed to be older, or lower in the series, as were also the beds extending South West from Maryborough. Mr. Daintree suggested the probable extension of auriferous land between those points. Beds of the same age were also noted at Mount Caroline, Perry's Ranges, Upper Burdekin, with a South West dip, representing the gold beds of Peak Downs, and forming the West side of an anticlinal axis, of which the Canoona and Maryborough beds might be the eastern bend. The coast ranges from Broad Sound North to Mount Elliot are composed of granite, and it is only through this rock that the gold drift streams of the district run. A recent Basalt covers the greater part of the country between the 19th and 20th parallels of latitude, having

flown from isolated craters ; and this by its decomposition forms a rich soil for pastoral purposes ; while, as in Victoria, the older Basalt is found in dykes cutting through the older rocks. The general geology of the country resembled that of Victoria, except at Fitzroy Downs, where the beds are found containing the Wollombilla Fossils, which I had the pleasure of determining at one of the former meetings of our Society, and so proving, for the first time, the existence of marine Oolitic formations in Australia, from the characters of the *Ammonites*, *Belemnites*, and other Molluses found in them.

Mr. Daintree also tried to settle the points in dispute between the Rev. Mr. Clarke and myself, relative to the age and position of the beds associated with the coal of New South Wales, but failed, from the very spot where sections might have given a definite result being covered up, so that he could not advance our knowledge on the matter. He mentioned, however, in the course of the discussion, a fact of the highest importance, and which may be found in some measure to reconcile the views of Mr. Clarke and myself, namely, that Mr. Clarke in making his original collections for determination had mixed together the fossils of the upper and lower beds. Now, as a portion of the fossils could be identified with European species, and there were among them two genera of Trilobites (*Phillipsia* and *Brachymetopus*), characteristic of the mountain limestone as found in Ireland and Russia, the clearly marked age of these would have determined the age of the whole, if, as was supposed, they came from the same beds ; and in this indirect way the *Pachydomi* and other new generic and specific forms, which from their novelty could not afford any indication of age of themselves, came to be considered as Palæozoic forms from their supposed associations with those which certainly were of that age. It is obviously, therefore, necessary to collect and investigate the evidence afresh from each bed by itself with care, and I am happy to be able to announce the recent receipt of a letter from Mr. Keene, the New South Wales Inspector of Coalfields, in which he informs me that in consequence of the suggestions which I made at the meeting referred to of our Society, as to the scientific necessity of having the materials collected anew with scrupulous care, and which suggestion was forwarded by his Excellency, our then President, Sir Henry Barkly, to his Excellency, Sir J.

Young, he was now engaged officially in making such a collection, which he promises to send to me to enable me to determine, as I suspect may be the case, whether the marine fossils over the coal beds may be of a newer geological period than the Palæozoic strata under the coal beds. The result of the examination will, of course, be brought before our Society, for which purpose the investigations are being made.

At our August Meeting, Professor Neumayer read a paper, "On Observations made near Melbourne for Determining the Length of the Pendulum," and he subsequently demonstrated at his residence to the members of the Society the very ingenious mechanical arrangements he had made for the purpose.

On the same evening a Farewell Address was presented to Sir Henry Barkly, and his reply received.

At our next Meeting, in September, Mr. Archer read a paper, "On an Improved Revolving Disc-holder for the Microscope, and a New Mode of Mounting Opaque Objects, so as to get Lateral Views of projecting parts; also on an Improved Method of Mounting Pollen."

On the same evening, a paper by Mr. Osborne was read, "On the Qualities of Victorian Essential Oils," accompanied by a paper drawn up on the subject by Dr. Gladstone.

The September Meeting was a special one, for alteration of the Rules; but at the Meeting in November, the Rev. Dr. Bleasdale read a paper, "On the Precious Stones of the Colony," illustrated by a beautiful collection of gems. Neither Mr. Selwyn, the Director of the Geological Survey, nor Mr. Brough Smith, the Secretary for Mines, nor myself, have ever had any direct evidence of the occurrence of diamonds in Victoria, although rumours have been published many years ago of their occurrence. Dr. Bleasdale, on this occasion, referred to information he had had relative to the occurrence of diamonds in the Ovens District; and he exhibited two, one of three carats from Beechworth, and one small one from Collingwood, found on a garden walk, in gravel probably brought from the neighbouring Johnston-street Bridge. None of those examples had, however, occurred to Dr. Bleasdale himself.

On the same evening, a paper was read from Mr. F. C. Christie, on that most important practical subject, "The Making Storage Reservoirs for Water." At the same Meeting, the Surveyor-General, Mr. Ligar, one of our Vice-Presidents,

gave a most interesting description of the newest and richest of our gold-fields at Wood's Point, which he had just visited ; and entering at some length upon the vexed question of whether, as a general rule (omitting small exceptions or little rich patches or spurs), the gold-reefs of the Colony were richer near the surface or at greater depths, he ventured the suggestion that as the richest known reefs, those at Wood's Point, were 4,000 to 5,000 feet above the sea, while Ballarat for instance was only 1,000 feet, and various less rich places still lower, that it seemed as if the reefs were rich in proportion to their height above the sea. These observations of Mr. Ligar on a new and remarkable locality, tend, together with a great body of evidence taken by the last Gold-fields' Commission, to support Sir Roderick Murchison's original views on this point, which always seemed to me to be borne out by this country generally.

The most glorious work of the Royal Society has been brought to a formal termination during the past year, by the presentation at our Meeting in August last of the "Final Report of the Exploration Committee of the Royal Society of Victoria." This great undertaking, of exploring a route from Melbourne to the Gulf of Carpentaria through the central area of the Australian Continent, was set in motion by the anonymous donation by a member of our Society, Ambrose Kyte, Esq., of £1,000, on condition of our Exploration Committee raising £2,000 more, by public subscription, within a year. The condition was fulfilled, and with this £3,000 of private money in hand, the Government of the Colony was asked for £6,000 in addition, which, with that enlightened liberality which has always distinguished the Victorian Parliament towards scientific objects, was voted at once, and the task of organizing the Expedition was confided to the Exploration Committee of the Royal Society, and vigorously commenced. Five thousand pounds worth of camels, both of the swift and of the strong carrying breeds, were sent for to India, and on their arrival the members of the party were appointed, and equipped with a most ample provision of stores of every kind that could be useful.

When the most advanced portion of the party with their stores had reached Cooper's Creek, a depôt was formed there, and left in charge of Mr. Brahé and a small party, while the leader, R. O'Hara Burke, with only Wills and

King and Gray pushed on, and gave to this Colony the glory of sharing in their brilliant achievement of first opening up a path across the Continent, and proving that the great interior, instead of being a barren arid waste, as was previously supposed, was in reality for the most part a rich pastoral country, opening a boundless future of greatness to our Colony, which, from its commanding position on the seaboard, and Great Melbourne and Murray River Railway, must reap all the material advantages to be derived from supplying the wants and receiving the merchandise of the settlers, who are so rapidly taking up the new country. Not only may this direct route possibly afford a line for telegraphic communication by Batavia and India with England, but our Exploration Committee can claim, by the labours of the explorers sent out on the main and subsequent assistant expeditions, to have achieved the valuable result of showing the connection by a wide tract of fertile, well-grassed, and comparatively well-watered country between the lands discovered by Leichardt on the Burdekin, those of Burke towards Carpentaria, those discovered by Stuart towards Arnhem's Land, and those of the two Gregory's from North West Australia to the Northern parts of West Australia. So rapid has been the occupation of this hitherto unknown country, that on the east coast alone the sheep-stations now taken up and stocked extend from the settled districts in an unbroken line to within one hundred miles of the Gulf of Carpentaria.

The heroic success and melancholy death of Burke and Wills are known in every civilized part of the earth, but, from ignorance or forgetfulness of facts, the blame has been thrown on the Committee of such neglect or mismanagement as it was supposed had led to the death of those two lamented men. Although a member of the Exploration Committee myself, I think the feeling of indignation which prevented the Committee as a body from defending itself against those animadversions, is perhaps unfair to the public, which is never wilfully unjust or ungenerous, and I take this occasion to clear the Royal Society of blame by a simple statement of facts, the more willingly as they are not distinctly set forth in the published reports.

It was said the Committee established no depôt with stores at Cooper's Creek, and hence the misfortune.

The fact is, the Expedition started with ample stores and

instructions (both of which can be seen in the formal reports published), which were sufficient to insure success. The leader, however, divided his party and stores, taking on with him to Cooper's Creek only the smaller portion, and leaving the larger party to follow under the leadership of a bushman, Mr. Wright, appointed and instructed not by the Committee, but by Mr. Burke himself in the field, when the Expedition was practically beyond the control of the Society. This person failed to carry out the instructions of Mr. Burke for the immediate advance of the reserve party and stores to Cooper's Creek. Mr. Brahé remained at his post with his little party and the stores first brought up, at the depôt at Cooper's Creek, until long after the date at which Burke on parting with him left him orders to return; and as it was well known that if the Gulf of Carpentaria were reached, the safest and easiest route home would be by the watered and grassed north-east coast line leading down to the settled districts of Queensland—and this route had actually formed the subject of their last conversation—Brahé felt at last that there was a probability that Burke was already at home by that route, and that at any rate the time had arrived, not only when he had overstaid the period allotted him by Burke, but when the provisions had become so far reduced (as Wright and the reserve party had not come up), that he had only enough left to carry his party down to the next depôt, and leave a sufficient supply buried to bring down Burke and his companions also, if they should come.

This reasoning was approved at the time by the Committee and the public, and it was obvious, apparently (not then having the knowledge of after events), that the party could do no good by remaining beyond this point, but, on the contrary, that further delay would diminish the stock of food, already reduced to the lowest point of safety for both parties; yet, when subsequent misfortunes became known, this man was assailed with almost inhuman cruelty and injustice by the press and the public, as the direct cause of the calamity which followed, and I was almost alone in raising my voice in his defence, by showing that his conduct was approved when the public knowledge of following events was no greater than his at the time.

But now comes the sad story of the unaccountable chapter of unlucky mischances which clouded all the glories of the Expedition, by the loss of the leader and his second. Brahé

buried the stores at the foot of a tree, and put a notice with the word "dig" upon it, and the better to conceal the *cache* from the natives, he lit a fire over the spot, and then tied some camels during the last night over the place, so that by their soiling and trampling the ashes into the earth all traces of the excavation might be obliterated. And then, on the the morning of the 21st April, he left the depôt—on the very day on which Burke and Wills and King returned to it. The Explorers opened the *cache* and found the ample supply of food, and, as we now know from the survivor, King, they debated about following the party who had only a few hours before left the spot, and which, as a first day's journey is generally short, would be encamped so near that the night would probably be sufficient to come up with them. But, unfortunately, it was decided not to follow, but to remain to recruit their strength; and when sufficiently recovered to undertake a journey, they determined, instead of following the obvious track home, to endeavour to find a new one into South Australia, in which they failed, although without knowing it they had actually reached within about sixty miles of the station at Mount Hopeless, when they exhausted their strength and provisions by returning again to Cooper's Creek. The most inconceivable part of this unlucky series of mischances has yet to be told, and has never been clearly set down.

Before leaving Cooper's Creek for Mount Hopeless, the explorers buried their papers, &c., in the *cache* from which they took the food, and then with fatal accuracy restored everything above to the exact condition in which they found it—they not only lighted their fires over the disturbed ground, as Brahé had done, but actually picketed their camels to the tree, to trample in the ashes and leave their soil and footmarks exactly as he had left them, and finally, by an almost incredible mischance, they neither defaced nor altered Brahé's notice on the tree, nor added any note or mark or sign of their own to show that they had been there. And this cost our heroes their lives. For while they were on their fruitless journey towards South Australia, Mr. Brahé, having joined Mr. Wright, returned with him to Cooper's Creek on the 8th of May, so as to get a further chance of seeing if the party had returned from Carpentaria, but they found everything exactly as Brahé described to Wright his having left it; and the latter who was an excellent bush-

man seeing the ashes and camel marks, &c., was convinced that no natives could have disturbed the *cache*, and as the notice on the tree was not interfered with, it seemed no white man had been there; and so not wishing to disturb the *cache*, and having nothing further to add to the previous notice, they returned to bring the remainder of their parties now suffering from sickness, back to the settlements; and when Burke and his companions shortly after again came to Cooper's Creek they did not recognise any sign of their visit which might have cheered them to exertions to follow even then the tracks homeward towards Menindie. When Brahé's news came of the non-arrival of Burke within a time to which the provisions he took with him could have lasted his party, the Exploration Committee immediately equipped several relief parties; H.M.C.S.S. *Victoria*, under Commander Norman, was dispatched to the Gulf of Carpentaria, to make search by boats up all the rivers on the banks of which Burke might be, and to convey horses and stores for a land party, under Mr. Landsborough, to form a depôt on the Albert River, and follow any tracks of Burke until he was found. At the same time a party of native black mounted trackers was dispatched, under Mr. Walker, to search north from Queensland in hopes of meeting the travellers if they were coming that way. While the South Australian Government aided promptly by sending the party under M'Kinlay to search the northern districts of South Australia, in case the Victorian Expedition might have taken that direction; and finally, a party with large stores was dispatched from Melbourne, under Mr. Alfred Howitt, to replenish the depôt at Cooper's Creek, and maintain it as long as any of the relief parties were in the field and might want aid.

All these parties aided greatly in the unexampled advance made in knowledge of Australian geography, and the energy and liberality of the Victorian Government cannot fail to redound greatly to the credit of the colony at home, when it is known that Victoria's share of the expenses of the explorations was (£35,000) thirty-five thousand pounds, while the only other contributor, Queensland, gave but (£500) five hundred pounds, and that to be spent within her own boundaries.

To Mr. Howitt's party, as you all know, it was alone permitted to give any succour to the missing explorers, and he found on his return to Cooper's Creek that the only

survivor was King, a brave young soldier, formerly in the Indian army, and who having tended Burke and Wills to their death, and preserved their papers with a faithful devotion and constant heroism worthy of the Victorian Cross, was found living in a deplorable state among the natives.

The Government and Parliament in voting a public funeral for the leaders who fell, and £4,000 to erect a monument to their honour as well as any other mark of respect that could be suggested, and granting the survivor King a pension of £180 a-year for life, have shown a noble spirit of appreciation of the services of the explorers; and I trust, after what I have said, that it will be clearly seen that for the misfortune at the close of the Expedition no shadow of blame directly or indirectly can attach to the Exploration Committee of the Royal Society.

Passing now to the consideration of Victorian scientific works not immediately under the control of the Royal Society, though for the most part carried on by officers or members of our body, I will first refer, as connected with the highest branches of exact science, to the Astronomical, Magnetic, and Meteorological Observatories directed by our Honorary Secretary, Mr. Ellery, in the early advancement of which by the Government our Society played an important part.

In 1856, Professor Wilson brought under the notice of this Society the important discoveries in Stellar astronomy which had been made by Lord Rosse. The great optical power which he had brought to bear on the double and multiple stars, and on the nebulae, had revealed features in the constitution of these systems, opening up wide fields for the investigation of the student of physical astronomy.

One of the most important points in connection with the subject at that period was the marked difference in the appearance of many of the nebulae, as seen in Lord Rosse's telescope, from their appearance in telescopes of lower power. He pointed out that the southern heavens are peculiarly rich in objects of this kind, and that the only observations which had been made were those of the two Herschels, at the Cape of Good Hope, with telescopes of power far inferior to that which modern mechanical skill places within the reach of the astronomer.

The Royal Society of Victoria appointed a committee to take steps for inducing the Government to furnish the requi-

site means for establishing a powerful reflecting telescope in Victoria; and again in the following year appointed another committee to consider the whole question of the establishment of a Magnetical, Meteorological, and Astronomical Observatory, on a scale commensurate with the position occupied by the Colony.

At that time astronomical observations were carried on at Williamstown, by Mr. Ellery, with great zeal and energy, though with very insufficient instrumental means, and in a situation singularly unsuitable for the purpose.

A series of meteorological observations were being carried on by Mr. Brough Smyth, at the Crown Lands Office, and Professor Neumayer had just at that time arrived in Melbourne, furnished with sets of instruments both for carrying on a systematic series of magnetical observations and for conducting a magnetic survey of the Colony.

The Committee recommended the establishment of an observatory in the Royal Park, in which these three branches of science should be carried on under one superintendence. After specifying in detail the instruments, buildings, and personal staff requisite for carrying the recommendation into effect, the Committee added:—

“We wish it to be borne in mind, that in recommending to the Government the establishment of an observatory, the Philosophical Institute (which was the title at that time of our present Royal Society) is not asking anything for itself, but is only coming forward to urge upon the Government to undertake in its own way, what it believes to be a great national work.”

Though this recommendation met with no immediate response, beyond a verbal expression of approval on the part of the Chief Secretary, still in due time it bore its fruits.

Ample funds were supplied to Professor Neumayer, by the Legislature of Victoria, for carrying out an elaborate system of magnetical and meteorological observations, extending over a period of five years, and also for completing a magnetic survey of the Colony.

The Astronomical Observatory at Williamstown, also received additional instruments, and the buildings were rendered somewhat more suitable for the purposes of the observer.

As the expenditure on these institutions increased with their growth, it was considered necessary that there should

be some supervision, which, without interfering with the individual exertions of the gentlemen in charge of the observatories should be able to report officially to the Government as to the usefulness of the work which was being done, the manner in which it was executed, and the adequacy of the means for the purpose. With this object the Board of Visitors to the Observatories, was appointed in 1860, in accordance with a vote of the Legislative Assembly.

Since that period, the representations of the Government Astronomer, backed by the recommendations of the Board of Visitors, have been promptly attended to, and Melbourne now possesses an Astronomical Observatory which, in situation, in instrumental appliances, and in personal staff, is second only to the great metropolitan observatories of Europe, and in many points may be compared favourably with them. With one exception, every recommendation of the Committee of the Philosophical Institute, 1857 (or Royal Society as it is now called), has been carried out on a larger scale, and in a more complete manner, than the Committee then ventured even to hope for.

The magnetic survey of the Colony is now just completed, and funds have already been transmitted to England for printing the results of that survey, and also the five years' series of magnetical and meteorological observations. The Astronomical Observatory has already acquired credit for itself in Europe by the valuable series of observations of Mars which it contributed, and which, in conjunction with those at Greenwich, occupy the most prominent place in the determination of the increased value which must be assigned to the solar parallax; and it is now preparing to take its part, in conjunction with the observatories at Madras and the Cape of Good Hope, in a systematic cataloguing of the southern stars, which is about to be carried on under the auspices of the Royal Astronomical Society.

The one exception alluded to, is the recommendation for the establishment of a great reflector, and there is every ground for confidence that this will not long form an exception.

Whatever reasons could be assigned for it in 1856, still weightier reasons exist now. From the experience acquired in England during that time, the construction of a telescope of the kind required a reflector of four feet aperture, has

become a matter of mechanical certainty, and no longer an experiment with a great risk of failure.

Lord Rosse also reports that on comparing his earlier drawings with those made at a later period, he has observed in some of the nebulae systematic changes of form. If this is really so, and there seems no ground for doubting it, what a vast field for speculation and research is opened out by it; that we should be able to look at other systems, grander and more complicated, perhaps, even than our own firmament, but placed at such a distance that we can see them as a whole; that we should be able to watch in them gradual changes, which we can only infer in our own from laborious observation of details, is indeed a triumph, the achievement of which is worthy of our best efforts.

In 1862, Sir Henry Barkly forwarded to the Duke of Newcastle a series of resolutions passed by the Board of Visitors at Melbourne, requesting the advice of the Royal Society of London, and the British Association, as to the best form of telescope.

In his annual address to the Royal Society in December that year, General Sabine, the President, after announcing this, added:—

“I cannot close this brief notice without congratulating the Society on the prospect thus opened, of accomplishing an object of such manifest importance, as to have induced the Royal Society and the British Association to solicit jointly the aid of Her Majesty’s Government in effecting it; and, however great their disappointment may have been at the refusal which they received on that occasion, they will if the present hopes are realized, have no reason to repent that it has been left to the Colony of Victoria to carry into execution an undertaking, which may well be expected to hold a high place in the annals of science in all future time.”

During the early part of 1863, an extended correspondence was carried on amongst the men most distinguished in this department of astronomy in England, for the purpose of determining the best form of telescope for the purpose, considering the especial objects for which it is designed. This correspondence has resulted in the offer by Mr. Wm. Lassell, of the four-foot reflector, which he erected at his own expense, and which he has been using for several years at Malta, as a free gift to the Colony of Victoria, on

the sole condition that it is considered suitable for the purpose.

The success of Mr. Lassell's observations leaves no room for doubt as to the excellence of the optical part of the telescope; it will, however, require very considerable alterations in the mounting to suit it to the latitude of Melbourne, and the greater increased range of zenith distance which will be requisite, in order that it should take in some of the most important of the southern nebulae; and the Legislature of Victoria has just voted £3,000 that the colony may avail itself of Mr. Lassell's most munificent offer without delay.

In the past year, the Observatory has been removed from Williamstown, where it had gradually grown since its first establishment in 1853, to the new Observatory erected in the Government Domain near the Botanical Gardens. This was accomplished in June last, and soon afterwards the Magnetical and Meteorological Observatory, which had been for several years so ably directed by Professor Neumayer, was combined with the Astronomical Observatory into one department under the direction of Mr. Ellery, our Honorary Secretary. Professor Neumayer, having completed the Magnetic Survey, returning to Europe.

While taking credit for the part which the Royal Society had in urging forward the formation of an Observatory, we must not omit to give honour where also it is justly due, and it is with great pleasure that I am able to state that the rapid advance which the Observatory has made is mainly due to the first Honorary Secretary of the Board of Visitors, the Hon. George Frederick Verdon, M.P., who, as an independent member of the Legislature, and subsequently as Minister of Finance, exerted his influence in so powerful and beneficial a manner that to his advocacy we owe, not only the worthy condition of efficiency in which the Observatory has been placed, but also much of the progress of the other scientific, literary, and æsthetic establishments in the country, maintained or established at the public expense.

The new Observatory is a substantial building, erected with special regard to the modern requirements of astronomy, magnetism, and meteorology. The principal instruments are a four feet transit circle by Throughton and Simms, a chronographic apparatus by Siemens and Halske of Berlin, two sidereal clocks by Frodsham of London, besides other clocks, barometers, and other meteorological instruments,

and a complete set of magnetic instruments, both for absolute and differential determinations.

The work of the Observatory, besides the ordinary routine of observations for some instrumental errors, meteorology and magnetism, has consisted principally of a revision of star catalogues, with the immediate view of completing the Williamstown Star Catalogue now in the press. This volume, which will shortly be published, will contain the results of all the work done of late years at the Williamstown Observatory in Melbourne, up to the date of its removal, and will contain a complete catalogue of the places, precessions, proper motions, &c., of 550 stars, the results of 9,000 complete observations. It will also contain the "Series of Mars Observations," taken in connection with Greenwich, Pulkowa, and Cape of Good Hope, for the determination of the sun's mean distance.

This series has made our Colonial Observatory already famous at home, and is very favourably referred to in the *Quarterly Review of Science*, as in the note at foot of the page.* The Magnetic Survey of the Colony was completed in the month of January of the present year. The last work

* "To Eneke we owe the best discussion of the observations of the transit of Venus in 1769: he determined the value of the sun's parallax to be $8''.5776$, from which we infer the earth's mean distance from the sun to be 95,283,115 miles. Now the time occupied by a ray of light reaching the earth from the sun is known very exactly to be 8 min. 13 sec., from which a velocity of about 192,000 miles per second is deducible. Foucault, of Paris, however, by the optical contrivance of a "turning mirror," due to Professor Wheatstone, has concluded that this value is too great, that it is more precisely 185,170 (English) miles. Assuming that Foucault is right, and all his predecessors wrong, it follows that the solar parallax must be $8''.86$. Two most singular coincidences must here be disposed of. (1.) The 'theoretical' value assigned by Le Verrier, irrespective of all instrumental measurements, and purely on physical grounds, is $8''.95$; and (2.) the discussion, by Stone, of Greenwich, of the observations of Mars (adverted to above in Mr. Hind's 6th point) taken by Ellery at Williamstown, Victoria, N. S. W., give a value of $8''.93$, with a probable error of only $0''.03$. Combining the foregoing, we find that three different observers, working in three most diverse ways, have all arrived at the same general result, and more than this, at actual valuations, the extremes of which differ only by the minute amount of $0''.09$. It is impossible for us to withstand the conclusion that our estimations so long adhered to must sooner or later be materially 'reconstructed,' and, as a consequence, that those portions of our treatises involving this distance must be unceremoniously pulled to pieces and built up again. An original calculation of the mean distance of the earth from the sun, amended according to Stone and Ellery's value of the parallax, makes it 91,512,649 miles."

was the survey of Gipps Land, in which part of the Colony 25 localities have been examined, with a view to determine the magnetic elements. Throughout the whole of the Colony 230 places were in this way determined at all elevations, from the level of the sea to 7,200 feet; the aggregate number of miles passed through amount to nearly 11,000, over which the magnetic stations are distributed in such a manner, that the greatest distance between them is 30 miles, frequently only 18 or 20. As by far the greater number of places had not previously been accurately determined with regard to geographical position, the latitude had to be observed for the purpose of obtaining an accurate azimuth, necessary for the determination of the magnetic declination of the needle.

The computations based upon these observations have been completed, and their publication will be undertaken without delay at the public expense of the Colony. The maps, also, to accompany the work are already compiled. In conjunction with the Magnetic Survey a hypsometrical survey was carried out, and the elevation above the sea of upwards of two thousand places was ascertained by means of mercurial barometers; the results of this work will be published as an appendix to the Magnetic Survey.

The results of the labours of the Magnetic Observatory in connection with the Magnetic Survey are so extensive that it was thought advisable to publish them in London on behalf of the Colony, and at the colonial expense. The survey and the original observations of the Magnetic Observatory, will appear in two or three large volumes.

The Geodetic Survey being another great national scientific work, under the direction of Mr. Ellery, the Secretary of our Society, may be considered immediately after the Observatories, and is a subject likely to interest scientific departments in other countries.

This Survey, which was commenced here under the advice of our Vice-President, Mr. Ligar, in the end of 1858, has now gradually progressed over a large portion of the country.

The objections that were raised so loudly against this method of surveying at first, arose in great measure, no doubt, from a mistaken statement made in Parliament that it was intended as a cheap substitute for the great Trigonometrical Survey, and was to supersede it. These objections have by experience proved practically fallacious, and have died out.

Large tracts of country have been laid out under the Geodetic system in great blocks, each of which is then subdivided by contract surveyors, for sale. The great advantage is thus obtained of immediately embodying these numerous contract surveys in the general map of the colony with precision; and it is admitted by those undertaking the subdivision of blocks by contract, that much greater despatch and accuracy is obtained in their undertaking when the blocks are laid out geodetically.

The *geodetic division* of lands, of course, has only been applied to unsurveyed country, but the work of the geodetic surveyor extends beyond this: his duty is to afford data for the construction of an accurate map of the Colony, and this involves not only the connection of all the surveyed lands, but the erection of marks spread over the country, so that any future surveys may be at once accurately placed on the maps, and the survey of the boundaries of runs facilitated.

The great General Survey of the Colony is thus being done by the prosecution of the Trigonometrical Survey in connection with the Geodetic work proper. Trig. stations are erected, and their positions fixed, and lines (meridians and parallels), are run from those trig. stations, traversing the Colony in all parts,

The Survey extends now from the western boundary of the Colony to thirty or forty miles to the east of Port Albert, all the coast line between these points, with the exception of Cape Otway, is connected with the trigonometrical lines. The line of the boundary between South Australia and Victoria is now being determined; lines and trig. points are being laid down in the north west districts. The triangulation of the northern plains is in progress. In the north east of the Colony, Geodetic lines, with a secondary triangulation, have been extended from Benalla to the Indi and Snowy Ranges, and preparations are being made to connect by triangulation the work going on in South Gipps Land, with that in the north east, across the great dividing ranges, of which Baw Baw, Mount Useful, and the ranges about Wood's Point, form a part. Altogether 120 trigonometrical stations have been fixed, and their precise latitudes and longitudes obtained.

The construction of a new map of the Colony, from the work already done by the geodetic surveyors, is in progress: and the whole topographical work connected and fixed by

this survey is being laid down to a half inch scale in "divisions" containing one square degree, of which there are thirty-one contained in the Colony.

Another great scientific work carried on by a Government department, under the direction of a member of the Council of our Society, is Mr. Selwyn's Geological Survey of Victoria, —a work of which this colony may well be proud, and which cannot fail to be of the highest advantage in all future time to the colonists engaged in undertakings requiring a knowledge of the structure and composition of the earth, and the distribution of the mineral riches of the country.

From personal experience of the British Geological Survey, in which I at one time took part myself, I can confidently affirm, that the Geological Maps issued by the Victoria Survey, are equal to any in the world, and superior to most works of the kind which have been published, in the admirable accuracy of their detail; although the great additional labour and delay has been thrown on the department of making a great portion of the topographical map, and nearly all the physical feature-shading required as a basis on which to plot the proper geological work.

During the last twelve months, the field geologists have mapped an area of about four hundred square miles, a great portion of which, being more or less auriferous country, has required that the physical features should be minutely laid down: these include gullies, quartz reefs, igneous dykes, and the contouring of hills. This makes about 3,500 square miles of the Colony now geologically mapped. The staff engaged in this work has consisted of three field geologists, one assistant field geologist, and nine men. The districts in which they have been at work during the past year are Yandoit, Pentland Hills, Ballan, and the Campaspe, north of Barfold. Besides this regular and progressive work, the auriferous and argentiferous reefs of St. Arnaud have been carefully examined, as well as the processes in use there for treating the silver ores for the extraction of the silver, and a detailed report on the same by one of the staff, Mr. Ulrich, is nearly completed. The quartz reefs at Wood's Point have been also visited and reported on.

Amongst the more interesting points of discovery by the Survey during the year, is the occurrence of an auriferous drift resting on basalt, and overlaid by a subsequent flow of the same rock. This was met

with by Mr. Daintree, within little more than a mile of Mr. Lyons' homestead, at Ballan. A party of miners have been tunnelling this lower basalt under Mr. Daintree's direction, with a view to drain the water from the superincumbent drift, to enable them to work it more conveniently and economically. This basalt rests on the Bacchus Marsh sandstones, which again repose on lower Silurian beds. Of the age of these drifts all that can be said is, that they were deposited anterior to the basaltic lava, which now covers so wide an expanse of our western plains, and the older basaltic bottom on which they rest is merely a local feature.

Another peculiar geological feature discovered is the occurrence of horizontal undulating auriferous quartz veins traversing a broad dyke of greenstone, at Wood's Point; these have already, by their rich returns, conferred a widespread celebrity on the principal so-called "reef" there, the "Morning Star." This and other quartz reefs at Wood's Point have been made the subject of a special report to the Government.

The work at present in hand by the Geological Survey is more of an exploratory character. One party of a field geologist, Mr. Taylor, with a topographical surveyor and three men, has just been dispatched to examine the hitherto almost unknown country lying between the Snowy River and Cape Howe. The party was instructed to proceed in the first instance to Twofold Bay by sea, and thence to the Genoa River, to examine its valley and tributaries, information having been sent to the Minister of Mines, that gold had been lately found in the crevices and ledges of rock in the bed of that river. A letter recently received from Mr. Taylor states, that gold in small quantities has been found within a few miles of the river by a settler there, and that a considerable extent of country east of that river is occupied by drift that appears likely to prove auriferous; and further, that he has met with what appear to be Silurian rocks, and that Granitoid rocks are also abundant.

Another party, consisting of four men, is about to examine the Cape Otway ranges and district.

There will thus be henceforward no portion of Victoria of any considerable extent quite unvisited and unexplored by the Geological Survey Staff, although, as regards a thorough examination and mapping, by far the larger portion of the Colony must long remain uncompleted for want of topographical surveys.

The maps which are being executed by the Geodetic Survey, under the able supervision of the Honorary Secretary of our Society, Mr. Ellery, though on a rather small scale, will greatly facilitate the labours of the geologist, and in proportion to the physical and topographical details furnished in the surveys executed for the Government, will be the minuteness of the geological features and information which the Staff of the Geological Survey will be enabled to supply, and I may add the rapidity with which the work can be executed.

The publication of the general Geological Sketch-Map of Victoria, which Mr. Selwyn prepared at the request of the Royal Commission of Goldfields Inquiry, is so far advanced that it will probably be ready for issue during next month, and will no doubt prove a most interesting and useful index.

Mr. Selwyn, as Director of the Geological Survey, and myself, as Director of the National Museum, have on several occasions addressed joint representations to the Colonial Government, pointing out that it is impossible to determine many of the simple minerals and rock masses, occurring in the course of the Geological Survey, without a proper analysing room, in which all doubtful substances might be tested, before entering their names on the maps or depositing them in the cases of the National Museum. It was pointed out that the same provision was necessary for the determination of the various foreign rocks and minerals in the general Geological and Mineralogical collections of the National Museum, and we suggested that one such room would suffice for both Departments, and would be most conveniently and economically placed at the Museum. Our suggestion has been acted upon, and the Analytical branch of the Geological Survey is now conducted in rooms in the "National Museum Offices," where a chemical and metallurgical laboratory has been fitted up with nearly every requisite for conducting mineral analysis or research, as well as to afford to miners, prospectors, and others, a ready and reliable means of ascertaining the value of any mineral discovery which they may make. Without such information much of value has been hitherto lost or neglected, while in other cases loss and disappointment have been occasioned by a mistaken idea of the value of such discoveries.

For the public to take advantage of this arrangement, it

is necessary that a sufficient specimen or sample, together with a full description of its mode of occurrence, localities, &c., should be sent to the "Director of the Geological Survey" either through the Minister of Mines or any other channel, and if he thinks that it is a proper subject for examination, the analysis is made, and a report is forwarded to the sender, containing the results, with any notes or suggestions which appear of practical use.

An analytical chemist was appointed in April last year, who has since been constantly at work.

A great variety of interesting substances have been analysed during the year, as, for instance, the lignite from a remarkable deposit at Lal Lal. As a fuel, it was found both practically and theoretically to be a little better than wood; in fact, some of it resembled wood very closely, not only in retaining the external form, but in its chemical composition. On being submitted to dry distillation at various temperatures, it yielded numerous products—solid, liquid, and gaseous, acid, alkaline, and neutral, and if this subject were worked out in detail, it is highly probable that compounds of commercial value might be obtained.

The coal from Cape Paterson has also lately been the subject of careful examination. The "Cement Stones" or Roman Cement nodules, from the Tertiary clays at Schnapper Point, in the Bay, the Antimony ores of M'Ivor, and the Silver ores of St. Arnaud, and various iron ores, fire clays, gold-quartz, and auriferous pyrites, &c., have also been analysed.

Some minerals, collected by the officers of the Geological Survey, having a more purely scientific interest, have also been analysed. Of these, the most important have been the *Albite* and *Pholerite*, collected by Mr. Ulrich, at Blacksmith's Gully, in a quartz reef, and the *Oligoclase* and *Chabasite* from the basalt of Ballan. The minerals, composing the heavy sand accompanying the gold, have been also under examination, which is not yet completed.

In several cases the result of these examinations have prevented the useless expenditure of capital by detecting errors in the supposed nature of minerals; thus *Carbonate of Magnesia* was mistaken by the discoverer for *Carbonate of Zinc*, *Sulphide of Molybdenum* for *Graphite*, and stranger still, a mixture of fine quartz sand, oxide of iron and iron pyrites, the product of a gold extracting process, has been

declared to be pure *Emery* of the best quality by persons contemplating a mercantile use of it.

In this Colony, the importance of mining is so great, that many of the functions performed in England by the Government School of Mines and its Mining Record Office in connection with the Geological Survey, are now undertaken (together with various political duties) by a separate "Mining Department" of the Government, presided over by a Mining Minister, as political head, and having Mr. R. B. Smyth, who has twice held the office of Honorary Secretary to our Society, as the permanent head.

This Department has now the entire control of the large body of Mining Surveyors appointed by Government, not only to perform numerous duties connected with the official management of the gold-fields and regulating the entry of miners into possession of their claims, but many of them are required in addition to furnish various statistical and other scientific information touching their various mining districts, which are subsequently either published in various forms by the Mining Department or retained in the office for inspection of enquirers. Several important changes have been made lately by the Minister of Mines in the duties of the Mining Surveyors, a knowledge of which would probably prove of interest to other mining countries.

Formerly, these officers reported monthly, on the state of mining operations in the several mining districts of the colony, and forwarded more or less perfect geological and mining plans and sections of the progress of the workings, which they were expected to keep a record of; but now they are required to make quarterly reports, and if the instructions which Mr. Sullivan, the Minister of Mines, has issued, be complied with, the quarterly reports will be more accurate and comprehensive than those which have hitherto been published. By a recent arrangement, the Surveyors are required also to report promptly on new discoveries of gold. When a "*rush*" takes place, the Mining Surveyor furnishes a rough sketch shewing the locality, and gives particular information regarding the nature of the strata, the depth of sinking, the character of the adjacent rocks, and the minerals associated with the gold. He supplies too, a description of the country, of the sources of water-supply, and of the kinds of timber available for mining purposes. The Surveyors are likewise encouraged to collect minerals,

rocks and fossils, for the National Museum, and some of them, as well as some of the Wardens of the gold-fields, have shown praiseworthy zeal and much intelligence in gathering together specimens illustrative of the rocks in which auriferous veins occur. There is already a large collection of rocks and minerals acquired in this way in the office of the Mining Department, all of which will be transferred to the National Museum as soon as there is room to exhibit them. It is gratifying to find that the Minister of Mines, while he requires from the Surveyors strict attention to the several duties of their office, has evinced a strong desire to promote the interests of science by encouraging their scientific labours.

If the recent attempts to open up Northern Gipps Land succeed, the unknown country at the sources of the Delatite and King, on the western side of the Great Range, and the vast area East of the Snowy River, where surveying parties are now employed in clearing tracks,* the resources of an immense hitherto unexplored country will be rapidly developed.

Some rather unreasonable complaints have been made of the incompleteness of the mining statistics published by the Mining Department; but having regard to the state of mining in the Colony, the extent of territory over which mining operations extend, and the difficulty of travelling in some parts of it, they will probably be found to bear favourable comparison with those of most other countries. Here there are no large employers of labour from whom returns can be obtained; but instead we have some thirty thousand miners (among a total of ninety-two thousand†) who are ready for any "rush," and it is not easy to follow their movements or chronicle their proceedings. It is to be remembered, too, that until the year 1858 we had no "Mining Statistics," and that those which have been published have been obtained from returns furnished by gentlemen not wholly in the employment of the Government, and, until lately, but partially under its control.

The Mining Department co-operates with the Director of

* As suggested by Mr. Sullivan in a letter to Mr. Grant, which was published about three months ago in *The Argus*.

† The total number of miners at present is 92,368.

the Geological Survey, and much useful information is from time to time given to the public, both by communications to our Society, and in papers laid before Parliament, and published in Blue-books.

In this way we have learned that considerable quantities of the oxides of manganese occur in many parts of the Ararat District, both in quartz veins associated with gold, and in the alluvial deposits; that there are beds of lignite in numerous localities alternating with the lower strata of clays in the "deep leads;" that the ores of copper and lead are found in most of the localities where there are numerous quartz veins (and, though in small quantities, they deserve the attention of the geologist); that the sulphide and oxide of antimony in large quantities are not restricted to Heathcote, but occur in the basin of the Yarra, at Inglewood, at Steiglitz, and elsewhere; that in the neighbourhood of plutonic rocks there are nearly everywhere mingled with the drift titanite iron, pleonast, corundum, zircon, and topaz; that chromate of iron and chrome ochre are found in considerable quantities in the vicinity of basalt on the River Loddon; that pyromorphite is found at Ararat, and that lölingite and pyrrhotine are common at Maldon.

If many of these do not at present add to our national wealth, they serve to indicate fields of research for the mineralogist. I am also indebted to the department for the knowledge of the discovery of fossil bones on McCallum's Creek, near Talbot, by Mr. Hull and Mr. E. J. Bateman, who forwarded the specimens now in the National Museum, and which I found to belong to the *Diprotodon*. The Map of the Colony is being gradually filled in from the surveys made by the Mining Surveyors, which, together with the valuable results of the labours of Mr. Ligar's (the Surveyor General's) officers, will shortly leave nothing to be desired as regards the topography of Victoria.

The great credit of first discovering and practically applying a process for photographing maps, &c., on lithographic stones, and printing from such impressions directly, without the aid of a draftsman, is due to the Surveyor General's (Mr. Ligar's) department of this Colony, and the first successful steps in the invention were exhibited at a Meeting of our Society. Our Vice-President, Mr. Ligar, commenced, and is still carrying on, the series of experiments in the

course of which his assistant, Mr. Osborne, made this valuable discovery for which he was rewarded by Parliament with a grant of £1,000.

It is now acknowledged by those in Europe who are the best authorities in the matter, that to this Colony is due the merit of having first originated Photolithography, as now so extensively practised at the Crown Lands Office for the reduction and publication of the numerous sale-plans issued to the public by that department.

When first introduced by its inventor, Mr. Osborne, considerable doubts were expressed as to its practical utility, but such doubts may now be considered as set at rest, by the fact that the immense numbers of sale plans required by the Government in connection with the business of the Crown Lands Office are prepared exclusively by this process.

As an instance of the rapidity with which plans may be reduced and copied by it, I may state that upon the passing of the Land Act of 1862, upwards of 350 different plans of a large size were issued by the aid of Photolithography in the space of about four weeks.

The process is also frequently taken advantage of by the other Government departments for the purpose of making fac-simile reproductions of valuable documents both in print and in manuscript, as the copies are so minutely exact as to render it almost impossible to distinguish them from the originals. By this means also copies were made of the Chinese writings connected with the peculiar transactions of the Chinese merchants with the Custom House here.

I have dwelt now so long on the applications amongst us of the Exact Sciences, that I have scarcely space to say a word on the Natural Sciences:—Botany has always flourished in this Colony, from the early days before our independent existence, when our noble Botanic Garden was laid out and adopted as the favourite out of doors resort of the people; and since the appointment of Dr. Müller, the late Secretary and former President and Vice-President of our Society, as Government Botanist, the more exclusively scientific branches of the subject have been cultivated with a success which has attracted marked attention and admiration. During the past year, as in former ones, the collection of living plants in the garden has considerably increased; but the most important recent addition is the establishment, by the liberality of the government, of a Public Herbarium close to the gardens,

which now numbers about 200,000 specimens from all parts of the world. It is expected that the various fasciculi will be arranged in the course of the year.

Many of the new plants discovered by Dr. Müller in Australia, have been first made known through the transactions of our Society. The more extensive publications of his botanical labours for the Government have made a marked advance during the past year, in which part of the second volume of the "*Plants Indigenous to Victoria*," and part of the fourth volume of the "*Fragmenta Phytographica Australiae*" have been printed, so that they may be expected to appear this year. The specimens and observations accumulated at the expense of this Colony during several years, and which were originally expected to have furnished a separate Colonial Flora to our special credit, have been sent to London, to be incorporated in Mr. Bentham's "*Universal Flora of Australia*;" and although we cannot, like the State of New York, have our own special volumes, yet a great interest must be felt by the colonists in this work, the second volume of which, containing the *Myrtaceae* and *Leguminosae*, to which so many of our more important plants belong, amongst other orders, may be expected to appear this year.

The National Museum of Natural History and Geology, with the application of economic geology to mining, agriculture, and the arts, has rapidly increased in the last as in several preceding years, and would be found now, if sufficient space existed for satisfactory examination, to bear favourable comparison with some of the best in Europe in several branches. Mineralogy and Geology are particularly rich, although but a small portion of the collections can be seen, and amongst the general Zoological collections which are geographically arranged, a great number of rare and interesting types have been brought together, as well as the more ordinary species, in greater numbers than might have been expected in so short a time as the Museum has been in existence. One of the last additions is the famous collection of British insects of the late Mr. Curtis, containing all the species referred to in his great work on the subject, for all the original types in which our Museum must in future be quoted, as well as for the original types of several of Frazer's Niger Expedition species, and many other species described before the Zoological Society of London.

The assistance which I have received from the principal scientific men in Europe and America in my endeavours, as director, to make our National Museum worthy of the country, has been of the most cordial and active kind, every one entering into the spirit of the undertaking with a zest which must surely be due to kindly feelings of appreciation for this young country in its endeavours in every department to earn quickly a foremost place.

In the department of mining machinery, so important to the Colony, I have succeeded in getting together a series far surpassing those of most of the Government Schools of Mines in Europe, and scarcely behind any of them.

Considerable materials both in manuscripts and lithographed plates, have been accumulated for the publication of a serial memoirs of the Museum, in which catalogues and various treatises connected with the collections are to appear; and in the present year the publication will commence of a series of Decades which I have been preparing, illustrative of the Natural History and Paleontology of the Colony.

The most important step in the progress of the Museum was made last year, in the erection of rather less than half of the permanent building, devoted to containing the whole of the Government collections appertaining to the Natural and Applied Sciences, on a plot of ground granted by the University for the purpose, at about 150 feet from the University Science Lecture Rooms. This has afforded about half the space required for the arrangement of the mining, geological, and other collections, and secures the important advantage for the country of making the collections useful as aids to the instruction given in the adjacent lecture rooms (where non-matriculated students may attend lectures in any one of the branches of science illustrated in the Museum), as well as accessible to the general public, upwards of 40,000 of whom visit the rooms yearly.

The establishment of a Mining School is rendered easy by this proximity of the University Lecture Rooms (in which eight out of the ten courses of instruction required are already given) to the collections of geology, mineralogy, and mining models, in the adjacent National Museum.

If the building were completed, I believe the development of the Museum would satisfy even the Museum Committee

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