PHYSICAL DESCRIPTION

OF

NEW SOUTH WALES

AND

VAN DIEMEN'S LAND.

ACCOMPANIED BY

A GEOLOGICAL MAP, SECTIONS, AND DIAGRAMS,

AND

FIGURES OF THE ORGANIC REMAINS.

BY

P. E. DE STRZELECKI.

".....The duty really is, not to refute the experiments of others, nor to show that they are erroneous, but to discover truth, and that alone. It is startling when we reflect that all the time and energy of a multitude of persons of genius, talent, and knowledge are expended in endeavours to demonstrate each other's errors."— *Liebig's Chemistry of Agriculture, &c. &c.*

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TO

CAPT. SIR JOHN FRANKLIN, R.N.

COMMANDING THE NORTH POLAR EXPEDITION.

My dear Sir John,

Fully impressed with the idea, that a token seldom corresponds, and never is expected to correspond, in value to the sentiments it is meant to testify, I still take the liberty of inscribing to you this slight but most sincere tribute, not only of my regard and esteem, but of a gratitude far exceeding the ordinary sense of obligation, for those courtesies, and that hospitality, which, in common with every visitor, I experienced from you in Hobart Town.

In my case, indeed, I have to acknowledge far more than mere conventional civilities. When, after completing the exploration of New South Wales, I ventured on that of Van Diemen's Land, I was welcomed, on my arrival at Launceston, by a kind letter of yours, which is now before me, and which insured to me, a stranger at that time, all the protection and assistance which the pursuit I was engaged in could require. The two years and a half which followed, were often marked by instances of

that assistance, and always by the uninterrupted manifestation of a most kind and friendly interest, on the part both of Lady Franklin and yourself; and even when far away from Van Diemen's Land, in other climes and countries, the influence of your friendly disposition followed me still, as on my return to England I found myself honoured by an address from the Tasmanian Public, headed by your name, and which, from the motives which prompted it, will form the proudest memorial of my life.

Whilst acknowledging my obligations to you, permit me at the same time, my dear Sir John, to offer you in all sincerity my most warm and cordial wishes for the success of that important Expedition which in a few days will leave the shores of England under your command. Nearly eighteen years have elapsed since last you visited the Polar Regions,—three hundred since the first attempt was made to ascertain the practicability of navigating round the Northern Boundary of the American Continent: May the enviable lot of solving this still pending geographical problem fall to your share! and may that good fortune be united with a prosperous voyage, and a safe return to your country and your friends!

Believe me, &c. &c.

My dear Sir John,

Yours most sincerely,

P. E. De Strzelecki.

London, May 13. 1845.

PREFACE.

In the course of my travels and voyages round the globe, and which occupied twelve years, I had explored or visited both North and South America, part of the West Indies, the South Sea Islands, New Zealand, New South Wales, Van Diemen's Land, the Javanese Islands, part of China and the East Indies, and Egypt. On my return to England, I had the honour to receive, through the hands of Francis Corbould, Esq., the following address from the Tasmanian Public, dated Van Diemen's Land, June, 1843: —

"*We, the undersigned, cannot suffer you to depart from our shores without presenting to you the assurance of our sincere regret. The benefits which you have conferred upon our country have added other motives to those of private friendship, which call for a public and united expression of our esteem.*

"*We are conscious that much is owing to your scientific knowledge, and to your indefatigable exertions; much that will, from henceforth, advance the progress of science, and the developement of the natural resources of Tasmania; and, in thanking you for these benefits, suffer us also to acknowledge one still more valuable than these, and still more worthy of our gratitude — that example, namely, which has testified among us the*

reality and the dignity of his calling who exchanges the ordinary pursuits and pleasures of life for the patient and self-denying investigation of the works of God: may He amply reward you with that knowledge for which you seek.

"*Permit us, as your friends and well-wishers, bound to you more especially by the interest which you have attached to our adopted home, to offer our contribution towards the completion of your labours in illustration of the physical phenomena of this country. It was originally our purpose to have presented a chronometer as the token of our esteem, until we understood that you are already so well provided in that respect.*

"*We now beg to be allowed to leave to your better judgment the selection of a more appropriate alternative; feeling, at the same time, that the result of your labours, when given to the world, would form a most fitting and durable monument of your connection with those regions, and (we trust it may not be ungrateful to you to add) with the friends whom you have left behind.*"

The signatures to this address were headed by that of His Excellency the Governor, Sir John Franklin, R. N.; His Honour the Chief Justice, Sir John Pedder; the Colonial Secretary, G. Boyes, Esq.; and comprehended those of most of the settlers in Van Diemen's Land.

To the very flattering expressions and hearty good wishes which this address breathes throughout, was added a subscription amounting to 400*l.* sterling, 100*l.* of which was contributed by Sir John Franklin himself.

I need not say with what emotions of honest pride and pleasure I received this address and subscription, and how fully and gratefully I appreciated the ex-

treme kindness with which I was honoured by the Tasmanian Public; but I may be permitted to state that this testimonial became mainly instrumental in determining me to venture on this present publication of "The Physical Description of New South Wales and Van Diemen's Land."

This "Description," comprehending the fruits of five years of continual labour, during a tour of 7000 miles, on foot, is divided into eight sections, or parts.

The *first* embraces the history and results of the Marine Surveys of Terra Australis, and the Land Surveys made of New South Wales and Van Diemen's Land, to which countries the work refers.

The *second* treats of Terrestrial Magnetism.

The *third* is devoted to Geology and Mineralogy, and furnishes the elements of illustration and reference for the succeeding sections.

The *fourth* treats of Climatology; the *fifth* of the fossil and existing Flora; and the *sixth* of the fossil and existing Fauna. In the first subdivision of each of the two last sections will be found the description, determination, and comparison of all the organic remains which afforded geological evidence as to the succession, analogy, or identity of the various formations.

The *seventh* contains notices on the physical, moral, and social state of the Aborigines, and the causes of their decrease.

And lastly, section *eight*, in glancing at the state of the Colonial Agriculture, exhibits what has already been done to turn to account the natural advantages of both countries; and points out what further resources are in store for the application of industry and capital on the part of the Colonists.

Whether the pages which follow, clothed, as they are, in a foreign and unidiomatic English, are worthy of being laid before the British public, will remain for the reader to decide. To the objections which may be raised to errors occurring in the course of the work, and which I cannot but myself perceive, I would merely reply, Go and do better; and you will see me greet your book with a joy far surpassing the pleasure which the writing of *this* has given to me.

I cannot refrain, on this occasion, from mentioning with grateful pleasure the ready aid and assistance which I have received, in all quarters of the globe, from the Officers of the Royal Navy; and who most hospitably received me in their ships, enabling me thus to visit many places which otherwise it would have scarcely been possible for me to have reached, and affording innumerable facilities for observation, which I could not otherwise have enjoyed. In particular, I must express myself in terms of grateful feeling to the Honourable Captain George Grey, for the warm and unwearing kindness I experienced from him during my stay on board Her Majesty's ship "Cleopatra," of nearly ten months, and this while that ship was visiting the Pacific coast of South America included between Chili and California; to Captain Russell Elliot, commanding Her Majesty's ship "Fly," and who afforded me the opportunity of visiting the Marquesas, Sandwich, and Friendly Islands; and, lastly, to Captain P. P. King, and Captain J. L. Stokes, for their steady friendship and their useful assistance during the whole of my travels and researches in Australia.

Not less great obligation do I owe to Sir Henry De la Bêche, and Dr. Fitton, for the kind interest and aid with which they promoted the publication of this work; and to Messrs. J. Morris and J. Lonsdale, for the valuable description which these two gentlemen furnished of the organic remains.

PHYSICAL DESCRIPTION

OF

NEW SOUTH WALES,

&c.

SECTION I.

MARINE AND LAND SURVEYS.

INTRODUCTION.

"In 1788," says Lieutenant-Colonel Collins*, "on the evening of the 25th of January, Governor Phillips arrived in Port Jackson, and anchored off the mouth of the cove intended for the settlement. The spot chosen for this purpose was at the head of the cove, near a run of fresh water which stole silently through a very thick wood, the stillness of which had then, for the first time since the creation, been interrupted by the rude sound of the labourer's axe and the downfal of its ancient inhabitants;—a stillness and tranquillity which from that day were to give place to the noise of labour, the confusion of camps and towns, and the busy hum of its new possessors.

"* * * The whole of the party then present were assembled at the point where they had first landed, and on which a flag-staff had been purposely

* Collins's "Account of the English Colony of N. S. Wales."

14

erected, and an union jack displayed; when the marines fired several volleys; between which the healths of his Majesty and the Royal family, with success to the new colony, were most cordially drunk. A portable canvas house, brought over for the governor, was erected on the east side of the cove, which was named Sydney. * * * Every person belonging to the settlement being landed, the numbers amounted to 1030 persons.

"As soon as the hurry and tumult necessarily attending the disembarkation had a little subsided, the governor caused his Majesty's commission, appointing him to be his Captain-General and Governor-in-chief, in and over the territory of New South Wales and its dependencies, to be publicly read, together with letters patent for establishing courts of civil and criminal judicature in the territory."

Such is the recorded account of the first settlement effected, in 1788, in Terra Australis.

In 1843, August 4th, we read in the "Australian," one of the Sydney papers*, as follows:

"Yesterday (August 3d) pursuant to the Governor's intimation to the Speaker, Mr. M'Leay, on the oc-

April, 1839.

* Since my arrival in Sydney, I cannot cease asking myself, am I really in the capital of that "*Botany Bay*" which has been represented as "*The Community of Felons*," as "*the most demoralised colony known in the history of nations*," as "*a possession which adds a tarnish rather than a lustre to the British Crown*," &c. &c.

Let the authors of these and other epithets contained in the numerous works which they wrote on New South Wales congratulate and applaud themselves: my mystification was complete. The evening I effected my disembarkation in Sydney, I did it with all imaginable precaution, leaving my watch and purse behind me, and arming myself with a stick; being resolved to encounter inevitable and imminent dangers with the least possible risk!! * * *

I found, however, on that night, in the streets of Sydney, a decency and a quiet which I have never witnessed in any other of the ports of the United Kingdom. No drunkenness, no sailors' quarrels, no appearances of prostitution, were to be seen. George Street, the Regent Street of Sydney, displayed houses and shops modelled after the

casion of his presentation, his Excellency, Sir George Gipps, proceeded to the Council Chamber, for the purpose of opening the session, and declaring the purposes for which he had summoned the members. At an early hour the house presented an animated and brilliant appearance; most of the seats in the body of the chamber being filled with elegantly-dressed ladies, amongst whom we noticed Lady Gipps, Lady O'Connell, Mrs. Deas Thomson, Mrs. George M'Leay, Mrs. C. M. O'Connell, and the female part of most of the families of the members of council and their friends. A guard of honour was drawn up in

fashion of those in London; but nowhere did its lamps and the numerous lights in its windows, which reflected upon the crowd, betray any of those signs of a corrupt state of society common to the streets of other capitals. Since then how many nights like the first did I not witness, in which the silence, the feeling of perfect security, and the delicious freshness of the air, mingled with nothing that could break the charm of a solitary walk! At ten o'clock all the streets are deserted: to the bustling industry of the day succeeds a happy repose; and to that again a day of fresh struggles, successes, or failures! Extraordinary race! the only people who—to speak the language of one's own craft—seem subjected to atomic laws, immutable and independent of the varieties of climate; aggregating by a kind of molecular attraction, constantly in the same order; and expanding, however dispersed, into a similar social structure, thus everywhere preserving those properties and tendencies which nature assigns to their primitive form.

Other races, like true children of the soil, identify themselves with it, draw from it their sustenance, their power, and their nationality; call it country; love and cherish it as such, and cling to its bosom, though at the cost of freedom, of comfort, of property, and even of life. Banished from it, they become but lost wanderers, and soon degenerate; like the alpine rose, which when transplanted even to more genial regions loses its blossoms, and sends forth only thorns.

The hardy nature of the Anglo-Saxon race is proof against the effects of transplantation: for it does not depend on the soil either for its character or its nationality: the Anglo-Saxon reproduces his country wherever he hoists his country's flag.

The United Kingdom is far from furnishing a just idea of this race. The traveller there is like one buried in the entrails of a colossus. It is in the United States, in the West Indies, in the factories of South America and China, in the East Indies, and in this town of Sydney, that the prodigious expansion of the Anglo-Saxon life, the gigantic dimensions of its stature and the energy of its functions, are fully perceived and appreciated.—*MS. Journal of the Author.*

the court-yard of the chamber, and his Excellency was received with presented arms, the band playing 'God save the Queen.'

"The Governor was received at the door of the council chamber by the Speaker, who conducted him to the vice-regal chair prepared for him on the *left* of the Speaker's chair. At this moment the appearance of the house was extremely striking; the elegant costumes of the ladies, and the brilliant uniforms of the official and military members, and of the numerous staff, which occupied places below the vice-regal chair, completing the *mise en scene*, which was in every respect worthy of the occasion. The mayor, aldermen, and common council of the city were accommodated with seats within the bar. The strangers' gallery was crowded to excess, as was also the reporters' gallery — of which, however, we should be ungrateful to complain, inasmuch as every desire has been evinced by Mr. Lewis and the other authorities to meet the views and adopt the suggestions of the respective journals. Reverting to the brilliant appearance of the chamber, we must not omit to notice the prompt adoption of our hint by Mr. W. C. Wentworth, who, on this occasion, appeared in the usual costume of the time — a mark of good sense that we gladly recognise.

"His Excellency having taken his seat, delivered the following address: —

"Gentlemen of the Legislative Council.

"The time has at length arrived which has, for many years, been anxiously looked forward to by us all; and I have this day the pleasure to meet, for the first time, the Legislative Council of New South Wales, enlarged as it has been under the statute recently passed by the Imperial Parliament for the government of the colony. I congratulate you very sincerely on the introduction of popular repre-

sentation into our constitution, and I heartily welcome to this chamber the first representatives of the people.

" The period, gentlemen, at which you enter on your functions, is one of acknowledged difficulty, and it is therefore more grateful to me to have my own labours and responsibilities lightened by your co-operation and assistance.

" I shall most readily concur with you in any measures which may be calculated to develope the resources of the colony, by calling into action the energies of the people, taking care, however, that we proceed on sure principles, and not overlooking the great truths, that the enterprise of individuals is ever most active, when left as far as possible unshackled by legislative enactment, and that industry and economy are the only sure foundations of wealth. Great as undoubtedly are the embarrassments under which numbers, even of the most respectable, of our fellow-subjects in the colony are now labouring, it is consolatory to me to think, that grievous though they be to individuals, they are not of a nature permanently to injure us as a community; that, on the contrary, they may be looked on as forming one of those alterations in the progress of human events, which occur in all countries, and perhaps most frequently in those whose general prosperity is the greatest.

" Nor should we, gentlemen, enter upon the labours of this session, without making our grateful acknowledgments to Almighty God, for the many blessings he has showered down upon us. Our embarrassments may be the effect of our own errors — but it is to His bounty and goodness we are indebted, that the fruits of the earth, as well as the productions of industry, abound throughout the land. If, in addition to the monetary confusion which has

grown out of our excessive speculations, it had pleased the Almighty further to chastise us with drought or scarcity, the condition of New South Wales, and more particularly that of the labouring classes of its population, might have been lamentable indeed. As it is I do not doubt that, by frugality and prudence, we may overcome all our difficulties; and, I am happy to say, there is nothing in what more immediately concerns the government, to lessen in any degree the confidence which I feel in the stability of the country. Cheapness and plenty cannot be permanent impediments to the advancement of any community.

"I shall immediately cause to be laid before you numerous public documents of much importance, and some projects for amendment in the law. Amongst these latter will be the draft of an Act for the establishment of a General Registry, and of one to regulate the office of sheriff. I shall also have to direct your attention to the state of the law under which the Savings' Bank of the colony is established: the propriety will, I think, be readily admitted of placing the credit of this most useful institution beyond the reach of doubt.

"I shall speedily cause the Estimates for the year 1844 to be brought under your consideration, and take advantage of that occasion to make a clear exposition of the financial state of the colony.

"The despatch from the Secretary of State, No. 181, of the 5th September, 1842, is a document of such importance, that I think it ought to appear on the record of your proceedings, and accordingly I shall lay it before you, notwithstanding it has been already printed by order of the late council.

"In this despatch, the views are explained of Her Majesty's government in respect to the Act of Parliament under the provisions of which I now meet you for the first time in this chamber.

" The benevolent intentions of Her Majesty, her Majesty's advisers, and of the British Parliament, are so well set forth in the words of the noble Secretary of State, that I feel I should only weaken the effect they are calculated to produce upon you, were I at any length to comment on them, or make to them additions of my own. I cannot, however, gentlemen, on this my first occasion of addressing you, avoid adverting to the peculiar constitution which has been given to your body — or to the fact, that to you singly have been confided by the Imperial Parliament the powers, which in some of the older colonies of Great Britain are divided between two separate bodies.

" The council, gentlemen, is composed of three elements, or three different classes of persons — the representatives of the people — the official servants of Her Majesty, and of gentlemen of independence — the unofficial nominees of the Crown.

" Let it not be said or supposed that these three classes of persons have, or ought to have, separate interests to support — still less that they have opposing interests, or any interest whatever, save that of the public good. Let there be no rivalry between them, save which shall in courtesy excel the other, and which of them devote itself most heartily to the service of their common country.

" His Excellency then retired."

The fifty-five years which fill the space between the two above noticed extraordinary and strikingly contrasting eras, 1788 and 1843 — a period unparalleled in the records of any colony — have been marked on the part of the colonists by many severe trials, continual struggles, extensive improvements, and that praiseworthy perseverance in developing the resources of the country, and in raising themselves in the social and commercial scale, which have at last

won the colony its richly deserved Representative government.

In a political point of view, the history of this intermediate epoch is replete with facts of the deepest interest to the philosopher and the statesman; affording, in many instances, an insight into the curious processes attending the elaboration of social schemes, and corroborating in others, what has been long ago proved to be the case, viz. that the most captivating theories are not always the most practicable and successful, and that a measure the least dependent on theories, but which results from, and is subservient to, the actual exigencies of society, never fails to promote its welfare.

Thus the system of transportation, which was denounced by European politicians and moralists, as fraught with mischief and ruin to society, because inconsistent with their theories and maxims of criminal legislation and political morality, has succeeded to a certainty as well ascertained as any circumstance may be by human experience; and has succeeded in spite of bitter invective, plausible reasoning, unmeasured censure; and, strange to say, through the very means which theory pointed out as having a most dangerous tendency, namely, the encouraging of free men to emigrate into a penal colony, and the encouraging of those in bond to industry and to the acquisition of property.

To enter at large into the benefits of transportation combined with free emigration; to point out the calumnies and wilful misrepresentations, or the unintentional, but not less flagrant misconceptions to which this question has exposed New South Wales and Van Diemen's Land; to attempt to remove the ridiculous prejudices, or the mistaken impressions, of the mother country in respect to the true state of these colonies; and, lastly, to render justice to the

colonists themselves for the steady deportment and the unwearying efforts they have so courageously displayed throughout their colonial career, would be to enter on subjects quite foreign to the physical description of the two countries.

The origin of the colonies has been touched upon, because that origin is to be ascribed to the hydrographical knowledge which the government of the mother country possessed regarding the capabilities of the eastern coast of New Holland: some of the events, also, connected with the progress of the colony have been just adverted to, because the importance they have assumed in respect to commerce and industry has operated most powerfully and beneficially in causing a completion of surveys by sea and land, the history of which is now laid before the reader.

MARINE SURVEYS.

THE first page of this history commences with the voyage of Captain Cook. With those anterior to his, whether undertaken by Portuguese, Spanish, or Dutch navigators, science has little to do. They were all jealous and avaricious, and kept their discoveries secret, seeking, and some of them indeed finding, their reward in self-aggrandisement: thus leaving behind names which only perpetuate their own or their country's illiberality.

Cook also transmitted his name to posterity, but it was by virtue of the benefits he conferred upon the aborigines of the different islands which he visited, and by those also which his voyages, through the medium of the press, secured to geography, natural history, navigation, and commerce. With him may be said to have dawned the first glimpses of positive knowledge which the civilised world obtained

regarding the existence of Terra Australis; and with him also commenced that series of maritime surveys which, followed up by Flinders and King, give to Great Britain the most legitimate title to the sovereignty of New Holland and Van Diemen's Land.

It was during his first voyage, in April 1770, that Cook, on leaving New Zealand, discovered, in the neighbourhood of Cape Howe, the eastern shore of New Holland. The place which he at first anchored at, the Botany Bay of our times, may be thus looked upon as the commencing point of his survey. From Botany Bay he proceeded to the northward. In the neighbourhood of Cape Tribulation, his ship struck on a coral reef; which accident threatened to be as fatal as the subsequent escape from its consequences appears wonderful. The vessel having been repaired at Endeavour river, resumed its voyage of discovery. Keeping along the shore, the expedition reached a point of land from which appeared an open sea to the westward, and passed through the strait between New Holland and New Guinea, the existence of which, although long ago discovered, had been partially kept a secret, and was considered by Cook himself as very doubtful. At Cape York, from whence the distinguished voyager directed his course to Java, terminated his cursory examination of that part of the east coast of New Holland which lies north of Botany Bay. Southward of that locality, nothing was known beyond what, in the second voyage of Captain Cook, Captain Furneaux, tracing the southern and a part of the eastern coast of Van Diemen's Land, reported, namely, "that there is no strait between New Holland and Van Diemen's Land, but a very deep bay!"

To the south-west and west, several points of the coast had been seen at different periods by occasional and transient navigators. Of the partial contributions which thus accrued to hydrography, none are more

worthy of record than those of the French expedition in 1792, which, while sailing under Admiral d'Entrecasteaux, in search of the unfortunate "La Perouse," favoured the scientific world with a published survey of the coast line from Cape Lecuwin to Long. 132° in New Holland, and of the south extremity of Van Diemen's Land, including the river Derwent and the channel which bears d'Entrecasteaux's name.

"The charts of the last survey, particularly those relating to the bays, ports, and arms of the sea of the south-east of Van Diemen's Land, and constructed in this expedition by M. Beautemps Beaupré and his assistants, appear to combine scientific accuracy and minuteness of detail with an uncommon degree of neatness in the execution. They contain some of the finest specimens of marine surveying perhaps ever made in a new country."—(*Flinders.*) The knowledge of the form and outline of this still mysterious continent, as derived from these occasional surveys, or from the rumours which naturally arose through the obstinate secrecy of the Portuguese, Spaniards, and Dutch, amounted pretty nearly to this:—that Terra Australis is composed of two large continents, of which the more easterly included Van Diemen's Land, and which were divided by a wide channel running from north to south, the Gulf of Carpenteria being considered the northern extremity of that channel, and the great Australian bight, the southerly one.

Such was the sum of geographical information or rather misinformation respecting this section of the world prior to 1797, when in that year, Midshipman Flinders, and Mr. Bass, surgeon in his Majesty's navy, visitors to the then already flourishing colony of Port Jackson, undertook a series of expeditions which not only led to a discovery of the straits between New Holland and Van Diemen's Land, but of various harbours and rivers in the two countries.

Their first attempt to penetrate to the southward of Port Jackson was made in a boat, eight feet long, called the "Tom Thumb," and of which they themselves and one boy formed the entire crew. Attended with more dangers and providential escapes than advantages, this adventurous expedition was but the forerunner of a bolder and more successful enterprise. In the beginning of 1789, Mr. Bass ventured in a whale boat along a coast line of 300 miles; and reached and discovered the straits since named after him, and Port Western, while Mr. Flinders on his side visited in a small, leaky, and unseaworthy craft, the land seen by Furneaux, and discovered the chain of islands between Cape Portland and Wilson's promontory. About the end of the same year, both the voyagers embarked in the "Norfolk," a schooner of twenty-five tons, and discovered Port Dalrymple, the river Tamar, the inlets and bays of the river Derwent, and Tasman's peninsula, and succeeded in circumnavigating Van Diemen's Land, thus completely establishing the fact of its insularity.

The perusal of the details relating to these discoveries, which are here only summarily noticed, cannot but excite in every one acquainted with the boisterous climate of the region in which they were made, and with the slender means by which they were achieved, sentiments of unmingled respect and admiration for the memory of the enterprising voyagers. Indeed to both of them may be applied the eulogium which, in his work, Captain Flinders passed on the labours of his departed friend Mr. Bass: "The public will award to the high-spirited and able conductors of these voyages — alas! no more! — an honourable place in the list of those whose ardour stands most conspicuous for the promotion of useful knowledge." *

* No public act or expression of opinion has as yet occurred which can be viewed as a fulfilment of this anticipation; but the more genuine

The charts, dated 1801, which were the result of the joint and separate expeditions of Messrs. Flinders and Bass, gave a delineation and a survey of the line of coast from Port Jackson to Western Port, of the islands of the straits, and of Van Diemen's Land, including the survey of the river Tamar, and the bays and coves of the river Derwent and Tasman's Peninsula. They combined with nautical information accounts of the productions and capabilities of the discovered and examined harbours, and were considered of such signal service to science, commerce, and colo-

and disinterested impulses of private feeling have already led a brother officer to pay an interesting tribute to the memory of Flinders.

Out of his own purse, and at a cost of more than 250*l*., His Excellency Sir John Franklin, late Governor of Van Diemen's Land, has, within the last year, caused to be erected on the peak of Stamford Hill, near Port Lincoln, a lofty stone obelisk, whereon is fixed a tablet bearing the following inscription, the kind and manly English feeling discoverable in which does honour alike to him to whom the monument is raised and to him who raised it.

THIS PLACE,
FROM WHICH THE GULF AND ITS
SHORES WERE FIRST SURVEYED
ON 26TH FEBY. 1802, BY
MATTHEW FLINDERS, R.N.,
COMMANDER OF H. M. S. INVESTIGATOR,
AND THE DISCOVERER OF THE COUNTRY
NOW CALLED SOUTH AUSTRALIA,
WAS
ON 12. JAN. 1841,
WITH THE SANCTION OF
LT. COL. GAWLER, K. H.
THEN GOVERNOR OF THE COLONY, SET APART FOR
AND IN THE FIRST YEAR OF THE
GOVERNMENT OF CAPTAIN G. GREY
ADORNED WITH THIS MONUMENT
TO THE PERPETUAL MEMORY
OF THE ILLUSTRIOUS NAVIGATOR,
HIS HONORED COMMANDER,
BY
JOHN FRANKLIN, CAPTAIN R. N.
K. C. H. R. R.
LT. GOVERNOR OF
VAN DIEMEN'S LAND.

nisation, that no sooner had Mr. Flinders reached England, and made them known to the government, than he was promoted to the rank of lieutenant, and very shortly after, to that of commander, with a commission to the "Investigator," a sloop of war fitted out for the purpose of a complete examination and survey of New Holland and Van Diemen's Land."

The instructions which, on that occasion, Captain Flinders received from the Admiralty embraced a wide range of nautical and other scientific inquiry. The choice of instruments, books, officers, and scientific men was liberal and judicious. In the list of the latter appear the names of John Franklin and Robert Brown; names which, since that period, have been seen constantly connected with services rendered to science. The expedition was moreover secured against all chances of war, by a passport from the French Government, which, on principles worthy of the enlightened age, granted to it protection, assistance, and free ingress and egress to and from the ports of the French Republic.

In December, 1801, the expedition reached Cape Leeuwin. The line of coast stretching eastward of that cape to 130° of E. longitude had been, as already said, surveyed by the French under Admiral d'Entrecasteaux; but Captain Flinders, following the same track with the French chart in his hand, could not but improve upon that chart, partly in the details of many indentations of the coast, partly in soundings, in which the chart constructed by M. Beautemps Beaupré, geographical engineer on board the "Recherche," was particularly deficient. This re-examination of the French survey, besides securing the soundings, led to the fuller examination of King George's Sound, the archipelago of the "Recherche," by which Lucky Bay, and many other coves or places of shelter, were discovered. Arrived at longitude

130°, at which point the French survey ceased, the examination of the unknown coast was commenced with all the interest and excitement which the exploring of a new region imparts. Such was the mystery in which the actual form of Terra Australis was at that time still enveloped, and so great was the tendency to imagine it divided by a sea channel running from north to south, that when the expedition anchored in the evening at the south-eastern extremity of Thistle Island, and its coast was observed trending away to the northward until all signs of land disappeared in that direction, while at the same time no sensible tides were noted, numerous anticipations and conjectures were raised as to the probable existence of deep inlets, inland seas, and passages into the Gulf of Carpenteria, and prospects of finding large rivers flowing into them, with other still more interesting discoveries, were freely indulged in.

If, on the next morning and the following days, the further examination of the coast dispelled some of these expectations, it realised others, in the discovery of Spencer Gulf, Kangaroo Island, and Port Lincoln, which last has since become a prosperous outlet for commerce.

While engaged in the survey of the main coast eastward of Cape Spencer and of Cape Jarvis, the expedition met the "Geographe," a French ship, engaged also in a voyage of discovery, and commanded by M. Baudin. The situation of both the ships at the moment when they hove-to for the purpose of communicating, was, as determined by Captain Flinders, 35° 40′ south latitude, and 138° 58′ east longitude. Considering that the nations to which the ships respectively belonged were at that period at war, and that their respective flags, whenever brought in sight of each other, became the signal of a fierce and bloody

struggle, we cannot too highly estimate the advantages of civilisation when we find that, on this occasion, the display of the national colours of the "Investigator" and the "Geographe" aroused only sentiments of respect and regard for the interests of science.

Both the commanders met on board the "Geographe," in presence of Mr. R. Brown; exchanged freely and most liberally all the information which they thought would be most serviceable to each other, and parted on the 8th of April, 1802, Captain Baudin directing his course to the north west, Captain Flinders to the southward.

Before entering the straits, Captain Flinders made a running survey of the coast discovered by the French, and marked on the chart as Capes Bernouilly, Jaffa, and Buffon. Grant's discoveries, viz. King's Island, Cape Otway, Port Phillip, and Cape Shank, were next verified, as also the points marked in the previous survey of Bass and Flinders in Bass's Straits.

On the 9th of May, 1802, the "Investigator" entered Port Jackson, to refit for the prosecution of further surveys.

In July of the same year, she sailed for the northward of Sydney, and skirting the line of coast between Port Jackson and Glass-house Bay, began the examination of the north-east coast at Breaksea Spit. The survey of the Great Barrier Reef, which from that parallel stretches along the coast to the northward, was together with many indentations of the coast itself, replete with as much interest as danger. The examination of Harvey's Bay, Bastard Bay, Port Curtis, Keppel Bay, Port Bowen, and Broad Sound, also furnished many valuable observations connected with science and with the capabilities of the country. The main object, however, of the expedition being to

reach the Gulf of Carpentaria before the north-westerly monsoon set in, Captain Flinders deferred to a more suitable season the farther examination of the easterly coast, and eagerly set about seeking a passage through the Great Barrier Reef, in order to take the outer route to Torres Straits, and ensure, as he thought, a safe and speedy voyage. After leaving Sandy Spit, this Barrier presented an uninterrupted wall exceeding 100 miles in length. Abreast, however, of Cape Cleveland, it was broken by a narrow channel, of which advantage was taken; the expedition passed through, cleared Torres Straits the close of October, and began, with the 1st of November, the survey of the east side of the Gulf of Carpentaria.

The shallowness of the water made it impracticable to keep close to the shore, and allowed only occasionally an approach to or landing upon it. The examination, therefore, of such features of the coast as are recorded in the course of the voyage, was mostly made at three or four miles distance. To the objects, however, of a survey, this was unimportant, as the 450 miles of coast were so low that the highest elevation, which was observed at Sweer Island, did not much exceed that of the ship's mast-head.

About this locality, the progress of the expedition was interrupted by damages discovered in the ship, and which proved to be of a nature calculated to deject and discourage the spirit of the most undaunted voyagers. Her timbers had become so rotten that she could not bear heaving down, and it was found that laying her on shore for the purpose of repair would only endanger her farther. This unfortunate situation, so entirely beyond the reach of remedy, was rendered worse by the presence of a monsoon unfavourable for a return to Port Jackson *viâ* Torres Straits; and considering that the expedition was at that time at the height of its labours

and its expectations, and had arrived at them through many toils, dangers, and anxieties, one cannot wonder, that when it was reported that the "Investigator" was "incapable of encountering bad weather, and, even if constant fine weather could be secured, and all accidents avoided, was incapable of running more than six months," Captain Flinders should feel his surprise and sorrow beyond the "power of expression."

The westerly route, being the only one left for her return, was, with all the chances of a boisterous sea off the western and southern coast, instantly decided on; and the more readily, as this course offered a prospect of completing at least the examination of the Gulf of Carpentaria.

Hitherto, Captain Flinders, animated by a strong desire to unite to a determining of the general outline or exterior form of Terra Australis, all those interesting and valuable details regarding its coast, which might lead to the discovery of some interior inland communications, fearlessly approached the shores and explored bays and rivers, whenever the soundings or wind allowed. During the remainder of the expedition, however, the idea that the "Investigator," "getting on shore under any unfavourable circumstances, would go to pieces," predominated, and the object of the survey became secondary to the safety of the ship's company.

The natives too, who until now had not molested the expedition, began to offer opposition whenever landings were made for effecting astronomical observations, or conducting researches connected with natural history and botany. Indeed their character, as compared with that of the natives of the south coast, or even with that of those of Torres Straits, who were seen to approach the vessel freely for the sake of barter, exhibited very unfavourable traits;

their conduct being marked by distrust, hostility, and not a small share of that cunning which inspires confidence and profits by credulity. Along the whole length of the western side of the Gulf of Carpentaria, and on the islands which lay here and there opposite the mainland, the expedition had, when wooding and watering, to be constantly on their guard against attacks and ambushes, especially at Wellesley's Islands, Sir Edward Pellew's, Gray's, and Grote Island, and at Blue Mud Bay, where they had to deplore the loss of two men.

The coast also, of which the fore-ground consisted of mud flats or mangrove trees, and the back-ground of equally low land, presented a tedious and monotonous uniformity of aspect that was far from diverting the anxieties or cheering the drooping spirits which the state of the ship and the inhospitality of the inhabitants had not failed to produce.

With Arnhem Cape, where Captain Flinders terminates the examination of the Gulf of Carpentaria, — an examination which, exclusive of the numerous islands and openings, embraced a tract of little less than 400 leagues in length, — with that cape may be said to conclude the record of all his labours and surveys in Terra Australis, and to begin that which relates only to his disappointments and misfortunes.

Indeed his return to Sydney, amid dangers and difficulties arising from the state of the ship, and the sickliness of the crew; his departure in the "Porpoise;" his wreck on Cato's Bank; his being driven in the "Cumberland" by distress to the Mauritius; and his unwarrantable detention during eight years, in spite of passports and remonstrances, by General de Caen, include a history of moral and bodily sufferings, which nothing but an energetic character and a not less vigorous constitution could have sustained. His work, with an atlas, published soon after his re-

turn to England, while bearing evidence of both these qualities, which so eminently distinguished Captain Flinders, displays also uncommon ability and talent for observation; and for the minuteness of details and the mass of valuable information it conveys, may be ranked amongst the most important contributions ever made to general knowledge, and towards promoting the interests of colonisation.

Contemporaneously with the expedition of Captain Flinders (1801), that of the French under Captain Baudin appeared on the south-east coast of Van Diemen's Land. Their discoveries on the southern coast of New Holland are included between 37° 36′ and 35° 40′ of south latitude, and 140° 10′ and 138° 58′ longitude east of Greenwich, — a coast-line of about 50 leagues in length, devoid of rivers, inlets, or place of shelter.

In its further progress to the N. W., the line of coast from Cape Leeuwin to Rottnest Island, and including Swan River, was examined by the expedition, and correctly laid down on the chart. The survey S. W. of Cape Londonderry came next; but, with the exception of Cassini Island, it does not possess the merit of the preceding survey, as the coast was passed at too great a distance to allow of correctly laying down the numerous islands which front it, and the details in the configuration of the mainland. To the southward of Melville Island, many points of the coast and of the islands fringing it were discovered, and their position accurately ascertained.

After the terminations of Flinders's and Baudin's expeditions, an interval of twelve years succeeded, during which neither the English nor the French were in a position to divert their attention from the field of war to that of geographical discovery. The peace, however, of 1815, which was productive of so many political and social advantages, gave a fresh stimulus to the suppressed and confined energies of

England. Amongst her naval officers particularly, the recollection of former glory, earned in the field of discovery, acted as an incitement to new attempts and adventures. With some, indeed, the military spirit seemed entirely subordinate to the attractions of scientific enterprise; and it was then that the English government, fully impressed with all the advantages likely to accrue, promoted those expeditions of Ross, Parry, Franklin, Owen, and King, which in point of extent, importance, difficulty, danger, variety, and the skill with which they were conducted, stand unparalleled in the history of voyages.

On the last of the above-named officers devolved the important task of completing the Australian survey, which, as stated before, was interrupted by the unfortunate circumstance of Captain Flinders' detention.

The instructions given to Captain P. P. King directed the examination of the eastern coast, from the Tropic to Cape York; the survey of the hitherto unexplored shores from Arnhem Bay, near the western entrance of the Gulf of Carpentaria, westward and southward as far as North West Cape, including the Gulf of Van Diemen's Land and the cluster of islands called Rosemary Islands, together with the inlets behind them; and also the examination of the western coast between North West Cape and Cape Leeuwin; forming, in all, a line of coast amounting to 4000 miles.

The importance which the English government attached to this mission caused Captain King to lose no time in proceeding to the scene of his labours. He was appointed in February, 1817, and in the following September he arrived at Sydney; purchased and completed the outfit of a colonial vessel, the "Mermaid," eighty-four tons; and reached North West Cape on the 1st of January, 1818.

Commencing with the examination of Exmouth Gulf, the survey embraced in its course the entire line of coast extending to Deputch Island, with the group of islands which front it. The name of Dampier's Archipelago, given to that group by the French, was admitted by the expedition, with the difference only of its being extended to the islands forming the east side of "Mermaid's Straits," which islands are laid down on the French chart as part of the mainland. The whole coast was found composed of very low shores bordered either by "dunes," or by impervious forests of mangrove trees, beyond which no part of the interior could be seen.

With the natives, both on the mainland and on the small islands fronting it, every means was resorted to for establishing a friendly intercourse. One of them even, while passing from one island to another on a catamaran, formed of two mangrove logs lashed together, and on which he sat astride and paddling with his hands, was intercepted, brought on board, caressed, fed, and sent back to his alarmed friends with presents; but all these attempts proved of no avail, as, with but few exceptions, wherever a necessity for landing occurred, the unfriendly disposition of the natives led them either to oppose it, or to molest the whites when it was effected.

The expedition next determined the position of the long shoal called Rowley Shoal, a dangerous reef in the open sea about 120 miles from the coast; and as the easterly monsoon was at hand, it then sailed to the northward, in order to resume the survey at Cape Arnhem, at which point Flinders' survey ceased. Contrary winds, however, only allowed the vessel to reach that part of the coast called Point Braithwaite, from whence it was, that, in proceeding to examine the coast to the westward, Captain King discovered Port Essington, — an important discovery, as its situation

not only connects it with the commercial interests of the opposite islands and settlements, but, in case of war, enables it to protect the passage through Torres Straits.*

* In the address on the anniversary meeting of the Royal Geographical Society, the distinguished President of that Society, Roderick Impey Murchison, Esq., said, in reference to the importance of Port Essington : —

"If we are to confide in the clear and decisive testimony of Sir Gordon Bremer and other naval officers, including Captain Sir Everard Home, as well as in that of Mr. Earl and Captain M'Arthur, who have thoroughly examined the regions around it, we should be led to think that in all her schemes of future commerce, Great Britain has rarely had it in her power to place her standard on a more desirable spot than Port Essington. With an outer harbour capable of containing the whole British navy, and an inner harbour in which twenty-five sail of the line can lie at ease ; with a climate peculiarly healthy to Europeans ; in which spices, indigo, sugar-canes, the cotton, and the choicest woods, can be grown in abundance, whilst the sea swarms with the finest fish ; this port further offers the great advantage of having a quiet and industrious race of inhabitants in the adjacent islands, who, as well as the more active inhabitants of Timor and the neighbouring isles, and also the Chinese, are ready to flock to the settlement. I am, indeed, led to believe, that no sooner shall our government render Port Essington a permanent and independent colony of the Crown, than several rich mercantile houses in London will at once set up establishments there, and freight large vessels for the trade which they would carry on, through it, with the Eastern Archipelago and China. Already many of the enterprising Malays resort thither for the fisheries, and are ready to exchange their salted fish and other products for British cottons ; and as an entrepôt, it is daily becoming more important, from the rapidly increasing intercourse between our Australian and Indian possessions. Grand as is the future prospect of intercourse with India, the Eastern Islands, and China, Port Essington is not, however, to be viewed merely in reference to commerce. As a place of refuge in a wide ocean, it has a strong claim upon our nation, and it has already, even in its infant state, been the means of saving the lives of crews who had taken to their boats even as far off as Torres Straits. In this respect, indeed, a more intimate acquaintance with the Gulf of Carpentaria and Torres Straits, so dangerous from the adjacent coral reefs to ships which try that passage, may lead to the discovery of an additional harbour in its vicinity. But independently of this consideration, Port Essington ought to be viewed as a most advantageous naval station for Great Britain in case of war ; and with the extension of steam navigation, it is further to be regarded as the point by which, in all probability, our future correspondence with our South Australian colonies might be most expeditiously and beneficially carried on."

The landing on the northern coast was as much interfered with by the hostility of the natives as that on the western; and on one occasion, when the boat with the principal officers of the expedition was entangled amongst mangroves, this hostility very nearly proved fatal to them, as the concealed natives assaulted them with clubs, spears, and stones: notwithstanding the danger which thus attended the landings, they were persevered in, whenever the interests of the survey and of science required it.

Shortly after the survey of Port Essington was completed, the expedition was forced to return to Port Jackson, owing to the injuries sustained by the vessel, the loss of anchors, and the sickly state of the ship's company.

Their stay in Port Jackson was short, as the anxiety of Captain King to lose no time expedited every necessary arrangement in the outfit. So great, indeed, was the solicitude he evinced for the interests entrusted to his care, that, having some time to spare before the monsoon would allow him to proceed by way of Torres Straits in order to resume his labours, he sailed for Van Diemen's Land, for the purpose of surveying and exploring Macquarie Harbour, and verifying some other positions on its southern coast.

This being accomplished, the expedition returned to Port Jackson, and, immediately after, sailed to the northward and surveyed Port Macquarie, the River Hastings, and Rodd's Bay; re-examining also the position of parts of the great Barrier Reef, and of the numerous bays and inlets of the eastern coast which front it, and which were embraced in the previous survey of the "Investigator." Where that survey ceased, the survey of Captain King began; and in its course finally led him to the important discovery of the inner route for vessels bound through Torres Straits, and which, in point of easy, safe, and speedy

sailing possesses incontestable advantages over that called the outer route.

After rounding Cape York, and passing the Gulf of Carpentaria, the survey of the N.W. coast was resumed at Cape Wessel: in the course of a month it was carried out so as to connect itself with that of the last year; and on comparing the relative meridional distances ascertained in the two surveys, the difference was found to amount only to 1′ 2″, — an instance of the accuracy of the nautical observations, and the goodness of the chronometer, as gratifying to every lover of exact science as it must have been to Captain King.

Passing Melville and Bathurst Islands, the examination, omitted the previous year, of the coast to the S.W. of Vernon Island was continued. On arriving at Cape Londonderry, the expedition found that the plan of the islands which face it, as given by the French, was, with the exception of Cassini Islands, so defective that many of them could not be recognised. In the space embraced between Cape Bougainville and Cape Voltaire, and which was named Admiralty Gulf, Captain King fixed the position of at least forty islands and inlets.

The leaky state of the vessel, with loss of anchors and want of provisions, compelled the expedition to return to Sydney, which was reached on the 12th January, 1820. On the 21st of June, the repair and refitting being completed, the "Mermaid" sailed on her third voyage, being her second through Torres Straits, and resumed the survey with the coast S. W. of Cape Londonderry, from which, as before said, the French kept at a distance, and were thus prevented not only from noticing the minuter but even some of the main features of the coast. The survey of Montague Sound, York Sound, Prince Frederick Harbour, and the Hunter and Roe River followed; and there is no doubt that the greater part of the

unsurveyed coast laying between Cassini and Deputch Islands would have been also duly examined, had it not been for the leak which the cutter had sprung, the necessary repair of which delayed the expedition at Careening Bay, and ultimately forced it back to Port Jackson.

On her arrival at Sydney in December, 1820, the cutter was condemned, and another vessel being provided, the expedition sailed in May on its fourth voyage, and, passing for the third time through Torres Straits, resumed and completed the survey of the coast-line between Careening Bay and Cape St. Eveque, including its bays, inlets, and rivers, and Buccaneer's Archipelago.

In Hanover Bay, the expedition tried again, by presents and kindness, to conciliate the natives, but on this occasion they showed their inimical disposition more than upon any, as, on the party's turning their backs to regain their boats, the surgeon of the expedition, Mr. Hunter, was dangerously wounded with a spear.

The fatigue of wooding and watering, and the constant harassing employment attendant on the survey of this part of the coast, produced bilious fever attacks amongst the crew, which, together with the dry provisions, much spoilt by rats and cockroaches, and the loss of two anchors, obliged the expedition to seek assistance at the Mauritius. Accordingly, it left the coast in September, and returned to it from Port Louis in December. The examination of the coast from Cape Leeuwin to Rottney Island, which followed, proved that a portion of it was correctly laid down by the French; but as the outline of that part to the northward of Rottney Island, as given in their charts, was chiefly taken from Van Keulan, Captain King made a survey of it, and continued the same to Dirk Hartog's road. The examination of the coast

of the north-west cape came next, which proved the position of the cape to be 10° southward of that assigned to it by the French, while neither Hermit Island nor the land laid down on their charts as being westward of Trimouille Island was to be seen.

The expedition likewise revisited and verified the position of Barrow Island, Montebello Island, Rowley's Shoals, Cape l'Eveque, and Buccaneer's Archipelago, and terminated its labours by the examination of Cygnet Bay. In April it anchored off Sydney, after 344 days of absence, and in the same year returned to England.

The results of this four years' labour may be given in the following summary: —

1st. A running survey was made of that portion of the east coast which is situated between Perry Island and Cape York, a distance of 900 miles, and which, being laid down for the first time, became a valuable and convenient track for vessels bound through Torres Straits.

2ndly. The examination was effected of the N. and N. W. coast from Cape Wessel to Cape Villaret, including Port Essington, — a distance of 1100 miles.

3rdly. Of the coast between Deputch Island and Cape Leeuwin, a distance of 700 miles.

This makes a total of 2700 miles of surveyed coast; besides Macquarie Harbour, Port Macquarie, and Rowley's Shoals, &c. Those who have not been professionally employed in similar undertakings can scarcely conceive the amount of labour which is involved in a survey of 2700 miles; neither could any description give them the remotest idea of the difficulties, the trying situations, and the anxiety, which the commanding officer in such a survey has to encounter. Personal peril and the inconveniences arising from cold, heat, wet, fatigue, and frequent want of food, are sufferings which a man passionately

fond of his profession, and ardently devoted to his enterprise, little cares for; they are indeed trifling in comparison with those bitter disappointments and harassing anxieties which unfavourable weather, adverse winds, the wear and tear of the vessel, the loss of boats, anchors, and instruments, produce, or which the sick list of the ship's company, the deterioration of water and provisions, &c. entail upon the commander of the expedition: and when, as regards the case of Captain P. P. King, it is added that that part of the coast of Terra Australis which was entrusted to his survey, far from presenting any of those interesting and picturesque features which by enhancing curiosity relieve anxiety, was mostly barren, and displayed, with few exceptions, only flat, low shores bordered by shoals and reefs or studded with an impervious growth of mangrove trees, rarely supplied with fresh water, and inhabited by an intractable race, whom nothing could conciliate, or deter from murderous designs; when it is considered that the act of landing to explore or to take observations was generally attended with a struggle for life, and that the nearest place from whence effectual assistance could be obtained in the case of any damage which the vessel might sustain, was as far off as New York is from Liverpool, and that, in consequence of this circumstance, the completion of 2700 miles of survey required nearly 40,000 miles of sailing; when all these difficulties, which Captain King in his Australian survey had to encounter, and all of which he surmounted, are duly considered, the merit which would attend the execution of so extensive a survey under common circumstances is indeed greatly enhanced.

His work on this survey and the atlas appended to it bear the date of 1827, and form a most valuable reference in all questions, whether nautical or scientific, connected with Terra Australis.

Much, however, as had been effected, some details in the description of the coast, particularly portions of the N.W. coast, still remained to be filled up, having hitherto escaped the notice of, or not having been visited by, any navigators. The following is the account which Captain P. P. King has furnished of the voyage of Her Majesty's surveyor-ship, "Beagle," which was sent out to complete what still remained to be done.

"The 'Beagle,' left England originally under the command of Captain J. C. Wickham. This officer, however, after two harassing voyages to the north-west coast—in which several interesting points were established, and two rivers (the Adelaide and the Victoria) discovered—was necessitated to return to England, on account of bad health, brought on by the extreme heat of the climate, when the command devolved upon Captain J. L. Stokes, who has completed the objects of her voyage, and now takes her home—to receive, it is hoped, the reward of his long and useful services.

"To describe the work performed, in the succession in which it was executed, would be out of place here. It is better, therefore, to give a general summary of the different portions of the survey in the order, as to *position*, in which they follow each other.

"Commencing, therefore, with the eastern coast. The inner route towards Torres Straits was twice navigated on the way to the north coast, and several important corrections and additions made to the charts now in use. Of the latter may be mentioned, the determination of a better outlet than the one to the north of Wednesday and Hammond Islands, viz. by passing through Endeavour Strait, which hitherto has been considered to be too shoal for vessels of large burthen. Captain Stokes has, however, ascertained, that by keeping nearer to Wallis Isles, a good channel

or outlet exists in which there is not less that five fathoms water. The passage, therefore, through this part of Torres Straits has been very much improved.

"The next important feature of the 'Beagle's' voyage was the discovery of two considerable rivers at the bottom of the Gulf of Carpentaria, flowing through a fine country in a south-westerly direction for sixty miles, navigable for thirteen miles for vessels of thirteen feet draught, and to within five miles of where the water is fresh; the boats, however, traced it for nearly fifty miles further, to the latitude of 17° 59′ and longitude 139° 30′. The climate was found, in the month of August, to be of an agreeable character, the thermometer in the month of August indicating an average temperature of 60°, the minimum being 50°. To these rivers the names of Albert and Flinders were given. The character of the country is low, and the soil chiefly alluvial. No satisfactory reason has been given for the low temperature of this tropical region, which, as the latitude is about 17°, ought to have been at least 70° or 75°. The situation of these rivers may at no distant period open a road to the interior, which is at present wrapped up in doubt and mystery.

"The next discovery in succession, to the west, was that of the Adelaide River, at the north-west part of the Gulf of Van Diemen, similar in character to the Alligator Rivers, which were discovered in the year 1818, falling into the gulf at its southern part. Proceeding farther, another river was found of more importance, as to size, than any previously known in Intertropical Australia. It was called the Victoria. It extends for about 150 miles to the S. E. by E. and is navigable for vessels of burthen for sixty miles from the entrance: its further examination was made by a pedestrian party to the latitude of 15° 96′ and longitude 130° 52′, and was left still flowing from the

south-east. This position is about 500 miles from the centre of the continent. The character of the river may better be understood from the following extract from Captain Stokes's Journal: — 'The valley through which the river passes varies in its nature, from treeless, stony plains, to rich alluvial flats, lightly timbered with a white-stemmed gum; the banks are steep and high, thickly clothed with the *Acacia*, drooping *Eucalyptus*, and tall reeds. There was no perceptible stream in the upper reaches; but, if we may judge from the inclination of the stems of the trees growing in the bed, and heaps of large boulders in the channel of the river, the Victoria, at some recent period, must have been a large and rapid river.'

"Whilst employed in making observations at Cape Pearce, which forms the north entrance of this river, Captain Stokes was treacherously speared by the natives; the wound was a severe one, but assistance being rendered, his life was happily saved. It is a curious coincidence that the three officers whose services as surveyors in the late expedition have been most prominent, viz. Captain Stokes, Mr. A. B. Usborne, master, and Mr. Fitzmaurice, mate, each met with serious wounds in the prosecution of their duty, — Messrs. Usborne and Fitzmaurice, from muskets accidentally exploding: the former was obliged to be invalid in consequence, and the latter, who, however, has persevered to the last, will be lame for life.

"The rivers Albert and Flinders to the eastward, and that of Victoria to the westward, converge in the direction of their sources apparently to one common point; to which also do the intermediate rivers — the Alligators and the Adelaide. It seems probable that all derive their origin from some large inland marsh or lake, to which they serve as drains. It is not unlikely that there may be a low tract of land between

the Gulf of Carpentaria and the Great Horseshoe Swamp, found by Mr. Eyre in the northern part of the province of South Australia.

"With respect, however, to the climate of the country, in the neighbourhood of the Victoria, the temperature, ranging between 95° and 110°, was found by the 'Beagle's' officers in the month of November to be almost insufferable, and quite different to that experienced at the Albert, in the Gulf of Carpentaria. It would seem from Captain Stokes's description above inserted to resemble in character the country about Cambridge Gulf, which has its embouchure to the sea, a short distance to the westward.

"The next part of the north-west coast visited by the 'Beagle,' was the opening that was supposed to exist at the back of the Buccaneer's Archipelago. Perhaps no part of the whole coast promised to be of greater interest, and raised hopes of the existence there of a large river,— hopes that were justified by the great rise and fall of the tides, which exceeded thirty-six feet. It was, however, found to be but a comparatively unimportant indentation, the eastern part or Collier's Bay being nothing more than a shallow sinuosity of the coast line, and the western part narrowed gradually into a tolerably extensive sound, terminated by Fitzroy River, which was traced for twenty-five miles in a southerly direction, draining the lowland from and through which it flowed. The opening near Cape Latouche-Treville, which was thought also to be another outlet of the supposed river, or else the mouth of a second, was an open bay not affording even sheltered anchorage. The interval between this part and Deputch Island was also explored, but not found to contain any inlet or feature of importance. It is generally a sandy and low sterile coast, fronted by a shoal approach and several sand-banks, the positions of which were ascertained. The Monte-Bello Islands were also correctly

and minutely surveyed, as also some rocks in the neighbourhood, which are doubtless the Trial Rocks of former navigators.

"On the west coast, the Houtman's Abrolhos was also explored and surveyed, together with the coast within it, where the fertile appearance of the coast gave strong indications of the presence of a country favourable for settling. It is here that Governor Grey recommended the Australind Company to establish themselves. Fortunately, however, they had located themselves at the inlet called Port Leschelnault: for they afterwards ascertained that the former would not have suited their wants. Several new anchorages about Rottnest and Gage's Road, off Swan River, were also examined and surveyed, in which much advantage will be derived by the colonists at Western Australia.

"South Australia has also had the advantage of the 'Beagle's' services in the survey of the anchorage and port at Adelaide.

"But perhaps the most important — because useful — work performed by the 'Beagle' has been the detailed survey of Bass's Strait, which has been just completed by Captain Stokes, with the aid of the government of Van Diemen's Land, which, in the most liberal way, at once acceded to the request of Captain Stokes, by devoting to his services the use of the colonial cutter 'Vansittart,' for the survey of the southern portion of the eastern entrance of the Strait. The command of the vessel was temporarily given to Mr. C. C. Forsyth, mate of the 'Beagle.'

"The result of these labours has been the completion of the survey, in which the proper and relative position of the various headlands, capes, and islands, which are so prominent and numerous in the Strait, are laid down; with the tides, soundings, and description of several new anchorages, in a manner that cannot but be of immense importance to the commercial interests

of the colony. Much important information relative to the entrance of Port Dalrymple, as well as that of Port Phillip, and the channel within it, the approaches to and anchorages to the southward of Corner Inlet, have also been furnished by the operations of the 'Beagle' during this important survey. Much labour and personal exertion have been bestowed upon this work, and too much praise cannot be given to those who have been prominent therein. It may be, however, necessary to say, that it was commenced by Captain Wickham, and completed by Captain Stokes.

"This, however, would not have been the last work which the 'Beagle' would have performed for the colony, but for obstacles which unexpectedly presented themselves, and prevented Captain Stokes from making a survey of the neighbouring coasts of Port Jackson. The necessity for a chart of the coast is very urgent, from discrepancies which have been found to exist in the only chart now in use, and the principal materials for it have been from time to time prepared as the 'Beagle' passed up and down the coast. It is to be lamented that this desirable matter could not have been accomplished.

"It is unnecessary to follow the 'Beagle' with more detail through her various movements upon the long and tedious service upon which she has been employed. Suffice to say, that the fruit of her voyage has been of the greatest importance to the navigation of the coasts, which will be amply proved when the charts of her voyage, particularly that of Bass's Straits, are published, and placed within the reach of navigators, by whom alone, from the unpretending manner in which the work has been performed, it can be estimated as it deserves." *

With the above briefly described survey of the

* From the "Sydney Herald" of February 10th, 1843.

"Beagle," which will be more fully detailed in the forthcoming work and charts of Captain Stokes, terminates one of the most extensive series of coast surveys ever undertaken. For completeness, skill, and the strict accuracy with which they were executed, and in the important bearing they have on navigation and commerce, the charts of these surveys may be said to rank foremost amongst the documents of British Hydrography.

LAND SURVEYS.

On that immense continent to the shores of which the above reviewed marine surveys are confined, five colonies have been established. Each of these has, with more or less spirit, carried on the work of inland discovery: each boasts with reason of having enriched the store of topographical knowledge relating to the interior of New Holland. As, however, these pages are limited to the illustration of New South Wales and Van Diemen's Land, we shall now proceed to notice only those geographical discoveries which are connected with the two above-named colonies.

The topography of New South Wales and Van Diemen's Land, like the hydrography of Terra Australis at large, has its list of successive meritorious contributors. The first to whose energy and enterprise we owe the earliest map of New South Wales is John Oxley, R. N., Surveyor-general of the colony. His two expeditions in 1815, which he undertook by order of Government, and which furnished materials for the map that followed, are the only explorations of that time accompanied by authentic records. In his expeditions westward of Sydney, to the sources of the rivers Lachlan and Macquarie, and in that which was next carried eastward of the tributaries of

the Darling, as far as those of the river Hastings and Port Macquarie, he completed the discovery of that chain of mountains ranging from S. to N., which, dividing the drainage of the country into eastern and western waters, constitutes the prominent features in the configuration of New South Wales.

When on the westerly side of that chain, and only at 100 miles from it, his astonishment was great indeed to find that from 4000 feet, which was the elevation of the chain above the level of the sea, the altitude had decreased to 600 feet. On penetrating still further to the westward, the fall of the country became perceptible to the eye; but the want of provisions prevented his exploring the course of the Lachlan farther than longitude 146°, and following the course of the Macquarie through a low country, with a level and unbroken horizon to the west, brought him only to a marsh, in which that river ended; so that he was naturally led to conjecture that the westerly waters of New South Wales most probably lose themselves in the marshy interior of New Holland.

Captain Sturt rectified this notion by penetrating beyond the marsh, and discovering that its superfluous waters were drained by the river Darling, which he found the Castlereagh and Bogan rivers joined. The Darling, flowing from the N. E., was a new discovery: its course at the point at which Captain Sturt left it, was S. W. (145° 30′ E. longitude, and 30° 20′ S. latitude); and beyond that point nothing was known. In 1830, Captain Sturt again proceeded from Yass Plains westerly; and keeping along the banks of the Murrumbidgee, discovered its junction with the Lachlan. Here, the river offering a better route than the land, he descended it in a boat, and, in the progress of his journey, came to a second confluence, formed by a river from the S. W.,

to which the name of Murray was given; and further still, in latitude 34°, to a third, formed by a N. E. river, which had all the features and characteristics of the Darling, where he left it in latitude 30° 30′. From this junction it took Captain Sturt nineteen days to reach Lake Alexandrine and the sea (E. long. 139°), the farthest westerly point that had ever been attained in an overland journey of discovery started from the eastern shores of this continent.

The two expeditions of Captain Sturt thus achieved the important discovery, that the drainage of all the westerly waters of New South Wales is effected by one river, which disembogues through Lake Alexandrine into the sea.

Mr. Allan Cunningham, King's Botanist, started, soon after this, for Moreton Bay, by land; and keeping from Liverpool Plains to the westward of the dividing range, which he re-crossed not far from Moreton Bay, succeeded in reaching latitude 27° 50′. His expedition, notwithstanding that the special object he had in view was foreign to geographical discoveries, benefited the latter, as in its pursuit he bisected all the tributaries of the river Darling, and reached its sources.

Sir Thomas Mitchell's three expeditions, which he undertook by order of Government in 1832 and 1836, verified all Captain Sturt's previous discoveries. In his northerly course in 1832, Sir T. Mitchell penetrated farther than Sturt, and came on the Darling in latitude 29°. The westerly limit of his journey in 1835 was longitude 140° 40′; the southern in 1836 was latitude 28°.

The great benefit which resulted from Sir T. Mitchell's expeditions, besides that of corroborating all the geographical features and positions previously ascertained, and determining many new ones not less important, was the discovery of Australia Felix:

for the honour of this discovery must be considered due to him, since, though not the first who saw the region, he was the first to make known to the public what he saw.

It is true that the Van Diemen's Land graziers knew the country well, and grazed it with their stock long before the arrival of Sir T. Mitchell at the Glenelg. They had also similar stations at Port Phillip, as far even as the S. side of Mount Macedon; but, as they kept their knowledge secret, and used it merely for their own benefit and convenience, they can now only boast of their good fortune in having found the country, but not of the honour of having *discovered* it.

With the admirable surveys of Mr. Tyer between Port Phillip and the river Glenelg, and of Mr. Dixon at Moreton Bay, in 1840; and with the discovery of Gipp's Land made, in the same year, by the writer of this Volume, and accounts of which are fully detailed in the parliamentary papers of 26th August, 1841, closes the record of the journeys of discovery in New South Wales.

In Van Diemen's Land, the expedition in 1835 of the late surveyor-general, Mr. Frankland, was productive of many valuable discoveries. They were confined chiefly to the upper country of the island, and to the part which lies to the southward of Macquarie Harbour.

My own wanderings in Van Diemen's Land in 1841 and 1842 led to no discoveries of any importance: they secured nevertheless the object which they had in view, namely, the tracing of the great dividing range of mountains from Cape Portland to South Cape, and the determining of the position of the most characteristic and prominent topographical features of the island. Finally, the expedition of His Excellency, Sir John Franklin, to Macquarie Harbour in 1842, not only confirmed all the positions previously

ascertained, but was instrumental to defining the course of that range which flanks the eastern part of Macquarie Harbour.

To the materials thus furnished for constructing a correct map of New South Wales and Van Diemen's Land, the partial surveys of crown grants and crown lands would have been a most valuable addition, if those surveys had, at the outset, been based, not as they were upon the magnetic meridian, but upon a series of true meridians, each forming the base of a series of surveys of which the lines should have been made to correspond. This oversight must not, however, be attributed to any want of talent in the men entrusted with the surveys in either of the two colonies, but to the erroneous principle which had been laid down for them to act upon, by a department superior to theirs. Startling as it may appear, it is nevertheless true that these partial surveys, which cost the Government the enormous expenditure of more than 200,000*l.* have given rise only to conflicting claims and interminable litigations amongst the land-owners in both the colonies; while they do not furnish one single element worthy of being used in the projecting of such a map as the present state of topographical science requires.

Thus, as regards New South Wales, the construction of the existing map entailed upon Sir Thomas Mitchell, the surveyor-general, the necessity of making a new survey of the already surveyed country; which latter survey, based this time on true meridians, and on triangulation, and conducted with an accuracy highly creditable to the surveyor, produced the only topographical work of merit which has appeared.

Thus again, Van Diemen's Land, deprived as it has been of a trigonometrical survey, has actually no chart deserving the notice of science.

To our summary of the hydrographical and topographical labours which have determined the hori-

zontal aspect of New South Wales and Van Diemen's Land, we must add here the results of the hypsometrical survey, which has furnished data illustrating the vertical configuration of the two colonies.

The elements of that survey are of the highest value, as they tend not only to the deduction of the mean altitudes of the colonial areas to which they refer, but each separate element forms a valuable adjunct in the prosecution of the geological, mineralogical, climatological, botanical, and agricultural inquiry which will follow.

In the absence of any trigonometrical survey, the altitudes of all the mountain chains and peaks, the lakes, plains, and rivers, which we shall now give in a tabular view, with the names of the observers, have been determined by the barometer.

With the exception of the instrument carried by the late Mr. Cunningham, all those used in the survey were Gay Lussac's Syphon mountain barometers. Those of Captain P. P. King, R. N. and of his son, Mr. P. G. King, were of French construction: those used by me (12 in number) had been made under my directions by Messrs. Troughton and Simms, with a division carried to one-thousandth part of an inch; and in the excellent results they gave, could stand a comparison with the best mountain barometers constructed by Bunten.

The check on the errors which may have arisen in the barometrical survey, was the back survey, whenever such could be effected. In addition to that precaution, I used two barometers in each observation, and took the mean of their indications. I also used the boiling-water apparatus of Dr. Wollaston, constructed by Messrs. Troughton and Simms.*

* The computation of the altitudes was made according to the formulæ of the "*Astronomical Tables*," &c. of Francis Baily, Esq.

Altitudes, in English Feet above the Level of the Sea, of the most remarkable Mountains, Lakes, Watercourses, Plains, and Stations in New South Wales and Van Diemen's Land.

NEW SOUTH WALES.

				English feet.	
Peel Plains, New England	-	-	-	1800	Cunningham.
Mount Mitchell	-	-	-	4120	
Mount Lindesay	-	-	-	5700	
Mount Sturt	-	-	-	3735	
River Condamine (Lat. 28° 10′		long. 151° 40′)		1402	
Rocky Creek	-	-	-	1717	
Brushy Valley (Lat. 28° 20′		long. 151 °20′)		1504	
Apple Tree Flat	-	-	-	1091	
Dumaresq River (Lat. 28° 55′		long. 150° 40′)		840	
Glen River -	29°		151° 35′	1049	
Gwydir River -	29° 35′		150° 25′	895	
Mount Hundawar, or Harkwick -	30° 15′		150° 25′	2545	
Barrow Valley -	30° 40′		150° 20′	808	
Wallambora Ford	30° 40′		150° 25′	1016	
Mount Bathurst	31° 5′		151° 50′	4000	Oxley.
Glen Apsley River	31° 5′		152°	1000	
Bathurst Cataract, New England			-	235	
Beckett's Cataract	„		-	150	
Mount Sea View	„		-	6000	
Macquarie Cataract (Lat. 31° 55′		long. 148° 10′)		680	
Summit of Lapstone Hill (Cook)		-	-	747	Capt. P. P. King.
Springwood (depôt) (Cook)		-	-	1147	
Station on the Mount Road, Cook (Blue Mountains)	-	-	-	1707	
Caley's Rupulse, Cook (Blue Mountains)			-	1868	
Twenty-four Miles Hollow, Cook (Blue Mountains)	-	-	-	2738	
King's Table Land, Cook (Blue Mountains)			-	2790	Strzelecki.
Stone quarry on the right, one mile beyond King's Table	-	-	-	2882	Capt. P. P. King.
Weather Board Hut		-	-	2844	
Mount Hay	-	-	-	2425	Strzelecki.
Mount Tomah	-	-	-	3240	
Foot of Mount Victoria (Flagan's House)			-	2607	Capt. P. P. King.
Mount George	-	-	-	3620	Strzelecki.
Bridge over Butler's Rivulet, Vale of Clywd			-	2188	Capt. P. P. King.
Mount York, Vale of Clywd, Blue Mountains				3440	Strzelecki.

	English feet.	
Foot of Mount York, Collet's farm (Mr. Morris's)	2180	
Mount Adine, flanking Reedy Valley, West	3736	
Ford at Cox's River, Vale of Clwyd	2052	Capt. P. P. King.
Walerawang (farm and estate of Mr. Walker)	2410	Strzelecki.
Dividing range, S. W. of Walerawang	3480	
Fish River, on the road to Bathurst	3220	
Military station (barracks) Blue Mountains	3010	
Badger Brush Ridge	3290	
Police station, dividing range, Bathurst	2910	
Cox's River, before reaching Blaxland's	2266	Capt. P. P. King.
Mount Blaxland, the highest summit	3256	
Jock's Bridge	2921	
Hill beyond Jock's Bridge	3496	
Bathurst Town	2310	Strzelecki.
Woodstock	2600	
Guwong, Nicholson's farm	2950	
Summer Hill, Frederick Valley	3010	
Boree Plains	1560	
Mount Canoblas, Wellington	4610	
Captain Ryan's, Boree station	1992	
Molongorang (Mr. Passemore's)	2062	
Heregal (Mr. Maxwell's station)	1616	
Macquarie River at Wellington	1439	
Guantewang, N. E. of Wellington Vale	1410	
Camden (estate of James M'Arthur, Esq.)	248	Capt. P. P. King.
Mount Prudhoe (summit above the road)	1006	
Stone quarry creek, below the bridge	482	
Crisp's Inn, Myrtle Creek, Camden	783	
Bed of Myrtle Creek ,,	643	
Bargo River, ford ,,	771	
Lapton's Inn ,,	1206	
Little Forest Hill, half a mile beyond the turning of the road	1923	
Cutter's Inn, Camden	1967	
Mittagong Range, summit, or new line	2454	
Cordeaux farm	2222	
Cockatoo Hill	2356	
Berrima Inn	2096	
Bed of the Wingecarrabee River	2058	
Bed of Black Bob's Creek, under the bridge	2051	
The Kentish Arms Inn, three miles beyond Midway Rivulet	2028	
Bed of Midway Rivulet, Camden	2003	
Summit of Stony Hill	2400	
Wombat Brush, terrace above Paddy's River	2128	
Ford of Paddy's River, Camden	1856	
Arthursleigh (estate of Mr. H. M'Arthur, Argyle)	1977	

	English feet.	
Norwood, Argyle	2116	Capt. P. P. King.
Rosseville House	2057	
Breadalbane Plains	2278	
Summit of hill S. of Wallagoray	2606	
Tarrago Ponds, Argyle	2264	
Ajimatong Cottage (verandah)	2148	
Therolonong, summit above Ajimatong	3108	
Lake George Gap	2151	
Gidleigh, estate of Captain P. P. King	2358	
Sugar Loaf, or Squall Hill, near Gidleigh	3288	
Saddle Hill „	3001	
Rocky Bridge „	2695	
Big Creek, near the gap through the Black Range	2979	
Head of Big Creek and Stony Creek	3136	
Summit of Prospect Hill	3275	
Last Hill	3176	
Wollondilly River, below Rosseville	1971	
at the junction of Paddy's River	1840	
at the ford of Arthursleigh	1830	
at Detley crossing place	1752	
Summit above Ajimatong (*W.*)	2718	P. G. King.
Gundaroo, Murray	1746	
Davies Inn	1539	
Gum Tree Summit	1490	
Yass River Rivulet	1311	
Green's Inn	1204	
Burton's, Murrumbidgee River	806	
Broadribbs	799	
Ellerslie (sheep station of Hannibal M'Arthur, Esq.)	1261	
Nackie Nackie Hill	2242	
Dutzton, a sheep station of P. King, Esq., (Lat. 35° 27′ long. 147° 53′)	1844	Strzelecki.
Walerogang, on the river Hume	753	
Camp under the Snowy Range	1223	
Mount Kosciuszko, Australian Alps	6500	
Mount Dargal „	5490	
Mount Pinnabar „	4100	
Cowrang Creek „	1350	
Dividing range in the Omeo country	3800	
Source of the Mitta-Mitta River	1850	
Lake Omeo	3100	
Second branch of Mitta-Mitta River	1900	
The average height of the flats in Gipp's Land	210	
Range between Gipp's Land and Port Western	2510	
Mount Wilson, Wilson's Promontory	2350	

Islands of Bass's Straits.

	English feet.	
Rotondo	1130	Capt. Stokes.
Devil's Tower	350	
Hogan Group	430	
Curtis Island	1060	
Mount Quoin, Flinder's Island	736	
The Patriarchs	830	
Sugar Loaf	1410	
Strzelecki's Peak, Flinder's Island	2550	
Mount Munro	2300	
Clarke Island	690	

VAN DIEMEN'S LAND.

Mountains.

Mount Humboldt, Western Range	5520	Strzelecki.
Mount Ben Lomond, culminant point	5002	
, N. W. point	4354	
, South Bluff	4500	
Cradle Mountain, north of Lake St. Clair	4700	
Dry's Bluff, Western Tier	4590	
Mount Wellington, Flagstaff	4195	
Mount Arrowsmith, between Frenchman's Cap and Lake St. Clair	4075	
Western Tier, opposite Mr. Groom's station	3915	
Ben Nevis	3910	
Frenchman's Cap	3801	
Black Range, vale of Belvoir	3381	
Four Miles Rise, river Forth	2957	
Gad's Hill, river Mersey	2588	
Table Land, forming the base of Ben Nevis	2327	
Table Land, watered by the North Esk	2220	
Mount St. Patrick	2277	
Mount Stokes	2039	
Mount Herschell	1200	
Range between Mr. Whittle's farm and Watery Plains	1506	
Signal Hill (Mr. Kesmode's)	992	
Asbestos Range	1700	Capt. Stokes.
Mount Arthur	3900	
Badger's Head	1300	
Mount George, Signal Station	617	
Sugar Loaf, near Mount George	642	
Summit over fourteen miles Bluff	320	
Government Cottage, Georgetown	23	

	English feet.	
Lantern of Lighthouse on Low Head	140	Capt. Stokes.
Mount Direction	1233	
Valentine Peak	4000	
Mount William	730	
Mount Pearson	300	

Lakes and Watercourses.

Great Lake	3822	Strzelecki.
Arthur's Lake	3388	
Lake St. Clair	3239	
Source of the Nive	4033	
Source of the Leven	2404	
River Mersey (crossing place to V. D. Land Company's Station)	1012	
River Forth (crossing place, Circular Pond Marshes)	796	
Junction of the Tyne and South Esk	700	
Junction of the North Esk with a tributary from Ben Lomond	929	
Junction of the two branches of the River King	2150	

Towns and Stations.

Government Hut at the Traveller's River	3949	Strzelecki.
Sheep station of Mr. Wood at the Great Lake	3822	
Sheep station of Mr. James Clark, north of Marlborough	3124	
Bronte, Marlborough	2912	
Marlborough	2858	
Vale of Belvoir (V. D. L. Company)	2930	
Middlesex Plains (V. D. L. Company)	2709	
Government Hut, at the foot of Frenchman's Cap	2157	
Chilton, a station of the V. D. L. Company	2106	
Regent's Plains (Mr. Wood's station)	1892	
Hampshire Hills (V. D. L. Company's station)	1348	
Oatlands	1308	
Circular Pond Marshes	1140	
Mr. Reid's farm	963	
Caldstock	901	
Captain Lloyd's farm, Westbury	860	
Patcham (V. D. L. Company's farm)	839	
Arundel, Western Tier	879	
Coal Seam, Jerusalem	843	
Formosa (an estate of Mr. Lawrance)	806	
Mr. Legge's farm, Break-o' Day	848	

	English feet.	
Mr. Groom's sheep station, Western Tier	771	Strzelecki.
Adelphi (farm of Mr. Princep)	766	
Lake Mills (farm of Mr. Fletcher)	725	
Quamby's (the property of Mr. R. Dry)	691	
Cressy (farm of V. D. L. Horse Company)	654	
Blackman's Bridge	646	
Jerusalem Settlement	634	
Hummock Hill (Mr. T. Archer's station)	591	
Carrick	560	
Mr. Stieglitz's farm (Break-o'-Day)	577	
Mona Vale (property of Mr. Kermode)	585	
Campbell Town	567	
Black Boy's Plain (Mr. Talbot's)	571	
Egglestown (Mr. Headlam's)	549	
Malahide (Mr. Talbot's)	431	
Hamilton Town	346	
Mr. Steil's, St. Patrick's	243	
Rose Garland (property of Mr. Barker)	164	
Mr. Hull's house, Mount Wellington	169	
Risdon House	150	
Dr. Pugh's house, Launceston	142	
Richmond Town	67	
Ringarooma (property of the Rev. Dr. Brown)	11	

To the above table of altitudes, I may add a few other of the more important results which the hypsometrical survey furnishes.

1st. As regards New South Wales: —

The mean altitude of the *divisa aquarum*, in that colony, is 3500 feet above the level of the sea.

The average fall of its eastern rivers is estimated at 48 feet in every mile. The average slope of the land, produced by the transversal spurs, is 96 feet.

The average fall of the westerly waters is 9 feet in every mile; that of the country within 72 miles from the crest of the dividing range is 20 feet.

2d. As regards Van Diemen's Land: —

The mean height of the *divisa aquarum* is 3750 feet above the level of the sea.

The average fall of the eastern rivers is estimated at 93 feet in every mile; and the average fall of the country, at 120 feet.

SECTION II.

TERRESTRIAL MAGNETISM.

THE institution of a system of corresponding observations, organised, in 1829, by Humboldt and Kupffer for the advancement of the science of terrestrial magnetism, and the example which was set by Gauss in the establishment of fixed observatories on the Continent, was soon followed by the English government, which, at the instigation of the British Association, granted the necessary sums of money for the erection of magnetic stations throughout the British Empire.

The Royal Society, which was deeply interested in the undertaking, imparted, through the able exertions and the ingenuity of Professor H. Lloyd of Dublin and Lieutenant-Colonel Sabine, a character of superiority, to all the established observatories which the magnetic continental stations could not boast of; as, to the arrangements for a strict simultaneity in taking the observations, was joined an exact similarity of instruments and a uniform method of observing.

The superiority of this plan was recognised by the accession of 22 continental observatories to the compact which governed those of Great Britain; and, as a striking and characteristic feature of the advance and results of civilisation, it may be here mentioned that this accession formed a scientific league, in which the governments of Great Britain, France, Austria, Russia, Prussia, Belgium, Spain, Bavaria, the United

States, the Pacha of Egypt, the Rajah of Travancore, and the King of Oude were all peaceably united in the common interest of promoting the science of terrestrial magnetism.*

Great Britain numbers in that league twelve magnetic stations, viz. those of Greenwich, Cambridge, Dublin, Kelso (the private one of Sir Thomas Brisbane), Simla, Madras, Singapore, Bombay, Toronto, St. Helena, Cape of Good Hope, and Van Diemen's Land.

The last of these observatories was established in Hobart Town towards the end of 1840, by the intrepid navigator, Sir James Ross, then bound on an expedition to the South Pole. It was fitted up by him with the best instruments for magnetic, astronomical, and meteorological observations; and was left under the direction of Lieutenant Kay of the "Terror," a zealous, accurate, and intelligent observer, and under the protection of Sir John Franklin, then Governor of Van Diemen's Land, a friend and promoter of science, and who, to his valuable services in effecting the prompt erection of the required observatory, joined a readiness to assist the observers with his own experience and his personal co-operation.

The establishment of that observatory with the object of obtaining all the elements which were needed from that part of the world for elucidating the general question of the earth's magnetic force, has rendered the detached, unconnected, and minor observations of occasional observers of little or no value.

Amongst these, the writer classes his own labours, which he had commenced and pursued while sepa-

* "Account of the Magnetical Observatory of Dublin, and of the Instruments and Methods of Observation employed there," by the Rev. Humphrey Lloyd, D.D. Dublin, 1842.

rated from communication with the scientific world, ignorant of the association that had been formed, and which, although extensive, have, since he has examined and tested them by the standard of the present knowledge, possessed upon the subject, procured for him only the mortifying consciousness that the time which they took in making, might have been more profitably employed, and the cost of the instruments which they required, more usefully invested.

Independently of the circumstance of their being unconnected, the value of these observations is also greatly impaired by their having been made beyond the precincts of an observatory. Indeed, to any one who has the slightest idea of the nature of the observations alluded to; of the nicety and delicacy of the requisite instruments; of the accuracy with which they require to be mounted and handled; of the minute precautions which are necessary to insure successful results; and on the other hand, of the interference of external circumstances which a pedestrian explorer in the writer's situation has to encounter, such as the carelessness and clumsiness of the men who carry the instruments, the imperceptible dust which floats in the atmosphere, the effects of wind, heat, rain, and moisture, and of local attraction variously disseminated, and of various intensities, and against all of which a tent offers a very insufficient protection; to those familiar with these annoyances, the difficulties in securing good observations will be at once apparent.

The writer, then, anxious not to extend unnecessarily the pages of this volume, will limit himself to the noticing only of that element of Terrestrial Magnetism called *declination* or *variation*, and which, made under more favourable circumstances, furnishes a result which may be depended on, and which, if applied to the question of the land surveys conducted ac-

cording to the magnetic meridian, may be of some value.

New South Wales.									Van Diemen's Land.								
Latitude.			Longitude.			Variation.			Latitude.			Longitude.			Variation.		
°	′	″	°	′	″	°	′		°	′	″	°	′	″	°	′	
34	4	0	150	51	30	9	10	E.	40	50	0	144	54	00	12	10	E.
34	8	0	150	42	0	10	0		40	55	0	147	45	0	14	10	
34	19	0	150	39	0	9	0		40	57	0	148	0	0	13	20	
34	29	0	150	22	30	9	10		40	58	0	145	35	0	13	11	
34	33	0	150	6	30	8	50		41	3	0	145	50	0	15	10	
34	18	0	149	52	0	9	10		41	5	0	147	30	0	10	20	
34	55	0	149	27	0	10	0		41	6	0	148	5	0	11	10	
34	48	30	149	0	0	9	20		41	8	0	146	0	0	10	40	
34	50	0	148	18	0	8	30		41	10	0	146	5	0	14	10	
35	19	0	147	55	0	8	20		41	10	0	148	0	0	12	20	
35	30	0	148	0	0	8	0		41	22	0	146	0	0	10	30	
36	0	0	148	0	0	7	10		41	30	0	146	0	0	11	20	
36	20	0	148	15	0	8	50		41	42	0	146	0	0	12	10	
36	54	0	147	55	0	3	00		41	35	0	146	45	0	14	30	
37	25	0	147	30	0	20	0		41	15	0	148	22	0	12	11	
37	48	0	148	0	0	30	0		41	20	0	148	25	0	11	20	
37	55	0	147	25	0	15	0		41	30	0	148	30	0	10	30	
38	10	0	146	40	0	16	10		41	40	0	147	15	0	12	40	
38	15	0	146	30	0	13	20		42	0	0	147	37	0	11	40	
38	22	0	146	20	0	12	40		42	5	0	146	35	0	12	10	
38	22	0	145	50	0	15	30		42	15	0	146	15	0	10	40	
38	22	0	145	30	0	12	10		42	20	0	145	55	0	10	10	
									42	35	0	147	30	0	11	10	
									41	26	5	147	10	5	11	5	

SECTION III.

GEOLOGY AND MINERALOGY.

INTRODUCTION.

THE main object of my visit to New South Wales was to examine its mineralogy.

The excursions undertaken with a view to that object, led me through a very wild and broken country, often difficult of access, rarely permitting a rapid progress, or affording compensation for no slight degree of labour, fatigue, and privation. Indeed, the scarcity of simple minerals was such as might have discouraged the most ardent and persevering mineralogist who ever devoted himself to the science. But, although the scope for extensive mineralogical researches was thus narrowed, the country was soon found to present a vast field for a most exciting and interesting geological investigation. Viewed through the medium of Geology, it at once assumed the aspect of an historical ground, where, in the absence of monuments and records of human generations, nature unfolds annals of wonders; not indeed, that they can be so called, as furnishing new lights thrown upon the origin of things, but as yielding additional evidence that the structure to which they relate is analogous to that of the rest of the globe.

I entered therefore eagerly on a geological examination of New South Wales, as on a *terra incognita*, without guide or guide-book, as I had not the good

fortune to be acquainted with any of the previous observations upon the geognosy of the country. Hence, although the whole of that country appeared equally interesting to explore, still, unassisted as I was in a labour of such magnitude, I could not but prescribe boundaries to my survey. The geological description and map, which at the outset I had in contemplation, has in consequence been ultimately confined to the country running parallel with, and stretching 150 miles inland from the sea-coast, and comprehended between the 30th and 39th degrees of south latitude.

The mode adopted in my inquiry was as simple as is the geological configuration of the country. From the circumstance of the masses and strata assuming, with few exceptions, a direction from N. E. to S. W., the determination of their horizontal and vertical positions was accomplished by means of a series of zigzag sections, made across the country, and by the examination of the flanks of the dividing range, against which the different strata abutted.

Like the Alleghany Mountains in the United States, that range was as a book, the leaves of which contained all the materials needed for the investigation, and furnished not only a key to explain the order of its superposition, but also a guide towards Wilson's Promontory, the south-eastern extremity of New Holland, which I looked upon as the closing page of the intended geological inquiry.

When, however, the course of my perambulations brought me to the edge of that promontory, and thence to the islands of Bass's Straits, and from these again to Cape Portland, Van Diemen's Land; when, further, the survey of Van Diemen's Land led me winding east and west down to Research Bay, I found such striking correspondence of parts to the explored tract of New South Wales, that as I went on

I could not resist the temptation to extend my inquiry until it finally brought me to South Cape, Van Diemen's Land, and thus joined that island and New South Wales in one geological survey.

I have arranged the descriptive parts of this survey in epochs, which the geological formations have successively marked upon the surface of the two regions.

The mineral constituents of each epoch are distinguished by a strictly mineralogical nomenclature, in preference to a geological, as the latter can not as yet be applied to Australian rocks without involving questionable analogies, or implying identities with eras of deposition in other parts of the world.

Their geological relations have nevertheless been carefully taken into account, and described in respect to locality, extent, range, height, superposition, thickness, and inclination of the strata, organic remains, and mineral contents.

Their mineralogical character has been also noticed, and the chemical analyses of some will be given.

In the shape now offered to the reader, this geological description is far below what I had hoped at the outset my labours would have enabled me to produce. Neither perseverance nor devotion to the pursuit has been wanting. But these, combined with 7000 miles which I made on foot, have procured for me only the consciousness of how little I have done, and how much is still needful to complete such a delineation as the geology of the present day requires.

And all that I have collected during five years of labour I can view only as rudiments of what science may expect at a future period from the division of labour, and from the unparalleled progress of intel-

lectual and commercial development of New South Wales and Van Diemen's Land.

I have also prepared a geological map of New South Wales and Van Diemen's Land, upon which I have laid down and illustrated what the present description will relate in words; but that map I am unable to take upon myself to publish.

It is twenty-five feet long and five feet in width, and is on the scale of one fourth of an inch to a mile.

The geographical portion of the greatest part of that map was compiled from the hydrographical and topographical charts of New South Wales and Van Diemen's Land; where the colonial survey ceased, the continuation of the dividing mountain range (from latitude 36° to 44°), with all those characteristic features of the country which bore upon the inquiry, was projected from my field-book, in which the geographical positions had been determined either by means of astronomical or trigonometrical observation.

The barometrical survey carried out, by means of two Gay-Lussac mountain barometers, and Dr. Wollaston's apparatus for ascertaining the boiling point of water, furnished all the altitudes of the country required for the construction of a second sheet of vertical sections, which is twenty-six feet in length and three feet in width. In conformity with the very judicious recommendation of Sir Henry de la Beche, the base and the height of the sections are projected on the same scale, which is four inches to a mile, and by which projection, the eye can seize at once on the true configuration of the country, and not its caricature.

The colouring of both the map and sections has been executed according to a novel method, not perhaps, as *Montaigne* says, the best, but which is my own.

It was accomplished with four colours, divided into dark and light shades, the dark denoting the mineralogical, and the light the geological character. Thus, the light pink, light yellow, light blue, and light sepia, represent the first, second, third, and fourth of the geological eras; while the darker shades of the same colours represent the four classes of rocks; viz. the siliceous, argillaceous, calcareous, and the hornblende and augitic rocks; which again are distinguished, when crystalline, by a *moirée*, when stratified, by lines drawn in the direction of the strata.

The different species comprised under each class of rocks are indicated by small distinct marks: thus, under the siliceous rocks, granite, protogene, sienite, hyalomicte, mica schist, quartz rock, siliceous slate, siliceous breccia, sandstone, petrosilex, porphyry, are distinguished from each other by differently formed and easily remembered dots. Under the argillaceous rocks the distinctions between chlorite slate, clays, and argillaceous sandstones are yet more simple. Under the calcareous, they are very plain, and under the volcanic rocks, comprising serpentine, diabase, basalt, and trachyte, they are readily comprehended.

GENERAL PHYSICAL AND GEOLOGICAL ASPECT OF NEW SOUTH WALES AND VAN DIEMEN'S LAND.

When viewed from the east, New South Wales and Van Diemen's Land do not present any of those bold or fantastic features, by which the imagination is excited and curiosity enhanced. The foreground of the picture is commonly composed of an undulating country, richly wooded, and gradually rising westward, until it spreads into a centre ground formed of darkly verdant and round topped hills and ridges, promiscuously grouped together; beyond which rises

in the back-ground a range of high land that forms an outline on the horizon, only here and there broken by peaks of striking shape and lofty elevation. In latitude 30° this elevated land assumes the aspect of a mountain-chain crowned with peaked, acicular, dentiform, sharp-edged, or flattened granitic or porphyrytic crests, from which the eye may trace its course, winding from N. E. to S. W., until it gradually vanishes in the distance. On both sides the country exhibits a sloping surface, which the countless ramified spurs, branching off eastward and westward of the chain, deeply furrow with valleys and ravines. The waters run between and parallel with the spurs; their courses commonly flow in diametrically opposite directions.

At the point from whence this bird's-eye view is taken, that is at the 30° of latitude, the granitoite chain divides the sources of the river Peel, running to the westward, from those of the Hastings, flowing N. E. towards Port Macquarie. Further to the south, one of its eastern spurs of porphyry separates the river Manning from the river Hunter, after which, assuming a direction almost west, it divides in its windings the various tributaries of the Hunter from those of the Peel river. This part of the chain is commonly called Liverpool range, and is crowned by several peaks of greenstone, which rear their naked, conical, and distorted tops to the elevation of 4700 feet. From two of these, Mount Oxley and Mount M'Arthur, the eye is presented with a most beautiful panorama of broken country, blending into the Liverpool plains on the one side, and into the fertile valley of the Hunter on the other. To the westward of these peaks, and at the point where it divides the river Goulbourn from the Talbragar, the chain turns suddenly to the south-east, but resumes again its south-westerly direction at a locality rendered remarkable by the peaks of Coricudgy and

Payan, and the sources of the Colo and Cudgegong. On reaching Cullenbullen, the chain is granitic, and throws off a remarkable basaltic spur to the eastward, the curious sub-ramifications of which, render all that sandstone locality commonly called Blue Mountains, difficult to approach, and yet more difficult to explore. Mount Adine (4050 feet), Mount Clarence (3500 feet), Mount King George (3620 feet), and Mount Tomah (3240), crown the northern branch of that spur. Mount Hay (2400), and King's tableland (2790), surmount the southern. Between these ranges lie yawning chasms, deep winding gorges, and frightful precipices. Narrow, gloomy, and profound, these stupendous rents in the bosom of the earth are inclosed between gigantic walls of a sandstone rock, sometimes receding from, sometimes frightfully overhanging the dark bed of the ravine, and its black silent eddies, or its foaming torrents of water.

Every where the descent into the deep recess is full of danger, and the issue almost impracticable. The writer of these pages, engulfed in the course of his researches, in the endless labyrinth of almost subterranean gullies of Mount Hay and the River Grose, was not able to extricate himself and his men until after days of incessant fatigue, danger, and starvation.

"Some idea," says Sir T. Mitchell, in his work on Australia, "may be formed of the intricate character of the mountain ravines in that neighbourhood, from the difficulties experienced by the surveyors in endeavouring to obtain access to Mount Hay. Mr. Dixon, in an unsuccessful attempt, penetrated to the valley of the Grose, until then unvisited by man; and when he at length emerged from the ravines in which he had been bewildered four days, without ever reaching Mount Hay, he thanked God (to use his own words in an official letter) that he had found his way out of them."

The ascent of Mount Hay, when these difficulties are once surmounted, repays richly the exertions and fatigues which it entails. From its basaltic top, the distant views to the south and west are somewhat intercepted by King's table-land, and other mountains higher than Mount Hay; but to the east, the sea coast, bordering the interesting basin through which flow the rivers Nepean and Hawkesbury, the vicinity of Paramatta river, together with Sydney and Botany Bay, are distinctly visible. To the north also the prospect is extensive. At the foot of Mount Hay lies, in the foreground, the river Grose, in a sandstone ravine, the perpendicular depth of which is 1500 feet. On the further side of the torrent rise the steep basaltic eminences of Mounts King George and Tomah *, deeply clefted, and beyond in a strong

* Captain Town's Farm, Mount Tomah,
8th September, 1839.

The current of the river Grose and its precipitous banks frustrated all my efforts to regain Mount King George, on the side of Mount Hay, and obliged me to go round by the source of the river, crossing on the way all its tributary torrents, and plunging anew into those savage solitary defiles which remain in the same state as when the black men first surrendered them to the white.

Some days spent in toilsome climbing and scrambling brought me at length to Mount King George. Mount Tomah appeared quite close to it; but immense ravines lay between, and torrents of rain in a great measure concealed the view. To proceed onwards was, however, my only alternative. I therefore redoubled my pace; ascended and descended; climbing, sliding, and clinging, until at length I found myself in the midst of a forest of high and thick fern, bending beneath the weight of the still falling rain, and my progress through which resembled the act of swimming rather than of walking. The temperature, however, had hitherto rendered that progress bearable; but on approaching the summit of the mountain it changed; showers of hail began to fall, and were soon succeeded by a frost. My clothes stiffened on my limbs; the latter began to feel numb, and I soon felt it would be necessary to abandon the prosecution of the observations I had wished to make. I therefore began to descend the mountain, anxiously seeking, right and left, for some friendly cavern where I might be able to kindle a fire and dry my clothes. Three hours were vainly spent in search of one — night approached — the heavens lowered — the rain and hail continued to pour. The nearest habitation, as I had been informed, lay

relief, the predominating summits of the Payan and Coricudgy mountains.

Resuming the survey of the chain at the point

eighteen miles off, in the direction of the river Hawkesbury: fortunately for me, one, of which I had heard nothing, presented itself suddenly before my eyes. To perceive it—to utter a cry of joy—to encourage my exhausted and helpless servant, and to fly towards it, was the act of the same moment. To recognise our state of distress and to relieve it, was a part the owner of the dwelling performed with equal promptitude.

He took off my wet clothes, wrapped me in others from his own wardrobe, placed me before a blazing fire, brought me food, and surrounded me with every comfort, without once asking who I was, whence I came, or what might be my business!! My memory furnishes me with the recollection of few transitions so sudden and so agreeable; few states of discomfort transformed within the space of a few minutes into one of comfort so complete, and still fewer traits of hospitality so truly primitive.

The Evening of the 10th of September.
In a Cavern of Mount King George.

The host who so generously received me the day before yesterday, and with whom the state of the weather obliged me to remain until to-day, is a true son of the glebe. He was born in the fields, took root there, and has there flourished.

He arrived in the colony ten years ago as a simple labourer, and is now the successful cultivator of two farms, sorrounded with all the rude abundance of rural life, and having servants under him; though he by no means aims at playing the part of a master; but, on the contrary, eats at the same table with his dependents, accompanies them to the field, and sows and reaps with them as in former times, whether from an innate love of the occupation or as a grateful recognition of the prosperity with which he has been blessed.

The attentions he showed me, though somewhat *empressés*, were as benevolent and as simple as is the nature amongst whose works he dwells. His language was characterised by the unerring signs of that simplicity. I can fancy that I see him now, as he appeared yesterday entering my room, his head covered with an old hat, carelessly worn on one side, and broken in at the crown; the sleeves of his shirt tucked up, and holding in one hand a knife, in the other a fine piece of pork, fresh killed, while he good-humouredly addressed me:—

"There's going to be more rain—it already falls in the mountains—so I just killed a pig; for I thought to myself, our stranger can't leave to-day. Come, you'll stay—Yes! yes! you must stay!—Shall we boil or roast this piece?" Whereupon, without waiting for any reply, he called out to his wife, "I say, mother! he'll stay—get dinner ready!"

To-day I left his house—my knapsack completely stuffed with fresh provisions, and both myself and servant entirely recovered from our

where this spur composing the Blue Mountains branches off, we see it composed of sienite and granite, and stretching for a few miles to the S. W., where it gives rise to Cox's river, and forms the Walerawang and Clywd valleys.

Proceeding further, where it is known by the name of Honeysuckle range, its direction is S. E., and the mean elevation of its greenstone crest is 4050 feet; twenty-five miles beyond, bending again to the S. W., it attains a height of 4500 feet, and its character alters. The hitherto richly wooded greenstone tops are exchanged for naked, barren, and fantastically shaped sienitic peaks: the whole extent of Westmoreland country, including the Balangola and part of the Wollondilly valleys, is also rugged, and intricately broken. To the southward of Balangola shoots off in a northward direction a spur, which separates in its windings the river Macquarie from the Abercromby. This spur has been traced for 120 miles: at eighty miles from the chain, its basaltic ridge forms Mount Canoblas; at fifty more, Mount Contumbus. Both these elevations carry the eye far and wide, over the interminable extent of the western country, and afford also a fine view of the Wellington, Macquarie, and Lachlan valleys.

The chain itself to the southward of the two spurs above described assumes, in its S. W. bend, a more smooth, rounded, and wooded aspect, less elevated, and less intersected by ravines.

At Mount Fitton, about the source of the Wollon-

fatigue and sufferings. The debt of hospitality alone remains to be settled; for every effort to induce my host to accept a pecuniary recompence failed. He belongs to a class often calumniated; most frequently poor, and everywhere considered at the foot of the social ladder; but amongst whom—be they Pagan or Christian, idolaters or true believers—hospitality and charity are viewed as one and the same thing, and are practised as the most sacred of duties.—*MS. Journal of the Author.*

dilly, and at the head of Lake George, this character again somewhat alters. At the last-named locality, a westerly spur, composed alternately of serpentine and porphyries, and which divides the tributaries of the Murrumbidgee from those of the Lachlan river, winds its course through a very broken country. Further on, beyond Lake Bathurst, another spur branches off to the north-east, and stretches over Cambden and Cumberland, to the neighbourhood of Illawara and Shoalhaven, localities which possess the most picturesque, and the most gloomy and savage scenery. Sixty miles further south, where its previous southern course changes again to S. W., the chain in its elevation and general features becomes bolder. Its greenstone and sienitic crest at times assumes the appearance of Alpine table-land; at times rises, and breaks into sharp-edged and dentiform summits, capped here and there by snow, in the midst of summer, while the spurs which at that locality shoot from both sides of the ridge, carry with them throughout the same bold features.

That spur which to the eastward traverses Moneiro, and flanks the river Shoalhaven from its source to its mouth, renders the whole track over which it stretches a most intricately broken one. The locality of Deuna river, Mount Currumbilly, Budawang, and Pigeon's House, and the vicinity of Jarvis Bay, are intersected in all parts by precipitous and impassable gullies.

The spurs which run to the westward are not less imposing in their aspect. The forked one, which, at Mount Garangoora, winds between the rivers Murrumbidgee, Coodradigbee, and the Doomut, presents in its different parts features which, in boldness, are not surpassed by any hitherto observed. The cluster of broken peaks which mark the sources of the above rivers; the ridges which form walls as it were for

their respective courses; indeed, the whole structure of the spurs about this locality imparts to them the character of bold outworks in advance of that prominent group of mountains, known in New South Wales under the name of the Australian Alps.

Conspicuously elevated above all the heights hitherto noticed in this cursory view, and swollen by many rugged protuberances, the snowy and craggy sienitic cone of Mount Kosciuszko is seen cresting the Australian Alps, in all the sublimity of mountain scenery. Its altitude reaches 6500 feet, and the view from its summit sweeps over 7000 square miles. Standing above the adjacent mountains which could either detract from its imposing aspect or intercept the view, Mount Kosciuszko is one of those few elevations, the ascent of which, far from disappointing, presents the traveller with all that can remunerate fatigue. In the north-eastward view, the eye is carried as far back as the Shoalhaven country, the ridges of all the spurs of Moneiro and Twofold Bay, as well as those which, to the westward, inclose the tributaries of the Murrumbidgee, being conspicuously delineated. Beneath the feet, looking from the very verge of the cone downwards almost perpendicularly, the eye plunges into a fearful gorge 3000 feet deep, in the bed of which the sources of the Murray gather their contents, and roll their united waters to the west.

To follow the course of that river from this gorge into its farther windings, is to pass from the sublime to the beautiful. The valley of the Murray, as it extends beneath the traveller's feet, with the peaks Corunal, Dargal, Mundiar, and Tumbarumba, crowning the spur which separates it from the valley of the Murrumbidgee, displays beauties to be compared only to those seen among the valleys of the Alps.

From Mount Kosciuszko, the chain, resuming its

S. W. direction, still maintains the same bold character, but with diminished height. To the right and left, its ramifications are crowned by peaks, rendering the appearance of the country rugged and sterile. With the exception of the vicinity of Lake Omeo, and a part of the Mitta Mitta valley, lying between the spur crowned by Mount Yabbarra, and that surmounted by Mount Ajuk, a tract resembling a vast basin, without trees, and scantily supplied with water, but covered even during a parching summer with luxurious pasture, the whole region westward of the chain, towards Western Port, is rent by narrow gullies almost inaccessible, either by reason of the steepness of the ridges which flank them, or of the thick interwoven underwood which covers the country.

The region eastward of the chain in the direction to Corner Inlet presents a totally different aspect. At the latitude 37°, or about the sources of the river Thomson, the spurs are less ramified, and of considerable height and length, shaping the intermediate ground into beautiful slopes and valleys, which ultimately resolve into a fine open plain, richly watered, clothed with luxurious grasses and fine timber, and offering charming sites for farms and country residences. Viewed from Mount Gisborne *, Gipps Land resembles a semi-lunar amphitheatre walled from N. E. to S. W. by lofty and picturesque mountain scenery, and open towards the S. E., where it faces, with its sloping area the uninterrupted horizon of the sea.

The spur which bounds the southern limit of that area, and another which, on the western side of the chain, studs the territory of Australia Felix, and the neighbouring district of Western Port, with some

* Named after my lamented friend, the late Mr. H. J. Gisborne, son of Mr. Gisborne, M.P.

remarkable eminences, again change the face of the country, and by contrast enhance the beauty of Gipps Land. These two spurs constitute a broken inhospitable region, frequently unsupplied with water, and almost always ill furnished with either quadrupeds or birds. In the direction of Western Port, some parts of that country are rendered nearly impenetrable by the dense scrub, interwoven with grasses and encumbered with gigantic trees, fallen and scattered in confusion. The writer, obliged to cross this region from Gipps Land to Western Port, was forced, at its very outskirts, to abandon his packhorses and collections, and, with his companions and men, to devote twenty-six days of incessant labour to extricate themselves from a situation, in which they were in imminent danger of perishing. Such were the difficulties encountered on that occasion, that, with the utmost exertion, stimulated by the sense of peril, a progress of from two to three miles per day was all that could be accomplished.

In the vicinity of Corner Inlet, the chain of mountains dips under a low and marshy ground, above which its crest appears rising only at intervals. Ten miles beyond, it is seen again erect, jutting out boldly into the sea, and exposing its granitic flanks for a length of thirty miles to the lash of the infuriated surf.

At Wilson's Promontory the sea interferes with the visible continuity of the range, but does not terminate its course.

On a fine day, that course may be traced from the top of the headland, beautifully delineated by the chain of the islands of Bass's Straits. These islands, whether high and crowned with peaks, or low and crested only by the white sparkling foam of the sea, appear, in their winding and lengthened array, like the glittering snow-capped domes of the Andes, when

seen above the region of the dense clouds which bathe their lower region.

Rotondo is the nearest conspicuous island to the promontory: Moncur's, Sir R. Curtis's, and Kent's group follow, as if only to indicate the direction of the chain, which on Flinder's Island displays again an uninterrupted course of about seventy miles long. From the top of its rough and naked ridge, 2550 feet in height, are seen, to the eastward and westward, small islands, with reefs scattered alongside, which are so many crests of the branches and ramifications of the range. To the southward, Barren Island, Clark's Island, and Cape Portland are arranged, with their respective heights, in such perspective that, shutting out the intervening sea, the eye may glide uninterruptedly from the heights of Flinder's Island down to the far summits which crown the elevations of Van Diemen's Land.

Barren Island — worthy of its name — deeply indented with caves and strongly projecting headlands, exposes a bare denuded surface to the incessant stormy weather of the straits. Clark's Island and Swan Island partake of the same character: all three have nothing to offer but scenes of desolation.

From the granitic peaks of Clark's Island, the chain is seen beyond Cape Portland, in a southerly direction, gradually emerging from the ocean, and plunging into the interior of Van Diemen's Land. For thirty miles, its height does not exceed 700 feet. On arriving, however, at the point where it is commonly called Blackridge, it suddenly rises to above 3000 feet, and is seen casting to the right and left, in its S. W. course, towards St. Patrick's Head, three long ramified spurs, which, as it will be seen, stamp the whole of the north-eastern section of the island with a most striking and characteristic configuration.

The first of these spurs branches off at the source

of the river Bobiala, and terminates in a cluster of conspicuous granitic hills, of which the most prominent is Mount Cameron; next to it is that spur which is crowned with the greenstone protuberance of Mount Horror, Mount Barrow, Mount Arthur, and Mount Direction, and which, stretching as far as George Town, ends with Mount Royal. The last spur is characterised by the highest elevations of Van Diemen's Land, namely, Ben Lomond and Ben Nevis, and which are likewise composed of greenstone.

It is impossible to give an adequate idea of the *relievo* which the above spurs have produced; of those endless sharp-edged ridges, which run in all directions, interbranch, and form as it were, a net-work of mountain chains woven intricately together. At times the eye can seize upon their distinct and independent courses, radiating from a common centre, and gradually sloping into flat-bottomed valleys; at times, their flanks are erect and perpendicular, imparting to the ridges an appearance of having been rent asunder, and presenting, between, dark chasms and gorges, from which roaring torrents make their escape.

From no point is the grandeur and infinite diversity of this mountain scenery better viewed than from the lofty, craggy, and precipitous battlements of Ben Lomond.

The northern extremity of the mountain overhangs profound tortuous abysses, and commands an uninterrupted view of Ben Nevis, Mount Barrow, Mount Arthur, Mount Cameron, the northern coast, and the most conspicuous peaks of the islands of Bass's Straits.

From the southern side is seen the whole eastern labyrinth of ridges and chasms, the fertile valley of the Break o' Day, together with the beautiful outline of the bays and promontories of the eastern coast.

The central part of the mountain's top, as the spectator recedes from the verge of its precipitous flanks,

offers, again, views which have nothing in common with those already described. The scene is here one of unbroken solitude, silence, and desolation. On the bare earth, covered only here and there with patches of snow in the midst of summer, thousands of prismatic greenstone columns (of eight or ten feet in diameter) lie prostrate at the foot of the traveller; columns of gigantic order, chiselled by nature, and raised by her hands to this majestic elevation, where, overthrown and broken into huge fragments, their ends project over chasms 3000 feet in perpendicular depth.

From this table-land, however, of the mountain's summit, the fearful gorges, precipitous cliffs, and inaccessible ridges of its immediate vicinity disappear; while the distant masses of the western hills seem blended or levelled into one undulating valley, intersected by the windings of glittering streams of the valley of the Tamar, and bounded, on the remotest skirt of the horizon, by a finely-drawn chain of mountains.

The course of the chain, resumed at St. Patrick's Head, is found to recede from the sea, and to follow a south-westerly direction for about sixty miles, without presenting any particular features, either in its main or its lateral branches. At the point called Lake Tomb, and in the vicinity of the eastern marshes, it suddenly turns between those two localities, reaches St. Peter's Pass, and casts towards Spring Hill a spur, which separates the Coal River valley from that of the Jordan; and another, which separates the latter from the Clyde, and of which Table Mount is the principal eminence.

The dividing range next proceeds to the northward, where it divides Lake Sorrel from Lake Arthur. On arriving at Dry's Bluff, — a remarkable elevation, resembling in shape a commanding promontory, — it throws back again a spur, which encircles Lake

Arthur, and thus flanks the left side of Lake River, opposite to Miller's Bluff.

A glance from Dry's Bluff embraces all the beautiful sinuosities of the valley of the Tamar, with Ben Lomond, Ben Nevis, Mount Barrow, and Mount Arthur in the background; also those of the valley of the Meander, as far as the north coast; and the table land to the south, with the expanded waters of of Great Lake; its vast, verdant, marshy plains, stripped of timber, plentifully intersected by rivers and rivulets, and here and there broken with ravines and elevations.

Between Dry's Bluff and Western Bluff, the chain, in its semicircular bend, sends one spur to the northward, which terminates in Quamby's Bluff; and several to the southward, which divide the lakes from the tributaries of the river Derwent.

At Western Bluff, it casts to the N. E. a long spur, which separates the river Meander from the Mersey, rendering all the country which borders on Port Sorrel and the river Tamar extremely broken and hilly.

Throughout the whole distance from St. Peter's Pass to Western Bluff, the chain averages 3500 feet in height, and exhibits a greenstone crest of an extremely irregular aspect. That crest is almost every where craggy, fractured, and denuded of vegetation; its spurs steep and tortuous in their course, and angular and fantastic; and its innumerable ravines, invariably deep and dry, are strewed with masses of rock of immense dimensions.

The character which the dividing range displays to the southward of Western Bluff is still bolder: its spurs in the vicinity of Lake St. Clair, to the north, north-west, and west, are topped for the most part by more lofty, bare, and cloven summits of quartz rock and sienite, and are divided by darker gullies, the

beds of which, furrowed by the torrents in yet deeper trenches, are at times impassable. The greenstone and basaltic spur which divides the Mersey from the Forth, that which separates the Forth from the Lleven, that which spreads into the Hampshire Hills and stretches to Cape Grimm, and, lastly, the one which divides the river Arthur from the tributaries of Macquarie Harbour, all partake of the colossal, rugged, wild, and distorted features which here distinguish the chain.

Below Lake St. Clair there are two more spurs which deserve a notice.

The one which divides King's river and the Gordon, and which is crowned by Frenchman's Cap, displays from its quartzose summit, scenery of Pyrenean character, unequalled elsewhere in Van Diemen's Land. That also, formed of greenstone and basalt, which separates the Derwent from the Huyon, and which terminates with Mount Wellington, constitutes one of the most striking features in the configuration of the south part of the island. From both these spurs, elevated above all the adjacent mountains, may be seen a vast extent of surrounding and far-distant country. Below the first, stretches the whole scrubby and barren tract between Macquarie and Port Davy, a great part of the western coast, and the northern and eastern eminences of the Lake country: at the foot of the latter spur, are seen, on one side the conspicuous peaks of the elevated land about Lake Sorrel, the Great Lake, Lake St. Clair, and Lake Echo, and all the numerous valleys which ultimately resolve themselves into that of the Derwent; on the other, the Coal River valley, Tasman's Peninsula and the borders of the Channel, with Hobart Town in the foreground, and the indented and projecting southern coast in the horizon.

The chain beyond these two spurs bends in a south-

easterly direction, still sending forth minor branches; and studding with conical eminences the skirts of Entrecasteaux's Channel and Research Bay, until it dips under the sea, thus terminating its terrestrial course at South Cape.

We have now endeavoured to present the reader with a sketch, upon which, as upon that of an intended picture, the delineation of the geology of the two colonies will be rendered more clear and perspicuous.

Its most prominent and striking features consist partly in the character of the mineral masses which form the dividing range, which are composed of granite, sienite, hyalomicte, protogene, quartz-rock, petrosilex porphyry, serpentinous hornblende and augitic rocks; partly in the character of the sedimentary rocks, of siliceous, calcareous, argillaceous, aluminous, and bituminous character, which are confined to the eastern and western talus of that range, resting on it either in a vertical, inclined, or horizontal position.

Its main phenomena are referable to epochs of terrestrial revolutions; some relating to periods marked by a partial quiescence, and the deposition of sedimentary rocks; some to perceptible changes in the condition of the organic life inhabiting the sea; some others, again, to catastrophes which swept from the surface of the earth all its animal and vegetable kingdom.

We shall now select for our illustration of the geology of New South Wales and Van Diemen's Land such only of these epochs as we can classify by the incontrovertible evidences of superstructure, or by organic remains; and we shall review them in the stratigraphic order in which they present themselves to our investigation, beginning with those which belong to the remotest epoch.

FIRST EPOCH.

To this epoch we shall refer all the phenomena connected with the irruption of crystalline rocks amidst the submarine crust of the earth, and by which a tract of land belonging to New South Wales and Van Diemen's Land appears to have been raised, so as to preclude any farther accumulation of marine deposits.

This irrupted or upheaved land is composed either of crystalline and unstratified or of stratified rocks.

Amongst the former are —

Granite proper
Porphyritic granite
Glandular granite
Protogene
Sienite
Hyalomicte
Quartz rock
Serpentine
Eurite.

Amongst the latter are —

Mica slate
Siliceous slate
Argillite.

This tract, composed of the above specified mineral masses, and which we have distinguished upon the annexed small map by a pink colouring, appears by geological evidences to constitute the most extensive portion of the actual surface of the two colonies.

Its western limits in New South Wales seem to extend far back into the interior of New Holland, as at 160 miles from the present sea-coast such are not to be traced.

Its eastern limits are delineated by bold landmarks, and may be approximately traced by a line

drawn from New England, latitude 28° 30′, longitude 152° 20′ *, down to the head of the river Hunter; whence it proceeds westerly, through the peaks of Mount Temi, Mount Terell, Mount Oxley, and Mount M'Arthur, and along the dividing range, down to the sources of the Munmurra Creek.

From about that locality, the continuity of the raised land, in the direction of the dividing range, seems to be interrupted, being indicated only by occasional outcrops. At the sources of the river Goulbourn, its eastern limits again present a well-defined outline, parallel to the dividing range. They may be thus traced through Payan Peak, Blackman's Crown, Cullen Bullen, and the vale of Clywd to Mount Murruin.

On passing the sources of the river Abercromby, the continuity of the tract towards the south is again partially interrupted, as if by an intervening arm of the sea; its boundary line here branching off east and west. On the east side of the dividing range, it passes through Arthursleigh and Glenrock, in the direction of the Shoalhaven river, approaching to within fifteen miles of the sea-coast, in the shape of a narrow neck of land. On the west side of the range, it runs in a tortuous line towards Mount Canoblas, round the eastern and northern base of which mountain it bends. The line next strikes, for upwards of fifty miles, in an indented course to the northward, in the direction of the estate of Mr. Montefiore, and then loses itself in the interior of New Holland.

At the place where the continuation of the uplifted land to the southward was interrupted, some occasional outcrops still mark its course to Breadalbane Plains, where it again appears, bending on the one side to the south east, through Mount Wollowalar, Modbury, and Mount Tomawong; and on the other,

* Cunningham.

in a very tortuous line to the south-west, taking first the direction of the river Murrumbidgee, encircling afterwards Yass Plains; and lastly, striking, by a north-west course, through Barber's Station and the Jugion Creek range, on the western region of New Holland.

How far this portion of the raised tract extends in the interior, to S.W., W., or N.W., it is as yet impossible to decide.

On the east, its limits are most likely bordered by the Australian Alps, as they undoubtedly are in Gipps Land by the dividing range, as far as Wilson's Promontory.

To the southward of that promontory we have but the islands of Bass and Banks' straits, and which, instead of being vestiges of a former coast-line between Wilson's Promontory and Cape Portland, as some travellers supposed them to be, indicate only a submarine continuity of the irrupted chain of New South Wales and Van Diemen's Land. These islands present themselves in a form similar to that which may have characterised Van Diemen's Land after the first irruption of crystalline rocks.

At that epoch, Van Diemen's Land probably was composed of five islands: the first approaching to the form of a triangle, included between Cape Portland, St. Patrick's Head, and the head of the river Forrester; the second, constituting what are now called Asbestos Hills; the third, a small island, now forming the valley of the Lake River; the fourth, including the eastern portion of Hampshire Hills, and a part of the northern littoral; and the fifth, an oblong and indented island, comprising a part of Middlesex Plains, and enclosed between Macquarie Harbour, Port Davy, South-west Cape, South Cape, the right bank of the river Huyon, the west side of Lake St. Clair, and Western Bluff.

We shall now enter upon the mineralogical description of some of the crystalline and sedimentary rocks belonging to this epoch; under the consideration that, at the distance of the European reader from the Australian colonies, it is important that he should be put in possession of the specific character of each species of rock treated of in the geological inquiry, and thus understand the meaning of the nomenclature employed.

CRYSTALLINE ROCKS.

Granite.

Var. 1. *Granite proper.*

Composed of equal proportions of quartz, felspar, and mica. Structure granular: grains the size of a pea: dissemination of the ingredients regular: the predominant colour of the quartz, vitreous, with at times a smoky or greasy appearance; that of the felspar, a faintish red, and that of the mica, invariably black: the entire mass presents a reddish grey colour.

Localities. — Liverpool range, Bathurst, Wellington Valley, Shoalhaven, Jugion Creek, Ellersbie, Mount Kosciuszko (New South Wales). Eldon range, Ben Lomond, and Frenchman's Cap (Van Diemen's Land).

Var. 2. *Glandular Granite.*

Composed of oval-shaped masses of granular mica, tabular quartz, and tabular felspar, irregularly interspersed through a quartzose paste.

Localities. — Vale of Clwyd, Guantewang, Mount Kosciuszko, Gidley East, Modbury, Amprier West,

Wilson's Promontory (New South Wales). Flinder's Island (Bass's Straits). Cape Portland and the Black Ridge (Van Diemen's Land).

Var. 3. *Porphyritic Granite.*

A granitic structure of quartz and mica, with large oblong and irregular crystals of felspar, confusedly embedded in the masses.

Localities. — Vale of Clwyd, Guantewang, Gidley, Ellersbie, Lake Omes, Wilson's Promontory, Clark's Island, Black range, Ben Nevis, and Eldon range.

Remarks. — The granite of the three above varieties exhibits in some cases evident traces of a *flow*, similar to that of a *nappe de basalte.* The first variety presents very often the appearance of an intumescent paste, forming an extensive tract of New South Wales, *where neither mica slate or gneiss is to be found.*

The two last varieties have seldom this appearance. They consist mostly of moderate ridges, and serve as bases to other crystalline, stratified, or unstratified rocks.

Protogene (*Beudant*).

A confused crystallization of talc, felspar, and quartz, marked by an unequal distribution of ingredients, by the predominance of the *talc* over felspar, and by the entire exclusion of mica. Colour, a greenish white, sometimes inclining to red.

Localities. — Occupies a small isolated portion of the Manes range (Murrumbidgee), and is to be found in the Eldon range, resting on granite, which it resembles in the size and colour of the quartzose ingredient.

Hyalomicte (*Brongniart*, *Beudant*, Greisen of the German mineralogists,)

Is composed of a homogeneous milky or smoky-looking quartz rock, with an admixture of a white mica, to the entire exclusion of felspar.

Localities. — Is found at Ellersbie and Dutzton, and crowns also Mount Kosciuszko, the highest summit of New South Wales: when associated with sienite, as is the case in the Australian Alps, it has occasionally hornblende added to it.

Sienite.

Structure granular and massy; invariably composed of a vitreous and translucent quartz, and of hornblende, which is prismatic, and of a dark olive green. At times it is intersected by veins of sulphuret of iron, by which the already beautiful appearance of the rock becomes yet more resplendent.

Localities. — Is widely diffused through both the colonies. In New South Wales, it is found in Honeysuckle range; in Argyleshire, at Sharwin's West; and between Murrumbidgee and the Murray. It forms also the most elevated mountain in that colony (Mount Kosciuszko). In Bass's Straits, it is seen on Flinder's Island, Green Island, Mount Chappell, Preservation, and Clark's Island.

In Van Diemen's Land, it forms the eastern coast, Eddystone Point, St. Helen's Point, and St. Patrick's Head; and it is found on the Great and Little Forrester, on Mount Horror, Mount Humboldt, and at Port Davy.

Remarks. — Sienite is associated with striking uniformity with granite: its presence in any locality is a sure indication of the granite being near.

QUARTZ ROCK. (Syn. Quartz compact of *Beudant.*)

The quartz rock of the two colonies consists of two distinct varieties, the structure of which much differs, although appearing similar to the naked eye. The first variety is of a whitish or somewhat milky colour, at times translucent; it is free from foreign ingredients, and perfectly homogeneous. The second variety differs in colour and translucency, and shows, when examined with a lens, a granular structure, composed of concretions united into one mass by a paste perfectly similar to the grain: at times, as is the case at Dr. Hill's (Shoalhaven River, New South Wales), it presents the appearance of a jasperoid rock, with very indistinct concretions.

Localities.—The first variety is extensively developed about Bathurst, in Argyleshire, and on Mount Kosciuszko (New South Wales). In Van Diemen's Land, its most remarkable locality is the dividing range, west of Lake St. Clair, Frenchman's Cap, and the spur which unites that mountain to the main ridge of the dividing range, and which that quartz rock exclusively composes.

The granular variety is more generally diffused than the preceding one. In New South Wales, it is found in many places about the Upper Hunter, and particularly in Argyleshire, about Barber's Creek, Ajimatong Ridge, and Sharwin's Farm.

In Van Diemen's Land, it is principally found between the Meander and the Mersey rivers, at Rocky Cape, Cape Grimm, and the heads of the Derwent.

Remarks.—The first variety agrees in all its characteristics throughout the above-named localities, not only mineralogically, but also in its geological position and relation. This variety, in New South Wales, as well as in Van Diemen's Land, whenever it

reposes upon granite proper, serves as base to mica slate.

The second variety shows evidences, both geological and mineralogical, of being posterior in date to the first. In most cases it forms the superstructure of the rocks belonging to the second epoch, under the account of which, allusion will be made to it.

Eurite (Syn. Feldspath grenu, *Brard; Haüy;* Weisstein of *Werner;*)

Is composed entirely of felspar; sometimes aggregated in minute laminæ, in which case it is susceptible of a mechanical division, parallel to the laminæ; sometimes possessing a finely grained structure, and in such case exhibiting a conchoidal fracture; its colour is a pale yellowish red; it is inferior in hardness to quartz; adheres to the tongue, and exhales an argillaceous odour.

Localities. — It covers some portion of a granitic country about Wellington, and in the vale of the Clywd, and is also found on the summit of Flinder's Island. In Van Diemen's Land, it appears first between Mount Cameron and Waterhouse Point, and is next to be met with on the Black range. It is also found on the St. George's and Scamander rivers, to the north of St. Patrick and of Ben Nevis, and to the south of St. Valentine's Peak (Hampshire Hills).

Remarks. — This rock is seldom seen composing alone a tract of country. It is associated with granite; and frequently forms very large masses and veins conjoined with that rock, as is the case in the vale of Clywd, New South Wales.

SERPENTINE.

Colour, sometimes emerald, sometimes leek green, but never uniform throughout; the mass displaying in small spots, irised hues. Externally, it often shines with a waxy or resinous lustre: at the edges, it is translucent. It is found in masses composing a cluster of mountains in Van Diemen's Land, known under the name of Asbestos Hills. It feels unctuous: the streak is generally of the same hue as the rock, though sometimes varying from a brighter to a duller shade. It is solid, semi-hard, and brittle: the fracture earthy, uneven, sometimes laminated; the fragments irregular and splintery. It is traversed by short, curved, and narrow veins of a white, silky amianthus, the fibres of which are perpendicular to the direction of the vein. It does not affect the magnetic needle.

Localities. — In New South Wales, serpentine is found N.E. of Port Stephen, between Bathurst and Molong, and at a locality named Spring Hill; but the largest developement of this rock is in the range which lies between the Coodradigbee and Doomut rivers. It there presents beautiful specimens, approaching the character of precious serpentine, and containing fibrous talc and small fibres of amianthus. In Van Diemen's Land, the Asbestos Hills are the only locality where serpentine is seen in a mountainous mass. On the west side of those hills, it is associated with mica schist; on the east, with limestone; on the north, with greenstone. The maximum height at which it is found is 1500 feet: its structure is decidedly amorphous: but in the vicinity of the river Rubicon, it shows some slight appearances of stratification.

SEDIMENTARY ROCKS.

Mica Schist.

The difference in the colour of quartz and mica, and the varying proportions in which those minerals are aggregated, impart to mica slate an infinite variety of hues, including shades of green, white, red, blue, brown, and yellow. Its structure is distinctly slaty, yielding to the nail, and easily separating in thin layers. Sometimes the minute laminæ of mica render it more compact, when its slaty structure becomes indistinct, and the fracture splintery, and often conchoidal: in this case it appears to the naked eye homogeneous, and resembles flinty slate. It is mostly vertical and contorted; closely fitting the waving lines of the crystalline base upon which it rests.

Localities.—In New South Wales, its range is very limited: on the eastern side of the mountains, it seems abraded; on the western, much broken and contorted. As far as I was able to ascertain, mica slate in New South Wales is only to be met with on Mount Kosciuszko and Mount Pinabar (Australian Alps).

In Van Diemen's Land, it is found between Point Eddystone and Mount Cameron; Piper's River and Miller's Bluff; Port Sorrel and Asbestos Hills; on the rivers Mersey and Forth, Rocky Cape, Black River, and Cape Grimm.

Remarks.—The varieties of mica slate found in the two colonies have in a great measure resulted from the different circumstances under which the slates came in contact with the crystalline rocks. On Ben Lomond, mica slate was reduced to exfoliation, whenever it came into contact with greenstone. The same effect is observed in the mica slate of Piper's and the

Mersey rivers. Its strata are in most cases vertical. It is associated with granite (Mount Cameron); with sienite (Mount Kosciuszko, Mount Pinnabar, and Point Eddystone); with serpentine (Asbestos Hills); with quartz rock (Frenchman's Cap and the western dividing range); and with diabase (Lake River, Scrubby Den).

Siliceous Slate

Is most usually grey, though sometimes white, reddish, or yellowish: it is also opaque; but in a few instances translucent at the edges. The fracture in small specimens is a little conchoidal. The mineral is traversed by numerous veins of quartz, looks greasy, and is tough.

Localities. — In New South Wales it is found at Munmurin Brook, Dart Brook, the River Karua, Booral, St. Patrick's Plains, Vale of Clywd, Fish River, Campbell River, Molong, Wellington, Gidley East, Ajimatong, and on Manes Range.

In Van Diemen's Land, on St. George's River, Mount Cameron, Little Forrester River, Patcham, Hampshire Hills, Emu Bay, Rocky Cape, Montague River, Cape Grimm, the Eldon Range, and River King.

Remarks. — The strata of siliceous slate occur for the most part in a vertical position; at times, however, especially in flat or but slightly elevated countries, it is found very nearly horizontal, as on the river Karua. When in contact with crystalline rocks, it is seen usually associated with sienite, eurite, quartz rock, diabase, and porphyry. When in contact with slates, it rests on mica slate, and alternates with argillaceous slate. Its masses display distinct stratifications, composed of seams half an inch in thickness.

ARGILLITE, syn. COMMON ARGILLACEOUS SLATE (*Kirwan*); CLAY-SLATE (*Jameson*); SHISTE ARGILLEUX (*Bronchant*).

Colour a greyish black, with a bright silky lustre; substance opaque, with a smooth surface; adheres to the tongue, and yields a strong argillaceous odour: the streak is greyish; the structure foliated, the foliæ separating easily. The fragments are tabular, thin, shining, and friable.

Localities. — In New South Wales it is found about the Upper Hunter, the Vale of Clywd, the west of Mount King George, Badger's Brush, the western side of the dividing range, the north side of Argyleshire, Lake George, Gidley East, Long Swamp, Bango Range, at the Murrumbidgee River, Mount Kosciuszko, Pinnabar, Lake Omeo, Thompson's River, and in Gipps Land, on its N.W. and S.W. extremities.

In Van Diemen's Land, between Piper's River and George-town, where it is associated with mica slate and siliceous slate. Its strata here are nearly perpendicular; it extends uninterruptedly for about four miles in a southerly direction; crops out again about Miller's Bluff, associated with the same rocks, and finally disappears with them. The second locality at which it is found is Emu Bay East, where it is seen alternating with siliceous slate. Its strata here also are nearly vertical, and strike in the same direction as those of the former locality: it sinks however under the basalt of Hampshire Hills; reappearing at the foot of Mount Arrowsmith, (between Lake St. Clair and Frenchman's Cap,) where it is associated with mica slate, both lying in a vertical position. Has the appearance of roofing slate, and has often been mistaken for it in Van Diemen's Land; but the presence of mica, and its avidity for water, render it unfit for roofing.

General Remarks upon the First Epoch.

An examination of the evidences which prove the eruption of the crystalline rocks, shows that there were various degrees of intensity with which the expansive forces acted during that eruption. From the unequal heights which, under these circumstances, the crystalline rocks naturally assumed, results a want of uniformity in the inclination of the uplifted stratified crust, and a difficulty in assigning any prevalent dip to the sedimentary rocks.

Thus, at the highest point of elevation, Mount Kosciuszko (6500 feet), mica slate, and siliceous and argillaceous slates are vertical, and attain the height of 3200 feet; which is the case also on the western side of the dividing range, between Lake St. Clair and Frenchman's Cap (Van Diemen's Land). About the Trafalgar River, where the granitic floor has an elevation of only 1400 feet, siliceous slate has a dip of 45°. At Manes Range, between the rivers Murray and Murrumbidgee, the upheaved strata are nearly horizontal.

The best sections of the stratified masses (on the dividing range, Van Diemen's Land), between Lake St. Clair and Frenchman's Cap, also on Eldon Range and Ben Lomond, tend to prove that, of the stratified rocks, mica slate, being the nearest to the crystalline rocks, and following all the contortions of the base, forms the oldest portion of the crust, and that siliceous and argillaceous slates, which rest upon it, are the next in order of superposition.

Which, among the crystalline masses, claims a priority over the rest in point of age, cannot be ascertained with any certainty. The geological evidences that exist in New South Wales and Van Diemen's Land, (Vale of Clwyd, Bathurst, Mount Kosciuszko,

Lake Omeo, Ben Lomond, and the Western Range,) seem to prove that the incandescent granitic matter was the first to appear after the breach of the submarine crust; that it was on the granitic talus, that quartz rock and sienite forced their way to the surface; and that, upon the latter rocks, serpentine, porphyry, and greenstone made their appearance. Thus, about Bathurst, quartz rock overlaps granite; and on the Honeysuckle Range, porphyry overlaps sienite; on Mount Kosciuszko, S. W., granite is seen forming a base 2000 feet above the level of the sea, upon which sienite and quartz rock attain a further elevation of 4500 feet. Again, in Van Diemen's Land, sienite rests upon granite, and greenstone upon sienite. In the dividing range, between Lake St. Clair and Frenchman's Cap, the base is granitic up to the elevation of 1800 feet, upon which base quartz rock, massive such as has been described, rises in towering masses to 3200 feet more.

The fact of an alteration of the stratified rocks in contact with the crystalline masses, having in some instances taken place, is obvious in the region here described, though it cannot be as yet satisfactorily traced to its proper cause. Mica slate at times has its two ingredients, quartz and mica, perfectly and widely separated, exhibiting an irregular, nodular aggregation; at other times their intermixture is perfect and laminated: in both cases mica slate appears in contact with granite. The arenaceous sedimentary rock likewise presents a fused and homogeneous mass of granular quartz rock, in which the naked eye distinguishes the grains, although the interstices are obliterated. Such rock is also sometimes found in contact with porphyries, though at other times it is widely separated from any kind of igneous rock.

The extent which the stratified rocks occupy in

the two colonies is trifling. They are confined to a small zone, and have been much abraded, to furnish materials for the formation of subsequent rocks.

The crystalline masses may be said to form almost all that tract of the two colonies which is coloured pink in the annexed map, and may, throughout, be described as rising to higher level than the sedimentary rocks. Amongst the former, granite, sienite, and quartz rock preponderate. The first-named rock constitutes nearly the entire floor of the western portion of New South Wales, to the *entire exclusion of mica slate and gneiss*, and extends far into the interior of New Holland, in masses of mammillary, tuberous, globular, or botryoidal form.

In many instances, these masses possess a character analogous to that which the same rock assumes in Central Asia, and sometimes, as is the case in the tract of country lying N. E. of Wellington Valley, between the estate of Guantewang and that of Mr. Montefiore, they present so striking a resemblance to the granitic masses found in the environs of Altai, that the graphic description of that locality furnished by Humboldt may serve to delineate also the above-mentioned region of New South Wales.

" Nulle part, dans l'un et dans l'autre hémisphère, je n'ai vu des granites qui offrent plus le caractère des roches d'éruption ou d'épanchement que les granites qui entourent le massif de l'Altaï. Ces roches, isolées, comme le seraient des porphyres ou des basaltes, sont dépourvu de gneiss et de mica shiste. — Elles s'élevent dans la steppe au pied des montagnes Alpines, sous les formes le plus bizarres. Lorsque de la steppe de Platovsk, où on commence à distinguer à l'orizon les neiges des Alpes Tigirezk, on monte vers les bords rocheux du Lac de Kolyvan, on est frappé de ces *éruptions* de granite, qui, sur plusieurs lieux carrées sortent d'un sol entièrement uni. Les

rochers sont tantôt alignés, tantôt dispersés dans la plaine, affectant les formes les plus bizarres de mures étroits, des tourelles ou des polygones. — Les buttes les plus petites ressemblent à des tribunes, à des siéges, ou à des monuments funéraires. — Ce qui donne surtout une phisiognomie étrange à cette contrée, c'est le contraste de hauteur et de volume des masses granitiques. — Les unes ont quatre à cinq cent pieds d'élévation, comme la *Vysokaïa Gora ;* les autres atteignent à peine sept ou huit pieds d'élévation, et rappellent les petites soulèvements volcaniques qui hérissent ces plaines, que dans l'Amérique espagnole on designe sous le nom de *Mal-pays.* Arrivé au village de Sauchkina ou Sauchka, nous nous trouvames comme au centre de ces éruptions.

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" D'autres formes plus extraordinaires encore se présentent dans les rochers granitiques qui se sont soulevés le long de la pente méridionale de l'Altaï, entre Boukhtarminsk, Narym et le poste Chinois de Baty. Ce sont ou des cloches et des hémisphères aplatis, ou des cônes placés au milieu de la plaine du Haut-Irtyche, cônes terminés le plus souvent par des épanchements latéraux en forme de murs très bas et très allongés. On dirait d'une coulée, effet de la fluidité de la matière sortie sur une crevasse."

Asie Centrale, vol. i. p. 297.

SECOND EPOCH.

The rocks of this epoch, represented by the yellow colouring in the annexed map, are characterized by a group of different crystalline and sedimentary compounds, resting incumbent upon those just described, and which in Terra Australis contain the first record of organic life.

Amongst the unstratified rocks are found quartzose, petrosilex, feldspathic, and claystone porphyries, granular quartz rock, columnar, shistose and amorphous greenstone, serpentine, basalt, trachyte, siliceous breccia, compact, massive, and foliated granular limestone.

Among the stratified masses are siliceous and argillaceous slates, grauwakes, grits, pudding-stones, and conglomerates.

We will select the most important localities illustrative of this epoch, and begin with the north-east of New South Wales.

1st. *Port Stephens.* — Throughout the tract of country which lies between Port Hunter, Port Stephens, and Mount Wingen, the sedimentary rocks of this epoch are found widely separated; each detached portion having its own strike or dip. In this dislocated structure some evidences are nevertheless discovered by which their former continuity may be traced.

Nearly midway between the river Karua and Raymond Terrace there is a very slight elevation or low ridge of siliceous breccia and greywacke, ranging east and west. On both sides of it the country is overspread with a coarse arenaceous deposit, no natural sections of which are found; but a quarry four miles from Raymond Terrace shows that it is composed of two distinct and conformable members, the upper a conglomerate, the lower a friable sandstone, used for building, and containing the following fossils: —

Fenestella internata.
——— *ampla.*
Productus brachythærus.
Terebratula cymbæformis.
——— *hastata.*
Conularia levigata.

The sandstone and the conglomerate are but slightly inclined, and dip to the southward: at Raymond Ferry the conglomerate is found on the left side of the Hunter, almost at the level of its waters.

On passing due westward from Carrington to Booral, we find on a ridge ranging E. and W. a flaggy, greyish-blue argillaceous rock, in strata highly inclined, containing an admixture of calcareous matter and a good many organic remains, some of which, parallel to the laminar surfaces of the rock, are well preserved, and may be referred to

Icthyodorulite,
Littorina filosa,
Turritella tricincta,
Spirifer crebristria,

and the minute genus of Crustacea belonging to Cythere or Bairdia.

A further examination shows that this rock is associated with siliceous breccia and greywacke, which last has greenstone and feldspathic porphyry below. In the immediate vicinity are sandstones and conglomerates, similar to those of Raymond Terrace, at least in a mineralogical point of view; for the absence of natural sections precludes the discovery of the fossils.

At Booral, also, the three members of the group, namely, siliceous breccia, slaty blue argillaceous rock, and sandstone, appear. West of Strout, on the steep banks of the river Karua, four members may be easily traced; the lowermost greywacke, succeeded by a slaty rock, which in turn is succeeded by sandstone and conglomerates, as above described.

In tracing now the greenstone and feldspathic porphyry, which we saw lying below the flaggy argillaceous rock containing *Icthyodorulite*, we see that

greenstone and porphyry, about the sources of the river Hunter, is associated with granite belonging to the first epoch; and hence that the above surveyed tract of the country, which for convenience sake we have named Port Stephens, would present the following section in the ascending order: —

	Granite.
	Porphyry.
	Greenstone.
	Siliceous breccia.
Highly inclined	Greywacke.
	Argillaceous flaggy rock with Icthyodorulite.
Nearly horizontal	Sandstone with Conularia.
	Conglomerate.

2d. *At St. Patrick's Plains, Glendon, Harper's Hill,* the stratified rocks of this epoch rest upon a siliceous amygdaloid, which abuts against greenstone and basaltic dykes. It is associated with a massive limestone, much broken, and containing —

Platyschisma oculus,
——— *rotundatum,*
Spirifer Darwinii,
——— *subradiatus,*
Pleurotomaria Strzeleckiana,
Fenestella internata,
——— *fossula.*

3d. *The Upper Hunter.* — Here the rocks of the second epoch stretch from the environs of Dart Brook in a western direction, to Gummum Plains and Cassilis. About Coyal it seems to bifurcate to the west. In some parts of this zone, as in Dart Brook gulley, and in the gullies to the westward of Mac Arthur's Peak, the lowest bed is a fragmentary rock, com-

posed of granite, feldspar, mica slate, and argillaceous slate: over this are a sedimentary clay-slate and greywacke, nearly vertical; next above is limestone of two varieties, compact, and foliated granular, in which the traces of organic remains are very indistinct. The whole is crowned by a great development of pudding-stones and conglomerates, in slightly inclined beds.

In some places the described strata are distinctly separated from those of the first epoch by erupted greenstone, as may be seen on the southern flank of Liverpool Range; sometimes they are found abutting against granite and greenstone, as is the case between Coyal and the sources of the River Goulburn.

4th. *At the eastern environs of Cullen Bullen*, the rocks of the second epoch are found stretching partly over the Honeysuckle range, partly over the Wolgan, and jutting out in a neck of land even as far as the western side of Mount King George: they embrace also Mount Victoria, and part of the Vale of Clywd. In this locality we see a fragmentary rock abutting against either greenstone and basalt, or sienite, over which lie clay slate and compact, blackish limestone, in a vertical position, which again are crowned by conglomerates nearly horizontal.

5th. *To the eastward of Lake Barrabura*, in the environs of Glenrock and Barber's Creek, gritstones and fine-grained slaty greywacke form the lowest bed of the group of rocks under consideration; between which and the granitic base we see quartzose porphyries and jasperoid rocks intervening. The compact limestone which comes next above is either in contact with gritstones, or with porphyries; and passes imperceptibly into fossiliferous limestone. At Amprier, and east of Glenrock, the fossils which this limestone presents are greatly obliterated, and for the most part, they are but slightly delineated on

the weather-worn surface of the rock. They consist of

Amplexus arundinaceus.
Crinoidal stems, &c.

6th. *Illawara.* — Of the rocks belonging to the second epoch, this locality exhibits but the fossiliferous limestone, which we noticed in the described group of Harper's Hill: — that limestone is found amidst vast dislocations referable to different periods, and containing the following fossils —

Stenopora crinita.
Allorisma curvatum.
Pachydomus antiquatus.
——— *cuneatus.*
——— *lævis.*
——— *globosus.*
——— *carinatus.*
Orthonota costata.
Eurydesma cordata.
Pecten Illawarensis.
Productus brachythærus.
Platyschisma rotundatum.
——— *oculus.*
Pleurotomaria Strzeleckiana.
——— *cancellata.*
Terebratula hastata.
Belerophon micromphalus.
Spirifer Darwinii.
——— *subradiatus.*
Theca lanceolata.
Conularia levigata.

7th. *At Modbury West*, the group of this epoch is seen resting against argillite and granite: its limestone likewise bears only a very indistinct fossiliferous impression.

8th. *South-west of Arthursleigh*, about Greenwich Park, the limestone is associated with greywacke, which is separated by greenstone and serpentine from the granitic basis. In all cases the superstructure is pudding-stone and conglomerates, all in nearly horizontal position; some much worn away; some still overtopping the surrounding country, as is the case six miles S. W. of Arthursleigh, and to the northward about Ballangola.

9th. *To the westward of Lake Barabura and Lake George*, the rocks of the second epoch extend almost

in the same order of superposition as we have described in the already noticed localities. Thus, limestone presents itself first as compact and non-fossiliferous, and then gradually becomes a fossiliferous, having for its base either the sedimentary rocks greywacke, clay slates, or siliceous breccia, or quartzose porphyry, greenstone, and basalt. The conglomerates and pudding-stones which are overlaying this limestone, are in a state of partial disintegration, particularly about Yass Plains.

In consequence of this disintegration, the limestone is left exposed. In Wellington Valley, Molong, and Boree, its examination is very interesting, owing to the osseous breccia found in its caverns. On the north of Mount Canoblas and Yass Plains it is likewise so, on account of some fossils more or less perfect: which may be referred to

Favosites Gothlandica,
Crinoidal columns.
Orthoceras,
and *Impressions of Trilobites, not exceeding half an inch.*

In Van Diemen's Land, the localities at which the rocks of the second epoch occur are: —

1st. *Asbestos Hills on the south.* — The lowermost of the series here appears to be a slaty, micaceous, and argillaceous rock, highly inclined, resting upon siliceous amygdaloid and breccia, and at times abutting on a greenstone rock. Next to it is seen a compact limestone, gradually becoming fossiliferous: over this is a conglomerate, in nearly horizontal beds.

2d. *House-top Tier* (Hampshire Hills). — Feldspathic rock, with a slaty cleavage, at times conchoidal in fracture, is here the lowest member, resting either upon granite or feldspathic porphyry; and

subjacent to a granular limestone, which is without fossils. (Dr. Milligan.)

3d. *From Emu Bay to Cape Grimm*, extends a continuous tract of siliceous and argillaceous slates, reposing upon several parallel axes in the direction of north and south. The transverse section shows that the strata are contorted and wavy, with a varying inclination. The axes are composed either of granular quartz rock, basalt, greenstone, or a jasperoid rock; the slates are usually gritstones, and fine-grained, siliceous, and argillaceous slates of red, greenish, grey, black, and blue colour. This tract of slates is elevated but few feet above the high-water mark, and is surmounted here and there by horizontal beds of conglomerate.

4th. *Belvoir Valley, Circular Pond Marshes, and the limestone caves of the River Mersey* (Mr. Reid's farm), present similar geological features so far as regards the group of the second epoch. The three localities have for the lowest rock a flaggy gritstone, or granular quartz rock and clay slate, in an inclined position, resting upon quartz rock, feldspathic porphyry, greenstone, and basalt. A compact limestone, pudding-stones, and conglomerates are associated with them: the last is in horizontal beds. No organic remains have as yet been discovered here.

The limestone of the above three localities is much traversed by greenstones and basalts, and exhibits, in the structure of the caverns which it forms, and in the funnel shape which the surface in many places assumes, marks of partial subsidence. (Circular Pond Marshes.)

5th. *Norfolk Plains.* — Here the lowest strata are siliceous breccia, resting on a greenstone base: on these lies gritstone and fragmentary argillaceous rock of slaty structure, in an inclined position. The

limestone next above is flaggy, and the beds nearly horizontal: it contains the following fossils: —

Stenopora Tasmaniensis.
Productus brachythærus.
Spirifer subradiatus.
Pecten limæformis.

This limestone is covered by a conglomerate in horizontal beds, visibly indurated by the action of heat.

6th. *Ben Lomond on the N. E., and Ben Nevis on the S.*, show this group in the following ascending succession. First, siliceous breccia, composed of fragments of mica slate, argillaceous and siliceous slate; then greywacke; next, compact claystone; and lastly, compact limestone without fossils: the whole crowned by immense masses of greenstone, which are seen thrust between the members of the group and mica slate, and rising on the granitic base to the height of 5000 feet. In the eruption of the greenstone which constitutes the dentiform crest of Ben Nevis, the lower members of the series (the siliceous breccia and clay slate) were disjoined, and carried to the height of 3200 feet, where they are found lying on the neck which unites Ben Nevis with Ben Lomond.

7th. *Break-o'-Day Valley, East.* — A westerly section from St. Patrick's Head, beginning with the sienitic axis of the chain, furnishes the following members to the series: granular quartz rock, greywacke, gritstone, clay slate, clay stone, and massy and slaty limestone, with the following fossils: —

Stenopora Tasmaniensis.
Fenestella ampla.
——— *internata.*
Spirifer subradiatus.

This limestone is in a few instances overlaid by a conglomerate. The whole group, with the exception of the limestone and conglomerate, is thrown in a very inclined position by the greenstone of St. Patrick's Head, which greenstone burst up between it and the sienitic axis.

8th. *The sources of the river Nive, in the Upper Country, and the locality east of Marlborough*, exhibit perhaps the most complete section of this group that is to be seen. Here a massy fossiliferous limestone abuts against a very inclined argillaceous and siliceous slate: upon this limestone rests a slaty fragmentary rock without fossils; a fossiliferous, arenaceous, and argillaceous massive rock, with somewhat of a slaty fracture, follows. This is crowned by a sedimentary deposit of mud and fine sand, which reaches an elevation of 5200 feet. The series in this locality contains the following fossils: —

Crinoidal columns.
Productus brachythærus.
Spirifer subradiatus, and *S. Stokesii.*
Fenestella internata, and *F. ampla.*

9th. *Eastern Marshes.* — Greywacke with a slaty cleavage forms here a highly inclined base, on which rests a compact massive limestone, containing

Pecten limæformis,
Productus brachythærus,
Fenestella internata, and *F. ampla*,
Spirifer subradiatus, and *S. Stokesii.*

This limestone is covered unconformably by conglomerate, which is much worn away. The eruption of the greenstone which now separates the tributaries of Little Swan Port from those of the Tamar river does not seem to have affected the position of the limestone.

10th. *Mount Dromedary; Mount Wellington; Grass Tree Hill.* — The limestone of this locality is both

mineralogically and geologically similar to that of the Eastern Marshes, and the sources of the river Nive: it contains the following fossils: —

Stenopora Tasmaniensis.
——— *ovata.*
Fenestella ampla.
——— *internata.*
——— *fossula.*
Productus brachythærus.
——— *subquadratus.*
Pecten Fittoni.
—— *squamuliferus.*
Spirifer subradiatus.
——— *Tasmaniensis.*
——— *Stokesii.*
——— *avicula.*
——— *vespertilio.*
Pachydomus globosus.

The position of the two fossiliferous members of the group, on the east side of Mount Wellington, above Mr. Hull's house, as also the position of the conglomerate on the top of Mount Wellington, is owing to the eruption of the greenstone of that locality, by which the above-named members of the series were disjoined, and elevated far above the rest.

11th. *Spring Hill, West.*—A fossiliferous greywacke, with

Stenopora informis,
Fenestella ampla,
Pachydomus globosus,
Orthonota compressa,
Pterinea macroptera,

is the only member of the rocks belonging to the second epoch which is found in this locality. Its position relatively to the subjacent strata is difficult to be determined with accuracy, on account of the prevailing dislocations.

12th. *Eagle Hawk Neck.* — The arenaceous and siliceous, flaggy, fossiliferous rock, noticed in the vicinity of the river Nive and Mount Wellington, is here found at low-water mark, in almost horizontal strata. It is laid bare by the action of the sea-water on the superincumbent conglomerate, and exhibits a surface fissured in a series of rectangular squares.

This rock is characterized by the abundance of *Spirifer vespertilio* and *Sp. avicula.*

MINERALOGICAL DESCRIPTION OF ROCKS BELONGING TO THE SECOND EPOCH.

CRYSTALLINE ROCKS.

Porphyries.

The porphyries of the two colonies present five varieties which may be named from the varieties of the homogeneous and compact basis in which the crystals or grains of other mineral are embedded.

Var. 1. *Felspathic Porphyry.*

In the eight localities in which this variety of porphyry occurs, some differences are observable.

On the river Forrester, where the rock pierces through sienite and granite, its colour is greyish; its structure nearly compact; its fracture uneven, and nearly dull: it contains milky crystals of felspar, and highly comminuted grains of mica and hornblende, which latter predominate.

At Waterhouse Point. This porphyry is associated with granite and eurite; its colour is ashy grey, with a faint reddish tinge on the weather side, and a darkish cherry on the inside of the fresh broken. It is compact; fracture conchoidal and dull: it contains

grains of limpid quartz, and of flesh red felspar; some of which are rounded, some angular: those of felspar predominate.

To the South of Waterhouse Point, the felspathic porphyry is associated with eurite. Its colour is flesh red; structure nearly compact; fracture foliated; lustre glittering: it contains grains of hornblende scantily disseminated, and of laminar felspar, which predominate.

The vicinity of Mount Cameron.—This rock is observed between granite and granitic porphyry. Its colour is a yellowish red; structure compact; fracture uneven and dull: the embedded minerals are quartz, mica, and felspar; the last predominating.

In the Black Range, where it is associated with granitic porphyry and eurite, this rock is similar to that found to the S. of Watherhouse Point, excepting that it does not contain any crystals of hornblende.

At St. George's River it is found between granitic porphyry and siliceous slate. Colour yellowish; structure compact; fracture conchoidal and glittering Its embedded crystals are limpid quartz and felspar, the last predominating.

At the river Nive (twenty miles north of Marlborough), this rock is associated with granitic porphyry. Its colour is greyish green; structure compact; fracture uneven and shining. It contains grains of limpid quartz, crystals of hornblende, and rounded crystals of finely laminated felspar.

Before the blow-pipe, the paste of this variety melts into a white enamel, compact and translucent, and sometimes containing bubbles.

Remarks.—The most remarkable fact connected with these seven species of porphyry is, that, different as they seem to be, they are to be found *in one current, or rather in one mass of porphyry at Port Stephen, New South Wales.*

Var. 2. *Petrosilex Porphyry.*

Colour brownish black; structure compact; fracture uneven and dull. It contains crystals of felspar and hornblende, with some mica, those of hornblende greatly predominating. It resembles the melaphyre of Brongniart, and before the blow-pipe melts sometimes at the edges only into a blackish, porous enamel: is found at Cape Portland, and on the west coast of Van Diemen's Land.

Var. 3. *Quartzose Porphyry.*

In the localities in which this variety of porphyry is found, some difference in its external character is observable.

At Mount Cameron (V. D. L.), where it lies between granite and gneiss, it is of a yellowish colour; structure nearly compact; fracture uneven and at times splintery. It contains grains of limpid quartz, and of felspar minutely comminuted, the grains of quartz predominate.

At Barber's Creek, Modbury, Bango Range, and between *Derrangullen and Jugion Creek* (N. S. W.); on the *dividing range,* and at *Mount St. Patrick* (in V. D. L.), where it is associated with sienite, its colour is grey; structure very compact; fracture conchoidal, splintery and glittering. The contained crystals are limpid quartz, mica and minute grains of hornblende: the quartz predominating.

On the *river Forth,* the quartzose porphyry is associated with basalt and claystone porphyry: its colour is greenish. It contains crystals or grains of limpid quartz, hornblende, and minutely comminuted mica. Its structure is very compact; fracture splintery, lustre vitreous: the predominant ingredient is quartz.

Before the blow-pipe, the paste of this variety does not melt, except sometimes at the edges only.

Var. 4. *Claystone Porphyry.*

Occurs at two localities, the specimens of which present marked differences in their external character. That of *the river Forth*, east of Western Bluff, is associated with trachyte proper and cellular trachyte. Its colour is dark cherry brown; structure very compact; fracture uneven and splintery. It contains grains of glassy quartz, which predominate in the compound, and possess all the characteristics of the quartzose porphyry of Von Buch.

That of the *Vale of Belvoir* is associated with basalt and compact limestone. Its colour, like the preceding sub-variety is a blackish cherry brown; its structure compact: the paste, however, when examined with a glass, is found to consist of small shining grains in a state of vitrification. The fracture, though splintery, is more even than that of the river Forth: it contains felspar of a dull milky hue, which is sometimes rounded, sometimes angular. Subjected to the blow-pipe it melts at the edges only: that of the last-mentioned locality resists even the heat produced by oxygen gas.

This claystone porphyry occupies a larger extent of country than any of the other varieties; indeed, the whole range which separates the Vale of Belvoir from Mayday Plains is composed of the Belvoir porphyry, while that of the river Forth stretches on the eastern side of Western Bluff, towards the Eldon range.

Var. 5. *Mimophyre.*

This variety of porphyry is composed of grains of felspar, quartz, and at times of mica, embedded in an argillaceous cement. It occurs in New South Wales, south of Lake Burraburra, and on the banks of Mitta-mitta River. It passes into psephite, an argil-

laceous and sandy paste, which cements grains or fragments of mica slate, argillite, and quartz, irregularly interspersed.

Remarks. — Every where in the vicinity of the five above varieties of porphyries, phenomena of disturbance and disorder are perceptible, impressing the mind with an idea of that high degree of force and violence, by which they had been injected between the stratified and unstratified rocks. The porphyry of the river Nive, twenty miles north of Marlborough, seems to have exerted a greater chemical power than any of the others, having transformed a sedimentary rock of non-fossiliferous greywacke into a mass of porphyritic structure, and burst through the fossiliferous greywacke, and covered it with breccia, composed of fragments of quartz rock and mica slate. The porphyry of the river Forth is scarcely less remarkable for the extensive changes which its intrusion effected, or rather, which immediately after that intrusion were worked out. These two kinds of porphyry, as well as the others here noticed, when propelled from beneath, so convulsed, tore, and shattered the superincumbent rocks, that the crust thus loosened and weakened, became as it were a beaten track prepared for the subsequent intrusion of greenstone, basalt, and trachyte. Indeed the porphyritic ejections have given such facilities for the intrusion of other igneous rocks, that it is almost always from the vicinity of their eruption that greenstone, basalt, and trachyte appear to have spread, and now cover immense tracts of the country.

GREENSTONE.

DIABASE (*Brongniart*). DIORITE (*Haüy*).

The varieties of this kind of rock, belonging to the second epoch, are uniformly composed of felspar and

hornblende in the state of grains or of small crystals, in proportions somewhat different, but in which the hornblende constantly predominates. They vary also in their structure, which is either slaty, prismatic, or amorphous; as, however, that structure has been the result of peculiar agencies, acting evidently at very different geological epochs, their description and examination is given here separately.

Var. 1. *Slaty Greenstone, Diabase schistoide.*

Its invariable colour in the recent fracture, is between a leek and pistachio green; that of the exterior of the rock is reddish brown. The internal surface has a waxy lustre; the imbedded crystals of hornblende are generally brilliant.

Its structure is schistose, but the layers are never parallel; and are running from a thickness of two or three inches to a wedge-like termination. For the most part, these seams present a lenticular form resembling convex lenses closely fitting, and thus beautifully illustrating the successive overflowings of the incandescent matter. It does not adhere to the tongue, and exhales an argillaceous odour. The streak varies; the powder obtained by trituration is of a brownish yellow colour. The structure is compact and hard; the blow of the hammer on the mass merely detaches layers which exhibit surfaces of their own. The shape of the fragments is commonly tabular.

Localities. — It is found at Booral on the Upper Hunter in Argyleshire, and about Lake George. Its greatest extent occurs in the locality of the Upper Hunter, on the Liverpool Range, of which it forms the culminant point.

In Van Diemen's Land, it is found in every part of

the island. The localities which supply the most important facts bearing upon its geological relation are between Launceston and Mount Direction; Mount Direction and George Town; George Town and Stony Head; Cape Portland, St. Patrick's Head; between the Break-o'-Day River and the Tyne; Ben Lomond, Ben Nevis, Port Sorrel, Dry's Bluff, Lake Arthur, Lake Sorrel, the Great Lake, Lake St. Clair, Western Bluff, Mount Cradle; the source of the Nive and Mount Cameron West.

Remarks. — This variety of greenstone occurs at various heights above the sea and the shore, capping some of the most prominent elevations of the interior of the island. The greatest height which this greenstone attains is 5200 feet. It is invariably and intimately associated with porphyries, argillaceous schist, mica slate, sienite, granite, silicious slate, and limestone; when it is isolated from the prismatic or amorphous greenstone, its seams are horizontal. When, however, these varieties are in contact with it, the seams are vertical, broken, and distorted.

The examination of the great area which this schistose greenstone covers in Van Diemen's Land, leads to the discovery of sources from which it overflowed the island. The principal sites appear to have existed in the vicinity of Cape Portland; between Mount Barrow and Mount Arthur; on the north side of Ben Lomond, on Mount St. Patrick, at Port Sorrel, on Mount Cradle, Mount Cameron West; and at the source of the Nive.

In all these places, the schistose greenstone is associated with porphyries. This association of the two rocks strongly inclines me to believe that the slaty greenstone was erupted or propelled along the pre-existing side or slope of the consolidated porphyry.

Var. 2. *Prismatic Greenstone.*

Its colour in the recent fracture is blackish green; on the surface, yellowish brown. The lustre of the paste is waxy; that of the hornblende which it contains vitreous; it does not adhere to the tongue, and exhales an argillaceous odour; its streak is dissimilar and dull; its colour a brownish grey; when struck with the hammer, it gives a metallic sound: it is compact, hard, its fracture is somewhat conchoidal. The structure is prismatic, the prisms having three, four, five, six, or seven sides. Their diameter varies from three to eight feet; the length of two or three columns, which are still entire, exceeds 100 feet. The clustered columns are sometimes very closely united; sometimes they are only in close contact, and are separated by the fall of the masses. Some of the columns have but a slight influence upon the magnetic needle; and in these the axes range east and west. The columns lying parallel with the meridian, or nearly so, disclose a strong polarity; a phenomenon worth noting, as the property seems to be more dependent on the bearings of the axes of these columns than on their constituents. The discovery of this polarity was consequent upon the anomalous results which the observations of the magnetic intensity furnished me by the prismatic greenstone on Ben Lomond.

Var. 3. *Amorphous Greenstone.*

Its colour is like that of the preceding varieties, the fracture displaying sometimes a blackish green, sometimes a leek green; the exterior is invariably a yellowish brown.

Its paste has a waxy lustre. Its structure is amorphous; the fracture is somewhat splintery and

uneven; the shape of the fragments irregular. It has a dull sound when struck with the hammer.

Localities. — In New South Wales, this rock is found west of Port Stephen; also in the Liverpool and Honey-suckle Range, at Modbury and in Argyleshire. In Van Diemen's Land, it is distributed widely over the island; the principal localites are between Launceston, Mount Direction, and George Town, at Cape Portland, on Ben Lomond, at the junction of the North Esk with Ben Lomond Creek, between Quamby's and Port Sorrel, at Dry's Bluff, Miller's Bluff, Scrubby Den, Lake Arthur; between Lake Arthur and the Great Lake, at Lake St. Clair, on Eldon Range, Mount Cradle, Barn Bluff, Mount Roland, Mount Wellington, Tasman's Peninsula, Research Bay, Adamson's Peak, Bruin, Green Island (Bass's Straits), and Woolnorth, Cape Grimm, and Mount Cameron, West.

Basalt, Lava, and Trachyte.

From my own observations made among the volcanos of Europe, Mexico, and South America, and more particularly in the tremendous volcanic laboratory of Kirauea in the Sandwich Islands, I am inclined to believe that there will be found insuperable difficulties in the way of a classification of volcanic products.

In many instances, the existing subdivision of volcanic rocks into varieties is but imaginary — the distinctions referring rather to individual specimens than to the mass from which they were taken. Thus the three varieties into which basalt has been subdivided, and each of which is characterised by the preponderance either of labradorite, of orthoze, or of albite, have been found by the writer in one current of basalt (at Kirauea), within an area of four cubic

feet; some splinters of these being soluble in hydrochloric acid, while others were not.

Again, the four varieties of lava, distinguished by Dolomieu and others into granitoïte, porphyritic, micaceous, and hornblende trachyte, with still other varieties, is inadmissible from the fact that these varieties at times constitute a part of the continuous mass of rock, with such gradual transition, that it is impossible to assign the boundary where the one variety begins and the other terminates.

In illustration of this subject, I shall give here a brief description of the volcano of Kirauea, extracted from my manuscript notes.

"The volcano of Kirauea lies on the north-western side of Mouna Loa, about twenty miles from the summit of that mountain, and about forty from the Bay of Hilo: its latitude, determined on the spot, is 19° 27′. Its present size surpasses that of every other known volcano, yet it now hardly displays more than a third of its pristine grandeur. Like some of the old Egyptian cities, Kirauea has no other chronicles of the past than a part of its ancient walls still standing, and a part either in ruins, or buried at some period beyond the memory of man, under the ashes of successive eruptions, though still to be recognised and traced by means of the masses which stand at intervals as land-marks.

"When, pencil in hand, we take the circuit of these land-marks,—collect, as it were, the scattered materials, fill up the breaches, and thus reconstruct the former orifice of the crater,—we are thrilled with awe at the contemplation.

"Fearful and astonishing must have been the action of this volcano in the days of its former greatness,—when it belched its fires from a mouth twenty-four miles in circumference, and overwhelmed the country with its devouring floods. But as all power bears

within itself the seeds of its own destruction, so Kirauea, irresistible on every side, has ended its career by breaking down the bounds which contained it. The south-south-western walls, of which the exterior declivity is very steep, gave way the first; but those to the north and N. N. E., supported outside by the congealed volcanic masses which had previously burst their bounds, and flowed in confusion to a distance of forty miles, have stood firm; and, like precious monuments of history, form an interesting subject for the traveller's investigation.

"The highest point of these ruins was determined by repeated observation to be 5054 feet above the level of the sea. They resemble the outer edge of a cup, to which a portion of the overflowing matter still adheres; and show that the crater, just before being emptied, was brim-full of molten lava. This vast mass of igneous matter must, however, have been the result of long accumulation: the ancient walls to which I refer, show, by layers of carbonaceous and earthy matter interposed between those of volcanic origin, that they were respectively produced at distant intervals, during which there must have been a variation in the intensity of the heat, and in the concomitant circumstances. Frequently, a layer of blocks of lava, compact, fine grained, and united, follows one of volcanic ashes and earthy substances, similar to *tufa*, or rather to *peperino;* which, in its turn, had succeeded to one of porous lava. One layer is found to affect the magnet, another not; in some cases, the porous cavities contain crystals of laminar or ligniform talc; in others, augite, olivine, and shorl are found throughout the whole length and thickness of the bed. It would even appear, judging from a specimen which I discovered in a cleft of the ancient crater, that the same mass must have been ejected, and again undergone the action of other still more

powerful fires, by which its surface has been altered, so that the interior of the mass exhibits argillaceous substances, petro-silex, and crystals of hornblende; while the exterior, which formed part of the wall of the crater, has been vitrified and cracked, displaying in its crevices sulphur and muriate of ammonia.

"The interior and lower part of the emptied basin, as it now appears, offers interesting matter for investigation. Its vast platforms, often arrayed in terraces levelled by deposits of cinders and volcanic dust, solid in appearance though actually friable, are intersected by clefts, emitting hot clouds of watery vapour, which escape with considerable force, and with a sharp whistling noise like that of the valves of a steam engine. The character of these clefts appears to be uniform. The temperature of the vapour is variable: one cleft will give 156° at the depth of a foot from the opening, while another, a few paces off, will not give more than 140°.

"Even here, on these arid heights, burnt and dried up, desolate to the eye and depressing to the spirits, Nature, as if with a benevolent regard to those who come to behold her wonders, has caused a Decandria to spring up around one of these clefts to the height of three feet, so as to intercept the escaping vapours, and to help to condense them; the precious liquid, thus protected from evaporation, was found to be delicious water, offering, in a waste of thirty miles in extent, and destitute of moisture, a basin, ever full, ever fresh, ever ready to moisten the parched lips of the wanderer.

"At two hundred paces from the welcome reservoir is the sunken furnace of Kirauea, reduced from its former grandeur to eight miles of circumference, and presenting one of the sublimest scenes of nature, the interest inspired by which can only, perhaps, be rivalled by the awe which they impress.

" It is no small effort to recall the attention from the vague contemplation of that scene to the calm investigation of facts and phenomena before us.

" The point at which I computed the height above the level of the sea is on the N. N. E. of the crater: its height is 4109 feet, which is at least 950 feet below the brim of the ancient crater: and within two paces of this spot is the edge of the precipice, which falls perpendicularly 600 feet lower to the boiling surface of igneous matter.

" The descent to this level is often precipitous, and winds among a thousand openings which vomit forth hot vapours from an area thickly strewed with tabular masses of smoking lava. Like the ice in a blocked-up channel, these tabular masses remain either standing on end, or heaped in horizontal or half-raised beds, and gaping with fissures over fearful cavities, resounding with noises similar to those of a roaring stormy sea.

" Six of these cavities were in violent agitation while I was exploring the crater: the height of the banks which bounded them varied; four were not more than three or four feet high; the fifth, forty feet; the sixth, 150. The extent of their surface differed no less; the first five hardly contained 12,000 square feet each, while the sixth contained nearly a million. The surface of the fiery matter in all the six reservoirs kept at the same height,—rose, sank, and was agitated simultaneously; which seems to show that it belonged to one mass of liquid lava, filling the whole area of the interior of the crater, and that the cavities, or reservoirs, as I have called them, are mere openings, and the heaps of broken lava, which block part of the crater, a mere temporary covering, or bridges, as it were, over the formidable mass below.

" No pen or pencil could adequately describe the

stupendous grandeur of that ceaseless impetuosity and fury of the incandescent matter which is produced in these reservoirs by the violence and the intensity of heat; or of those fierce and glowing waves which, continuing to beat and splash against the walls of the reservoirs, produce a floating froth spun out by currents of air, in a form of capillary glass, similar to that of a floating gossamer.*

"The examination of these reservoirs is beset with danger: besides the suffocating fumes of sulphuric acid gas, the inhalation of which may prove fatal, there is a risk of falling into the fiery matter, which is every where below the superficial crust. Seldom does it confine itself to the reservoirs; often appearing unexpectedly through the cracks of the black and rugged lava over which the path lies, assuming the same outward appearance by rapid congelation, and moving almost imperceptibly in slow convolutions, twisted like a thick fluid when compressed by a porous covering. The danger is much increased by the character of the lava which this volcano produces. Information received from Sir George Mackenzie, the well-known explorer of Hecla, leads me to believe that this lava of Kirauea is a species of

* Even in the breasts of the natives the magical influence of this spot has not been unfelt; they approach it with a sacred awe, and offer their religious adoration. And this is natural. In the contemplation of the disasters which the eruptions of the lava have spread over the plains, and of the calamities which have consequently overtaken the inhabitants, man, in his primitive state, can only see his littleness, his nothingness,—he can only feel the presence of an invincible and angry power, whom he must appease and render propitious. The divinity called *Pelé*, supposed to reign as the Neptune of these fiery floods, receives their adoration, and has her priestesses and her sacrifices; nor can any ceremony of antiquity have been more striking than that of the Sandwich Islanders in their sacrifice of men and swine to the burning gulph. To the largest of the six reservoirs, called *Hau-mau-mau*, by the natives, the terrified people make their way with prayers and offerings: into its gulf also they consign the bones of high priests, distinguished chiefs, and of those who have deserved well of their country.

that kind known under the name of "cavernous," which by the intensity of its heat, and the abundance of its elastic gases, produces here, as in Iceland, tumefactions, varying from the thickness and delicacy of a soap-bubble to the size of caverns twenty or thirty feet wide. These caverns, which extend in every direction, form beneath the surface of the island subterranean channels, through which the overflowing lava makes its way; and are often covered by a hollow arch, which yields at once to the tread; so that I had frequently the misfortune of falling into them, in spite of all my precautions. Their interior furnishes for examination the most interesting incrustations of sublimed minerals, with crystalline forms, the perfection of which can hardly be appreciated without a microscope, and so delicate as scarcely to bear a breath.*

"On the western flank of the crater above described, the appearances render it probable that the former surface of the incandescent matter was 300 feet higher up than it is at present; and that the opening of the crater of Mouna Roa, which is now 8000 feet above, diverted the course of the intense subterranean heat from the crater of Kirauea, or at least lowered its intensity. A probability further exists, that the incandescent matter of the interior of the crater became refrigerated and solidified in the mighty cauldron; and that after a lapse of time the base on which it stood gave way, under the renewed agency of subterranean heat, when the mass cracked and slipped. It seems also that a large mass of the solidified lava must have fallen again into the abyss, to be there re-

* On the southern plane of the crater are deposited mounds of sulphur, more extensive than those of Solfaterra, in which the following mineral substances are found crystallised:— two varieties of the sulphuret of arsenic; the petro-alumine of tolfa and sulphate of alumine; and the ten secondary forms of the primitive octahedron of sulphur.

molten; while a part still remained lodged against the sides of the cauldron, and is now seen as a rock 200 feet in height, exhibiting basalt, trachyte, and lava of several varieties. *Between the scoriaceous lava, approaching to slag, which is uppermost, and the close-grained basalt, which forms the lowest portion of the rock, the transition is so gradual, that it is impossible to assign the spot where basalt ceases and trachyte or lava begins.*"

The enlightened Von Buch has remarked*, and Dufresnoy and Elie de Beaumont have confirmed the observation, that the word *lava* is an expression which relates only to the form. The facts collected in the crater of Kirauea would lead one to suppose that the words basalt, trachyte and lava, serve only to distinguish the upper from the lower part of a molten matter. It is probable also that the distinction of basalt into *columnar* and *amorphous* refers only to their relative form, and that both rocks belong to the same basaltic current, and most likely resulted from the angle of inclination of the plane or surface which that current has overflowed.

Thus, on the road from the heads of Cowrang Creek (New South Wales) to Lake Omeo, there is a basaltic, horizontal dyke, running from south to north. At the left bank of the river Mitta-Mitta, which bank is about 100 feet high, that dyke is seen precipitating itself downwards into the river, and thus appears like a frozen or petrified cascade. The dyke *throughout its horizontal course presents an amorphous form; in its downward fall it assumes insensibly the form of columnar concretions, till it reaches the bottom of Mitta-Mitta, where it exhibits three, four, six, and seven-sided regular prisms, not exceeding three inches in diameter.*

The localities at which basalt and its varieties occur

* In describing the tract between Lake Orta and Lake Lugano.

in the two colonies, are the following:—Port Stephens, the Lower and Upper Hunter, Mount Tomah, Mount Hay, Mount King George, between Bathurst and Boree; Frederic Valley, Mount Canoblas, between Molong and Wellington Valley; on the Razor Back range, at Illawara; on the crest of the Mitagong range, at Lake George, Shoalhaven, Dutzton at Lake Omeo, and the river Mitta-Mitta, (*New South Wales*). Kent's Group, Green and Swan islands, (*Bass Straits.*) Between George Town and Stony Head; at the Gardens; Ben Lomond; Vale of Belvoir; between Gadd's Hill and Middlesex Plains; Hampshire Hills; the Duck river; the Welcome river; Cape Grimm; Mount Cameron West; at Arthur's Lake; and the source of the river Nive; at Lake St. Clair; on Mount Cradle; between Brighton and Bridgewater; Mount Wellington; Hobart Town; Research Bay; Esperance Harbour; Bruni's Island, and Tasman's Peninsula; (*Van Diemen's Land*).

Breccias.

These rocks present two varieties: the first consisting of aggregated fragments, which preserve the character of the rocks from which they are derived; while in the second this character is entirely effaced, both the paste and the fragments passing through different stages of change, and assume at last the appearance of uniform pitchstone or jasperoid rocks.

First Variety.—An aggregate of unaltered mica slate, argillite, quartz rock, and felspar. The predominant colour is usually a shade of ash-grey. The cement seems to be composed of the same materials as the fragments, but consists of grains so minute that it resembles a homogeneous paste.

The *Second Variety* of breccia presents the appearance of a semi-fused compound of variegated colour. Its lustre is resinous; it is translucent at the edges;

compact, and extremely hard; having sometimes a splintery, sometimes a conchoidal fracture. This variety is frequently amygdaloidal, and though different in external character from the first variety, leaves no doubt that both were originally identical. They generally occur together, amongst rocks of the first or second epoch, in large masses. In New South Wales, the second variety is observed only at St. Patrick's Plains, Wellington Valley, and Lake George. In Van Diemen's Land, the two varieties crest the ridge which connects Ben Lomond and Ben Nevis, an elevation of 3200 feet; the first variety, incumbent on mica slate, quartz rock, argillite, and granite, is superposed by the second, which is connected with hornblende rocks. It occurs also at Waterhouse Point, between the river Tamar and Mersey, at Table Cape, Hampshire Hills; in the Vale of Belvoir; Dry's Bluff, Lake Mills river; in all the above localities the breccias are associated with eurite, quartz rock, and clay slates.

Limestones.

Var. 1. *Foliated granular Limestone.* (Jameson.)
Chaux carbonaté saccaroide. (Brongniart.)

That variety presents itself in different shades, from black to snow-white: these shades are sometimes uniform in the mass; sometimes they occur in spots, veins, or clouds of different hues. Its structure is both foliated and granular: in some cases the grains are only discernible by means of a lens. It is generally a pure carbonate of lime, and very seldom with admixture of foreign ingredients. In two localities only, it contains crystals of hornblende and shorl.

Localities.—In New South Wales granular limestone is extensively developed. It is found on the

Upper and Lower Hunter, between Wellington and Mount Canoblas; between Cullen-bullen and Wolerowang; on the Wollondilly; in Westmoreland; on the Shoalhaven river, between Amprier and Barber's Creek; at Lake George, Yass Plains, and Murrumbidgee; on the Murray and on the river Thompson (Gipps Land). In Van Diemen's Land, it is found south-east of Mount Horror; on Asbestos Hills; at Circular Pond marshes, Belvoir Vale, House Top Tier, and the sources of the river Nive.

Some parts of New South Wales can boast of most beautiful marbles, very valuable for statuary and other ornamental purposes; as on the Wollondilly, where the rock is as closely grained and as white as the Carrara marble; and at Amprier, Shoalhaven, where the stone is a jet black traversed by veins of a white calcareous spar: between Wellington Valley and Boree there are also innumerable varieties of finely variegated marbles, in which caves are found of the greatest interest to geology. The most remarkable in New South Wales are those in the neighbourhood of Wellington, Boree, Shoalhaven, and Murrumbidgee. In Van Diemen's Land such caves are limited to the river Mersey, and to Circular Pond marshes. The latter locality deserves to be noticed, as the funnel-like shape of its surface, combined with the form of the caves, would lead to the belief that the limestone tract has undergone partial subsidencies.

Var. 2. *Compact Limestone.* (Kirwan.)
Common compact Limestone. (Jameson.)

Is in colour as variable as the preceding variety: in the greater number of localities the ash-grey tint predominates. It is at times massive, at times has a somewhat stratified appearance. It is not a pure car-

bonate, but contains many foreign ingredients, and passes into the earthy variety of limestone. It resembles very closely the preceding variety, and in most cases, like the limestone of Boree, is intimately associated with it. It is this variety that contains the marine remains which have been already enumerated.

Localities.—In New South Wales this limestone is found at St. Patrick's Plains, Illawara, Shoalhaven, Yass Plains, Boree, and the river Thompson (Gipps Land).

In Van Diemen's Land the limestone belonging to this formation occupies both sides of the dividing range; and although much divided by the igneous rocks, it may, in all the localities, be still identified by the organic remains. The track of the western belt is indicated in four conspicuous localities, First, the Break-o'-day Valley, where the limestone lies at an altitude of 700 feet, incumbent on greywacke, and associated with greenstone. It is mostly massive, and contains numerous organic remains, and fragments of older rocks. The second locality, between Mona Vale and Ross, is at the height of 600 feet above the sea, where the limestone is associated with trachyte, and is fossiliferous; the third is north-east of Campbeltown; the fourth is on the west arm of the Tamar, where it is associated with greywacke and granular limestone. The eastern belt has also several localities where this limestone rock appears. First, the sources of the river Nive, where it is connected with granular limestone, and an arenaceous fossiliferous rock; second, the Eastern Marshes, where it appears in great fossiliferous masses, much fractured and dislocated by the intervening greenstones; third, the foot of Table Mount, where it is equally fossiliferous; fourth, Mount Dromedary; fifth, Mount Wellington. In the three last-mentioned localities the limestone contains many most interesting

organic remains, which will be fully described in the Zoological Section of this work.

SEDIMENTARY ROCKS.

Argillaceous or Clay Slates.

The clay slates which appear in the second epoch greatly differ, in a mineralogical point of view, from from those described under the first. They seldom possess a foliated structure; on the contrary, their stratification is often indistinct, and the fracture either slaty, conchoidal, or splintery. The numberless varieties of the rock, many of which differ only in colour, may be arranged under three species.

Var. 1. *Common Clay Slate* (shiste argileux).

Its colours are various: sea-green, yellow, bluish black, pearly grey, and reddish. It is dull, adheres to the tongue, and yields a strong argillaceous odour. Its streak is paler than the surface, structure earthy; it is soft; fracture, slaty.

Localities.—In New South Wales it is found on Mount Victoria; also between that locality and Mount King George; on the Middle and Northern Hunter, Campbell and Abernethy rivers; to the south of Arthursleigh, north of Modbury, east of Gidley; at Lake Omeo, and to the north and south of Gipps Land.

In Van Diemen's Land it appears between the mouths of the Great and Little Forrester rivers; at Emu Bay; Rocky Cape and Montague rivers.

Their inclination is irregular; their thickness does not exceed 25 feet.

Var. 2. *Claystone.* (Jameson.)

This assumes a variety of colours; chiefly yellowish white, lead grey, sky blue, and brick red. The stone

is dull, massive, semi-hard, slightly adherent to the the tongue; it yields an argillaceous odour; the streak is similar; fracture is splintery, uneven, or, in some cases, conchoidal.

Localities.—In New South Wales it is found to the west of Arthursleigh; in the vale of the Clwyd; at Coyal; to the north-east of the Hunter; and at Lake George.

In Van Diemen's Land it occurs at St. Patrick's Head; at Lake Tomb, Ben Lomond; between Tamar and Rubicon rivers; on the river Forth; at the Western Bluff and the sources of the river Nive.

Var. 3. *Aluminous Slate.*

Colour, greyish black, sometimes verging on iron black; external and longitudinal fracture shining at times with a metallic lustre; structure slaty, with layers straight or curved. It is unctuous and brittle; fracture somewhat laminated.

Localities.—In New South Wales it is found at Walerowang, also at Balangola and Arthursleigh. In Van Diemen's Land it appears at Emu Bay, and at Cape Grimm.

Greywacke. (*Jameson.*)

A somewhat arenaceous compound, of a yellowish, reddish, or bluish colour; composed of quartz, with occasionally mica and glassy felspar, cemented by an indurated argillaceous or felspathic paste. Its structure varies from a coarse sandstone to a finely comminuted and compact mass, seldom possessing a distinct cleavage, or exhibiting a slaty appearance. Its external and internal aspects differ very little; generally it adheres to the tongue, and exhales an argillaceous odour.

Localities.—In New South Wales it is found at Port Stephen West; at Booral; on the Upper and Lower Hunter; between Bathurst and Frederick Valley; at Lake George, and on the Shoalhaven. In all these localities its geological position is between the uppermost mineral masses of the first epoch and the lowermost sedimentary deposits of the second.

In Van Diemen's Land, greywacke extends over larger tracts of country. It is found on the river Bobiala; at Cape Portland; Mount Cameron, where it is associated with eurite and clay slates; at St. Patrick's Head, where it lies between siliceous slate and limestone; at the confluence of the Tyne and South Esk, where it is associated with siliceous slate and clay slate; on the south side of Ben Lomond, and the west arm of the Tamar, connected with the granular limestone of those localities; at the eastern foot of the Western Tier, between breccia and clay slate; at the source of the Nive, along with clay slates and limestone; and between Emu Bay and Cape Grimm, constantly associated with siliceous slates, granular quartz rock, and clay slates.

General Remarks upon the Second Epoch.

The geological and mineralogical discrepancies which will be observed to exist among the sedimentary rocks above described, great as they appear, are nevertheless such as might have been inferred from an examination of the form of the first upheaved land, which served as a ground-work for the further enlargement of the geological edifice.

The form of this land has given rise to eddies and currents, which, judging by what we see in the present day in Bass's Straits, may have either powerfully assisted the general agencies which effect the abrasion,

comminution, and dissemination of materials, and the reconstruction of rocks, or may have equally tended to counteract the effect of such. Thus the difference between two localities, arising either from a difference in the number or mineral character of the members of the series, or the abundance or paucity of the characteristic fossils, becomes only an evidence that one locality has been more favourably situated for the accumulation of certain geological records than another.

The organic remains which have distinguished this epoch had been found, by Mr. Lonsdale and Mr. Morris, to possess great analogies to those of the Palæozoic series. How far this analogy is borne out by the specific character of the Australian fossils, will be fully discussed in the able paper which these two eminent naturalists have furnished to the Zoological Section of this volume.

As regards the crystalline eruptive rocks, which have been noticed in more than one locality, partly as being merely associated with stratified rocks, partly as immediate causes of their dislocation, convulsed and confused groups as they present, their eruptions may nevertheless be referred to certain distinct and distant periods, and may be classed chronologically by means of the geognostic evidences furnished by the sedimentary rocks with which they are in contact. Thus the eruption of greenstone in the Liverpool, Coyal, and Honeysuckle ranges, those of the basalt along the spur which is crowned by Mount King George, and the eruption of both these rocks in the Westmoreland country, may be assigned to the period intermediate between the formation of the siliceous and aluminous detrital masses, and that of the aluminous and calcareous fossiliferous and non-fossiliferous sedimentary deposits. In all these three cases the siliceous and aluminous rocks, the lowermost of

the series, were in position highly inclined, while those which follow are horizontal, or nearly so.

To this period belong also the most striking eruptions of greenstone in Van Diemen's Land, namely, those by which the completion of the actual dividing range from St. Patrick's Head down to Table Mount was effected, and those which formed the elevations of Ben Lomond, Ben Nevis, Mount Horror, Mount Barrow, Mount Direction, and Mount George. To this same period may likewise be referred the greenstone and basaltic spur running between Western Bluff and Asbestos Hills, and that which shoots out from St. Valentine's Peak to Mount Cameron West, with all those lateral branches that contorted the clay-slate system between Emu Bay and Cape Grimm. In all these localities of Van Diemen's Land, as in the preceding ones of New South Wales, the lowermost arenaceous and aluminous detrital masses are the only ones which are disturbed, and which have a highly inclined dip.

Again, the date of the eruption of porphyries and greenstone at Port Stephen must have been at the period at which the deposition of the slaty argillo-calcareous fossiliferous rock terminates, and before that at which the formation of the coarse sandstone with *conulariæ* and *terabratulæ* began. Coeval with this porphyritic eruption may be classed the eruption of porphyries at Barber's Creek, and that of porphyries, greenstones, and basalts at Mount Canoblas, Boree, Molong, Narrigell, Wellington, and the west of Yass Plains. In Van Diemen's Land, contemporaneously with these eruptions, took place that which produced the spur that shoots off from Table Mount, and is crowned by Mount Dromedary. In all these localities we see every member of the series, including the slaty fossiliferous, greatly disturbed.

Next after this period we can trace the record of

disturbances which dislocated another member of the series, namely the arenaceous fossiliferous rock, which rests upon the slaty limestone. Effects of this event may be seen, in New South Wales, at St. Patrick's Plains and on Harper's Hill.

The latest eruption seems to have been that which intervened between the above-mentioned epoch and the following one, characterised by the deposition of coal. Its traces are visible on Mount Tomah in New South Wales, and on Mount Wellington and Dry's Bluff in Van Diemen's Land. They show that all the members composing the series belonging to the second epoch were affected by similar disturbances. In the case of the two latter localities, the eruption was of very limited extent; so that, while on the N. W. of Mount Wellington a part of the series is not disturbed, on the S. E. three of its newest members are dislocated, and the uppermost is severed, and elevated 2500 feet above the others. At Dry's Bluff, where the whole series is disturbed, the dislocated part is separated from the rest, to a superior height of 3900 feet. (Pl. V. fig. 2.)

THIRD EPOCH.

An inspection of the annexed map, in which the crystalline and sedimentary rocks of the preceding epoch are represented by the yellow colouring, will show, at the first glance, that the manner in which the mineral masses of that epoch were added to the original ground-work gave rise to the formation of basin-shaped localities, singularly adapted to the developement of the phenomena into which we are now about to inquire.

Three of these localties deserve particular attention. The first, in New South Wales, presents but the

westerly marginal portion of a once great basin, which portion is now watered by the tributaries of the rivers Hunter and Hawkesbury, and which we shall call, for convenience sake, the Newcastle Basin.

The second, the South Esk Basin, in Van Diemen's Land, is confined partly to the vales of Avoca and Break-o'-day, partly to the country watered by the Macquarie and Blackman's rivers.

The last, the Jerusalem Basin, also in Van Diemen's Land, includes the Derwent valley as far north as Hamilton and Bothwell, together with the Richmond and Coal River valleys, and presents, like the basin of New South Wales, no more than its westerly and northerly sides unaltered; its extent to the south and east being only indicated by the geological features observable on Maria Island and Tasman's Peninsula.

The walls of the three basins appear to have a contemporaneous origin; but the deposits which they include seem to differ in point of date, and lead to the belief that the geological conditions under which they were produced were modified, in each locality, not only with respect to time, but as regards the nature of coal and other strata which they contain.

We shall now briefly pass in review the geological evidence observable in each of these localities.

NEWCASTLE BASIN.

The point from which the most comprehensive view of this basin may be obtained is Port Stephen.

There lies between that locality and the river Hunter, a small ridge, dividing the drainage of the river William from that of the Karua. This ridge is composed of breccia, gritstone, greenstone, and basalt. On its southern flank lies a coarse sandstone, containing *conulariæ*, *spiriferæ*, and *productæ*, subjacent

to a conglomerate: these rocks constitute the uppermost members of the series of strata described in the preceding epoch, and both extending to the left bank of the Hunter. About the site of Raymond Ferry, the two members are found, at the level of the river, dipping to the south.

On crossing the Hunter, and taking a southerly course, we come on a ridge ranging E. and W., and composed of masses of sandstone, differing from that of the left bank of the Hunter. It is fine grained, contains mica and *iron glance*, and is in some places variegated by zones of different colours, in others interspersed with very thin seams of coal. On the southern side of the ridge, at Lake Macquarie, coal crops out from beneath this sandstone.

Should we now take an easterly course from the above locality until we reach the sea shore, and then proceed northerly, we should come in sight of a cliff, 200 feet high, and about 2000 feet long, displaying several seams of coal, arranged in parallel beds, of which the continuity is interrupted by faults, beautifully illustrating the dislocation of coal strata. (Pl. V. fig. 1.)

At the Island of Nobby, which stands between the cliff above mentioned and the opposite point of land forming the north head of Port Hunter, we find the coal strata dipping southward, and at the same angle of inclination at which we found the sandstone with *spiriferæ* and *conulariæ* dipping at Raymond Ferry.

On St. Patrick's Plains and the river Wolombi analogous relations between siliceous breccia, conglomorate, fossiliferous slaty rock, coal, and fine-grained sandstone are observable, confirming the inference that the ridge of siliceous breccia, greenstone, and basalt, between Port Stephen and the river Hunter, is

part of the north-eastern margin of Newcastle Basin; and that the coarse sandstone with *spiriferæ* and *conulariæ*, with incumbent conglomerate (Raymond Terrace), is the floor of its coal deposits.

The seams of coal in the cliff above referred to, are not there accessible, but they may be examined in any of the coal-pits which are sunk on the sloping side of the elevation. That which is nearest to the fall of the cliff, gives the following section, in the ascending order:—

	Feet.
A. Coal (the lowest of the deposit) - - -	3
B. Greenish sandstone - - - -	50
C. Coal - - - - - -	3
D. Greenish sandstone with blue veins - -	25
E. Coal - - - - - -	5
F. Clay rock (greyish), and shale (bluish), with impressions of *Sphenopteris lobifolia, Sphenopteris alata, Glossopteris Browniana, Phyllotheca australis* -	43
G. Coal - - - - - -	5
H. Cherts, gritstones, with angular fragments of flint intermixed with thin veins of coal - -	44
I. Coal - - - - - -	3
K. Conglomerate (the uppermost of the deposit) -	23
	204

Besides the impressions of *Phyllotheca* and *Glossopteris*, there was also discovered an impression of a fish, but too imperfect to allow of the determination of its character.

To the westward and southward of the cliff above described, the conglomerate K. of the coal deposit is seen dipping to the westward, under masses of variegated and fine-grained micaceous sandstone, which, in that direction is found gradually to rise to the height of 3000 feet; attaining, in some places, a thickness of 1400 feet, as may be observed in the valley of the Grose.

The average strike of this sandstone on the north-eastern margin of the basin is S. E.; on the westerly

margin it is E.; at the southern side, which is about Illawara, its strike is N. W.; the strata thus seeming to converge towards the county of Cumberland, the probable centre of the basin.

The variegated sandstone about Newcastle lies in a position conformable to the coal deposits; as is again the case with the latter, in relation to the Raymond Terrace conglomerates and sandstones, containing *spiriferæ*, *productæ*, and *conulariæ*.

SOUTH ESK BASIN (VAN DIEMEN'S LAND).

This basin is very limited in extent, and displays a margin much indented. Its section, taken from east to west, that is from St. Patrick's Head to Ben Lomond, presents, first, a greenstone axis, against which are abutted greywacke, clay slates, and grits, in vertical positions; next, a limestone rock, with spiriferæ, and a conglomerate, in horizontal beds; then, on the southern side of Ben Lomond, a seam of coal, over which lies a conglomerate and a variegated sandstone. The three last members of the deposits are dislocated, and uplifted 2100 feet above the actual level of the coal-beds. In this basin the variegated sandstone occupies the uppermost position amongst the sedimentary rocks.

JERUSALEM BASIN.

In going from the Eastern Marshes to Jerusalem, we observe, first, a limestone rock, containing *productæ* and *spiriferæ;* then, a conglomerate; and then, an outcrop of coal seams, — all dipping south. In Jerusalem coal-pits, the artificial section presents the following sequence of coal-beds, taken in the ascending order: —

	Feet.
A. Coal (the lowermost) - - - -	2
B. Blackish clay, with impressions of *Pecopteris australis* and *Zeugophyllites* - - - -	6
C. Greyish clay - - - - -	11
D. Blackish clay, with the impressions of the clay B. -	3
E. Greyish clay - - - - - -	12
F. Coal - - - - - -	3
G. Blackish clay, with impressions similar to the clay B. and D. - - - - -	2
H. Grey clay - - - - -	2
I Clay slate - - - - -	1
K. Greenish sandstone - - - -	3
L. Sandstone, with impressions of *Pecopteris odontopteroides* - - - - -	13
	56

In the southern dip, which it assumes, the sandstone L. may be followed up to Richmond, where it is found, as at Jerusalem, on the top of the coal.

Beyond Richmond it may be further traced to the edge of the sea at Pitt's Water; and at the coal-pits of Port Arthur it is again found cropping out with coal. The coal deposit of those pits, taking all the beds together, has a total thickness of 150 feet; its two uppermost seams correspond with the two coal seams, A and F, noticed in the pits of Jerusalem, as do also the intervening shales in respect to their fossil plant impressions.

At the settlement of Port Arthur, farther south than the coal-pits of the same name, the sandstone only is to be seen, dipping, as it were, under masses of clays which compose the island of Point Puer, and which contain *Pachydomus globosus*.

The line which we have just reviewed, that is, that from Eastern Marshes, over Jerusalem, Richmond, to Point Puer, is dislocated in many places by greenstone; and the evidence it furnishes would therefore be of little value, had not the Jerusalem Basin presented additional evidence regarding the order of superposition.

These localities are,—the estate of Mr. Parsons, not far from Bothwell; Jericho; Nine Mile Marsh; London Inn, Spring Hill; Research Bay; South Port; and Maria Island. At the locality of London Inn, a section taken in a well sunk close to a police station, when I was engaged in exploring that part of the island, identify the sandstone of that locality with that of the Jerusalem coal-pit, as beneath it was the shale with the impression of *Pecopteris australis* and *Zeugophyllites* overlaying a seam of coal.

If we draw a line from London Inn to Hobart Town, it would correspond in direction with that drawn from the Eastern Marshes, through Jerusalem, Richmond, and Port Arthur, to Point Puer, and would cut through the following successions of rocks: a sandstone with impressions of *Pecopteris odontopteroides* superposed by masses of clay, lying on the side of Spring Hill, and containing *Pachydomus globosus.*

Both the sandstone and clay dip S. W. About Greenpond and Brighton these masses are succeeded by a different sandstone, which is fine, micaceous, and without impressions of *Pecopteris.* At Hobart Town it is overlayed by a yellow limestone rock, containing *Bulinus* and *Helix.*

The first line showed, then,—	*The second, conjointly with the section of the well at London Inn,—*
1. Coal.	1. Coal.
2. Shale, with impressions of *Pecopteris australis* and *Zeugophyllites.*	2. Shale, with impressions of *Pecopteris australis* and *Zeugophyllites.*
3. Sandstone, with impressions of *Pecopteris odontopteroides.*	3. Sandstone, with impressions of *Pecopteris odontopteroides.*
4. Masse of clays, with *Pachydomus globosus*	4. Masses of clays, with *Pachydomus globosus.*
	5. Variegated sandstone.
	6. Yellow limestone, with *Bulinus* and *Helix.*

The two above lines are greatly dislocated by greenstones and basalts, and do not offer a continuity of

the enumerated members: both need a re-examination, by which the fact of the clays with *Pachydomus* existing in the position which apparently they occupy would be confirmed; and thus the question regarding the relative age of this coal solved. Until then, we can only admit as possible that the Jerusalem coal deposit may be somewhat anterior in date to those of the South Esk and Newcastle basins.

With the deposits of the three above-described basins we may connect partial outcrops of coal observed in a small valley called the Reedy Valley (the Vale of Clywd), north of Mount York, and east of Mount Clarence, and which seemingly belong to the Newcastle basin; a probability, however, rather invalidated by the fact of the coals overlaying masses of pure bitumen,— a circumstance not discovered to exist elsewhere.

The outcrops of coal observed by the late surveyor-general Oxley, to the northward of Port Stephen, at the heads of the rivers Hastings and MacLeay; those, again, noticed by Cunningham, at Moreton Bay, together with the outcrops of coal at Western Port,—are most probably indications of the margins of basins similar to that of Newcastle.

In all these outcrops of coal, masses of variegated sandstone appear above the coal strata: and this fact, connected with others, obtained in the examination of the Newcastle, South Esk, and Jerusalem basins, and of other tracts of the country, leads to the conclusion *that the variegated sandstone about Sydney, with the variegated sandstone and yellow limestone, with* Bulinus *and* Helix, *of Hobart Town, and above which no other formation has yet been found, constitute the highest beds in geological series of the two colonies.*

MINERALOGICAL DESCRIPTION OF ROCKS BELONGING TO THE DESCRIBED EPOCH, INCLUDING AN ANALYSIS OF SOME LIGNITES FROM ALLUVIAL DEPOSITS IN VAN DIEMEN'S LAND.

In the subjoined mineralogical description of some varieties of coal belonging to New South Wales and Van Diemen's Land, the specific gravity spoken of, has been ascertained by myself, through the means of a Nicholson's hydrostatic balance, capable of indicating distinctly differences equal to $\frac{1}{40000}$th part of the weight in the balance. The chemical character of each species and variety I have ascertained by two different analyses: —

1st. By that of separating the organic substance under examination into its proximate constituents.

2nd. By that of resolving it into its ultimate elements.

In the first analytical process, one portion of known quantity of coal was deflagrated by a known quantity of nitre; another portion was distilled in a small glass retort, — and the vapours which distillation yielded were condensed, as also the gases collected over water, into a graduated receiver. Thus, the quantity of *charcoal*, *bitumen*, *earthy constituents*, *coke*, and *coal-tar* was ascertained; and a further determination was made of the amount of *carbonic acid*, *sulphuretted hydrogen*, and the two sorts of *carburetted hydrogen*, contained in the gas receiver, by treating the gaseous mixture alternately with caustic potassa, carbonate of lead freshly precipitated from the acetate, and finally, with chlorine gas, both in darkness and in light.

In the second process, the elegant apparatus of Gay-Lussac and Liebig was made use of, and the oxide of copper freshly prepared employed as the oxydising agent. The *carbon* was estimated from the amount of carbonic acid absorbed by the balls containing

caustic potassa, and the *hydrogen* from the amount of water absorbed, as shown by the increase in weight of the tube containing chloride of calcium. The *oxygen* was estimated from the loss of weight of the combustion tube, deducting the carbon and hydrogen, as also the *nitrogen*, which was previously ascertained.*

Slaty Coal.

Houille grasse. (*Brongniart.*)

Loc. —*Newcastle, N. S. W.*

Colour, black, with a slight tinge of grey; structure foliated; fracture even, the fragments of indeterminate form; it soils the fingers, and is soft and brittle; specific gravity, 1·31.

Chemical Character. — It burns easily, with a reddish flame; swells and agglutinates; its constituents are —

Charcoal - - - -	62·8
Bitumen - - - -	25·2
Earthy matter - - -	12·2

One pound yields 1 foot 1·806 cubic inches of

* I shall seize this opportunity of offering my sincere and public acknowledgments to William Pugh, M.D., of Launceston, Van Diemen's Land, who, during my stay in that island, has lent me the use of his laboratory, and in many instances his personal co-operation, in the analysis of the Australian minerals and soils. Not less sincere thanks are due to Mr. Richard Phillips, F.R.S., and Mr. Richard Phillips, Jun., with whose able assistance I was enabled, last year, to complete, in the Laboratory of the Economic Geology, the remainder of the analyses, the result of which will be detailed in the Agricultural Section of this volume.

illuminating unpurified gas. The gaseous mixture contains, in 100 volumes —

Sulphuretted hydrogen	10
Carbonic acid	10
Olefiant gas	17
Carburetted hydrogen	11
Other inflammable gas	52

Every one hundred parts in weight yield —

Coke	71·2
Coal-tar and ammoniacal liquor	15·6

Its ultimate elements, deducting the earthly matter, stand in the following proportion: —

Carbon	70·5
Hydrogen	20·4
Nitrogen	9·1

Slate Coal.

Loc. — *Western Port, N. S. W.*

Its colour is black, with a resinous and glistening lustre; structure somewhat slaty; fragments indeterminate angular; it is brittle; specific gravity, 1·38.

Chemical Character. — It burns with a bright flame; swells and agglutinates; its proximate constituents are —

Charcoal	54
Bitumen	35
Earthy matter	11

One pound is equal to two cubic feet of illuminating gas. The gaseous mixture contains, in each 100 volumes —

Sulphuretted hydrogen	11
Carbonic acid	10

Olefiant gas	20
Carburetted hydrogen	10
Other inflammable gas	49

Every 100 parts in weight yield —

Coke	65
Coal-tar	20

Its ultimate elements, deducting the earthy matter, will stand in the following proportion: —

Carbon	70·1
Hydrogen	16·2
Oxygen	3·0
Nitrogen	10·0

Geological Situation. — It occurs in beds of sandstone and indurated clay; clay slate and coal alternating with each other, with the exception of the roof and the floor of the coal being invariably a fine brick clay. No fossil plants had been as yet discovered in that coal.

Coarse Coal.

Houille grossière. (*Brongniart.*)

Loc. —*Port Arthur, Jerusalem Basin, V. D. L.*

Colour, steel grey, sometimes blackish; structure usually slaty; cross fracture coarse-grained; it is harder than the common slate coal, and heavier; specific gravity, 1·44.

Chemical Character. — It burns with difficulty, and slowly, unless kindled with wood, and emits little or no smoke; its flame is blue, and clear as that of anthracite, which, in its external character, it most resembles; it does not agglutinate, nor cake; its proximate constituents are —

Charcoal	86·0
Bitumen	3·5
Earthy matter	10·5

One pound yields 1½ cubic feet of illuminating gas, and some water strongly impregnated with hydro-sulphurets, but no coke or tar. The gaseous mixture contains, in 100 volumes —

Sulphuretted hydrogen	18
Carbonic acid	12
Olefiant gas	3
Carburetted hydrogen	5
Other inflammable gas	62

Its ultimate elements, deducting the earthy matter, stand in the following proportions: —

Carbon	80·0
Hydrogen	8·8
Oxygen	2·0
Nitrogen	9·2

Slaty Glance Coal. (*Jameson.*)

Anthracite. (*Brongniart.*)

Loc. —*Richmond, Jerusalem Basin, V. D. L.*

Colour, bluish steel grey; structure, foliated; fracture slaty, sometimes composed of brilliant laminæ, variously arranged; specific gravity, 1·75.

Chemical Character. — It burns with difficulty, yields little or no flame, and no bituminous odour: its proximate constituents are —

Charcoal	60·0
Earthy matter	33·5
Water	6·5

One pound gives 1032 cubic inches of very feebly

illuminating gas. No coke or tar were obtained in the process.

The gaseous mixture contains, in each 100 volumes —

Sulphuretted hydrogen	10
Carbonic acid	25
Other inflammable gas	65

Its ultimate elements, deducting the earthy matter, stand in the following proportion: —

Carbon	63·3
Hydrogen	25·2
Oxygen	2·5
Nitrogen	9·0

Bituminous Wood. (*Jameson.*)

Lignite Xyloide. (*Beudant.*)

Loc. — *South Esk Valley, V. D. L.*

Its colour is clove-brown; structure ligneous; cross fracture conchoidal; lustre shining and resinous; the fragments have the external appearance of compressed wood; specific gravity, 1·29.

Chemical Character. — It burns easily, with a flame, without swelling or caking, and emits during combustion a sharp, fetid, and nauseous odour: its proximate constituents are —

Charcoal	33·8
Ligneous and bituminous matter	51·0
Earthy matter	15·2

Applied to the production of gas, one pound gives 3686 cubic inches of very impure and faintly illuminating gas.

Every 100 parts of weight yield —

Pyroxylic acid - - -	30·0

Its ultimate elements, deducting the earthy matter, stand in the following proportion: —

Carbon - - - -	70·0
Hydrogen - - - -	5·4
Oxygen - - - -	14·6
Nitrogen - - - -	10·0

Geological Situation. — It occurs in alluvial land, in detached masses, which are sometimes compressed, forming beds, of which one part is carbonised, while the other remains in the state of wood. The valley of the tributaries of the Derwent, and that of the tributaries of the Tamar, abound in lignites of this description.

Slaty Glance Coal. (*Jameson.*)

Anthracite. (*Brongniart.*)

Loc. — *Recherche Bay, Jerusalem Basin, V. D. L.*

Colour, iron black; structure compact; fracture slaty, and the layers frangible; specific gravity, 1·46.

Chemical Character. — It burns with difficulty, yields little or no flame, and no bituminous odour: its proximate constituents are —

Charcoal - - - -	74·4
Earthy matter - - -	20·0
Water - - - - -	5·6

One pound gives 1100 cubic inches of very faintly illuminating gas: no tar or coke were detected in this coal.

The gaseous mixture contains, in each 100 volumes —

Sulphuretted hydrogen - -	8
Carbonic acid - - - -	20
Carburetted hydrogen - -	20
Other inflammable gas - -	52

Its ultimate elements, deducting the earthy matter, stand in the following proportion: —

Carbon - - - -	14·35
Oxygen - - - -	4·50
Nitrogen - - - -	600

Geological Situation. — It lies among clays, in beds of two feet thick, in which no impressions of plants are perceivable, nor is any sandstone visible; and the want of a natural section precludes a more accurate detail: the two shafts, sunk to the depth of 150 feet below the crop of the seam, discover nothing but horneblende, dolerite, and steatitic rocks, with sulphate and carbonate of lime.

Slate Coal. (*Jameson.*)

Houille grasse. (*Brongniart.*)

Loc. — *Jerusalem V. D. L.*

Colour, black; structure slaty, the layers dividing into brittle fragments of indeterminate angular shape; fracture even, lustre resinous and shining; specific gravity, 1·33.

Chemical Character. — It burns with a splendid white and reddish flame, and is easily lighted; emits black smoke, and swells and agglutinates: its proximate elements are —

The Upper Seam.		*The Lower Seam, at 32 ft. deeper.*	
Charcoal - -	64·0	Charcoal - -	25·0
Bitumen - -	32·0	Bitumen - -	10·0
Earthy matter - -	4·0	Carbonate of lime -	57·0
		Silica - - -	8·0

The coal of *the upper seam* gives two cubic feet of illuminating gas for every pound consumed.

It moreover gives, in every 100 parts of weight —

Coal-tar and ammoniacal liquor	12·6
Coke - - - - - -	77·0

The gaseous mixture contains, in 100 volumes —

Sulphuretted hydrogen - -	1
Carbonic acid - - - -	5
Olefiant gas - - - -	19
Carburetted hydrogen - -	11
Other inflammable gas - -	64

Its ultimate elements, deducting the earthy matter, will stand in the following proportion: —

The Upper Seam.		*The Lower Seam.*	
Carbon - - -	72·2	Carbon - - -	52·3
Hydrogen - -	14·4	Hydrogen - -	17·2
Oxygen - -	4·6	Oxygen - - -	14·5
Nitrogen - -	8·8	Nitrogen - -	16·0

Slate Coal.

Loc. — *Jericho, Jerusalem Basin, V. D. L.*

Specific gravity, 1·30.

Chemical Character. — Burns with a splendid white flame, and is easily lit: its proximate constituents are —

Charcoal - - - - -	60
Bitumen - - - -	37
Earthy matter - - - -	3

One pound gives two cubit feet of an illuminating gas, like that obtained from the Jerusalem coal: the quantity of coal-tar is also the same, but there is less coke.

Its ultimate elements, deducting the earthy matter, are as follows:—

Carbon - - - - -	74·3
Hydrogen - - - -	10·4
Oxygen - - - - -	4·2
Nitrogen - - - -	10·1

Geological Situation. — From the examination of the place where it is found, and of the intervening country between the Coal River and Jericho, this deposit appears to be a continuation of that of Jerusalem. Its external and chemical character, as well as geological situation, identify the seam with the upper one of the latter locality.

Earthy Lignite.

Loc. — Nine Mile Marsh, Jerusalem Basin, V. D. L.

Colour, black; structure slaty, resembling coal; friable; soiling the fingers; specific gravity, 1·40.

Chemical Character.—Burns without flame or smoke; when exposed to strong heat, does not melt nor agglutinate: its proximate constituents are —

Charcoal - - - - -	40
Ligneous (not bituminous) matter	22
Water - - - - -	10
Earty impurities - - -	28

Geological Situation. — It lies in small beds, amongst greywacke and greenstones.

Limestone Rock.

The yellow limestone with *Bulinus* and *Helix*, and some impressions of leaves of an extinct vegetation,

and which was noticed at Hobart Town, as the next to the sandstone, which forms the highest beds in geological series of the two colonies, presents mineralogically four varieties.

First Variety. — Its colour is yellow; its structure rather peculiar; without the assistance of a glass, appearing to be very fine-grained homogeneous mass; but when viewed through the microscope, showing an aggregate of angular fragments of a brownish yellow limestone. The structure of the fragments, as well as of the paste, is not discernible. The fracture is even and dull, but the glass discovers in the paste a splintery appearance. It does not adhere to the tongue, but exhales an argillaceous odour when moistened.

Second Variety. — Structure cellular, and in crusts, having delicate undulated seams, and each bounded by its own surface; fracture splintery, the fragments angular.

Third Variety. — Colour, brownish yellow; consists of distinct concretions, which are sometimes very fine, and only distinguishable by their glimmering lustre; sometimes coarse and granular; the fracture is uneven and shining, the fragments angular, the external and internal aspect similar; it does not adhere to the tongue, neither does it yield an argillaceous odour.

Fourth Variety. — Is of a light straw colour; structure massive, slightly perforated, and composed of minute concretions; fracture uneven, the fragments angular; the external and internal aspect dull and earthy; it adheres to the tongue, yields an argillaceous odour, and is moderately tough.

General Remarks upon the Third Epoch.

Associated with the above-described mineral deposits, in the Newcastle, South Esk, and Jerusalem basins, are found greenstone, basalt, and trachytic conglomerates, the eruption of which, as attested by the effects it produced amongst the stratified masses, took place at four different periods.

The first period of eruption is coeval with the deposition of the coal in Jerusalem basin; that is, it came after the deposition of the second seam of coal, and before that of the superincumbent clays; the said *seam* consisting of altered coal, from which the bitumen has been in a great part expelled, and its place supplied by carbonate of lime. (*Vide the Chemical Analysis of the Jerusalem Coal.*) The clays which lie above this seam are somewhat unconformable to it.

After this came the irruption of basalt and greenstone, which must have taken place between the deposition of coal and that of the variegated sandstone. Thus at Research Bay and South Port the coal is mostly charred and converted into coke from the immediate contact with the greenstone, while the variegated sandstone is left undisturbed.

The third and last period of irruption may be traced to the closing of this epoch. Besides other effects, which will be noticed in the following pages, it caused great dislocation, amidst both the coal beds and the superincumbent sandstones. At Mount Wingen, it raised the lower arenaceous rock, containing *spiriferæ* and *conulariæ*, from beneath the coal deposits which it threw out. In the Newcastle cliff, as represented in the section, it produced seven different dislocations through the irrupted greenstone which is seen under that cliff. At Port Arthur coal-pit, innumerable *faults* are also observable; and

in the South Esk basin, the coal strata, with the variegated sandstone above them, were uplifted 2100 feet above the actual level of the basin.

FOURTH EPOCH.

ABOVE the series of strata, and the unstratified masses, composed of materials differing in origin, age, and mineralogical and chemical character, are found, both in New South Wales and Van Diemen's Land, here and there, multifarious accumulations, some of which, as sand, gravel, pebbles, &c., are seen to rest upon the surface, in the form of *loose gravel or sand*, or transported matter; others, as the *elevated beaches*, are disposed in indurated horizontal beds; some like the *osseous breccia*, at Wellington, fill the crevices of the rocks; but the greater part lie in confused masses, and in a state of partial decomposition, either filling the bottoms, or lodged against the sides of the valleys.

We shall now briefly review the forms under which these different accumulations present themselves.

LOOSE MINERAL SUBSTANCES.

Amongst the transported matter, gravel, sand, and fragments of rocks, are found oxides, phosphates, sulphurets, and arseniates of iron, oxides of titanium, molybdiate of lead, cornelian, opal, agate, and agglomerated pebbles of compound minerals. The range of the last-named substances, scattered, as we find them, over the surface of the two colonies, combined with the fact of their being composed of minerals varying extremely in specific gravity, and of their exhibiting mostly an elliptical and flat shape, leads to the belief that the surface of the colonies has been gradually rising, and had been for some time exposed to the

attritive action of shallow water, before it arrived at its present height above the sea.

ELEVATED BEACHES

Are disposed, at wide intervals, along the present coast of the two colonies: they present commonly horizontal beds, and occur at various heights above the existing sea; some showing marks of greater antiquity than others. Thus the elevated beaches at Lake King (Gipps Land) are seventy feet above the sea: they are composed of an indurated reddish clay and calcareous paste, containing *ostrea* and *anomia*, which are different from the existing specie; while the elevated beaches seen on the southern shore of New South Wales, between Cape Littrap and Portland Bay, contain *ostrea* of the present time, agglutinated by a gritty paste. The elevated beach which forms Green Island, in Bass's Straits, is again but a comminuted mass of shells, and rises to the height of 100 feet: that of the south-west point of Flinders Island exhibits the same character. The two last beaches are abutted against granite, sienite and greenstone.

At ten miles south of Cape Grimm, and west coast of Van Diemen's Land are found, at 100 feet above the present sea, elevated beaches, similar to those of Bass's Straits, and approaching in structure to a coarse and porous sandstone. The beds of these beaches are within the zone of clay slate of the second epoch, and in the vicinity of basalt and trachytic conglomerates.

At Table Cape, the raised beach contains —

Dentalium,
Venus,
Turritella,
Tellina,
with *Sponges* and *Corals*.

It rests upon basalt, and is seventy feet above the level of the sea.

The character of these elevated beaches, and their occurrence in localities widely separated, furnish important additions to the evidence collected in other parts of the world, not only respecting the agencies which still operate in uplifting the earth's surface, but to the local and confined manifestations of such upheavings.

Osseous Breccias.

Among the instances of brecciated accumulations in clefts or caves, the most remarkable is the osseous breccia of the Wellington Valley. The caves in which it is contained are similar to other limestone caverns: the nature of the breccia, in regard to the aggregation of the organic remains and brecciated rocks, does not present any characteristic marks of difference from other similar compounds; and the presence of both kinds of matter in this locality appears as difficult to account for here as the ossiferous caves in Europe.

The Wellington caves are nevertheless of great interest and importance, recording periods of terrestrial revolution in this country similar to those which have happened in other parts of the world; and presenting to us the remains of some of the land animals which were the first inhabitants of Terra Australis.

All their remains, hitherto discovered, consist of detached bones much broken, and very frequently in fragments. The genius, however, of Cuvier and Owen, to whom a broken tooth or vertebra has often sufficed for deciphering the form and character of the entire animal, has supplied the deficiency and the incompleteness of the Australian records.

It is thus that the Australian bones have been found to belong to extinct animals, some of which are unknown to naturalists, as the *Diprotodon*, and *Noto-*

therium; — some, as the *Macropus*, *Hypsiprymnus*, *Phascolomys*, *Dasyurus*, *Thylacinus*, presenting but typical forms of the existing species.

Availing myself of the liberality of Professor Owen, who has contributed the largest share towards our knowledge of the Australian fossils, I shall, in another place, lay an abstract before the reader of some of his most interesting papers relating to the subject.

DEBRIS ACCUMULATED IN VALLEYS.

Throughout the two colonies, the valleys are characterised by the more or less excellent soil they afford to agriculture. These soils differ much in different places, and possess characteristics by which they may be classified. Upon what that classification depends; what are the productive powers of each class; how far industry has availed herself of the virgin soils; and to what degree those under cultivation are susceptible of improvement,—will be discussed in the Agricultural Section, which closes this volume. But, independent of soils, the valleys possess fossil trees of great interest; some, as at Dart Brook and at Lake George, New South Wales, in fragments, imperfectly fossilised; some again, as in the Derwent Valley, Van Diemen's Land, in the form of truncated trees or stumps, perfectly opalised, imbedded in porous and scoriaceous basalt and trachytic conglomerate.

No where, to my knowledge, is the aspect of fossil wood more magnificent than at the place last mentioned; and no where is the original structure of the tree better preserved: while the outside presents a homogeneous and a hard glassy surface, variegated with coloured stripes, like a barked pine, the interior, composed of distinct concentric layers, apparently compact and homogeneous, may be nevertheless sepa-

rated into longitudinal fibres, which are susceptible of subdivision into almost hair-like filaments.

These valuable remains were examined, contemporaneously with my own visit, by Dr. Hooker, of H. M. Ship "Erebus," then bound on the South Polar expedition; and I shall quote, in the language of that zealous and distinguished botanist, the description of the characters which the fossil trees present.

"The most remarkable circumstance," says Dr. Hooker, describing one of the opalised trees, "is the manner in which the outer layers of wood, when exposed by the removal of the bark, separate into the ultimate fibres of which it is composed, forming an amianthus-like mass on the *ventricle* of the stump in one place, and covering the ground with a white powder, commonly called, here, native pounce. The examination of a single concentric layer from this part, shows that it may be detached from the contiguous layers of the preceding and following year's growth; there being no siliceous matter infiltrated into the intervening spaces. A portion of each layer is found to have a second cleavage, not concentric with, but in the direction of its radius, or of a line drawn from the centre to the bark of the tree. Such a cleavage is to be expected from the fact, that it is in the direction of the medullary rays that traverse every where the woody tissue. Each of these laminæ is of extreme tenuity, of indeterminate length, and of the breadth of the layers of wood; and is formed of a single series of parallel woody fibres, crossed here and there by the cellular tissue of the medullary rays, which do not generally interfere with their regularity. These plates, again, are separable into single minute fibres, which are elongated tubes of pleurenchyma or woody tissue, tapering at either end into conical terminations of indefinite length. They lie together in

such close approximation that the microscope does not detect an interstice, though the least force separates them.

"From the appearance of the fossil, its coniferous structure is almost self-evident. But to prove that it was a pine wood, as nearly as our present knowledge of fossil botany will admit of, it is necessary to examine so thin a slice that the nature of the woody fibre may be microscopically observed by transmitted light: such slices have hitherto only been prepared by the most skilful lapidary, and at a great cost. In this instance the wood is already separated into lamellæ admirably adapted for this purpose, and far more beautifully than could possibly be effected by hand. Under these circumstances, with a good microscope, each of these fibres is seen to bear the distinctive character of pine-wood, being marked with a series of discs, considered as glands, and which constitute the glandular woody tissue.

"The nature of these discs is still, perhaps, disputable, and is not immediately connected with the present subject. Such a structure is nearly confined to the conifera, and is essential to them, so far as we at present know.

"Hence it is almost certain that the present fossil belonged to trees of an order whose different species never grow separately, but cover immense tracts of land with, often, a gigantic vegetation.

"How the silification was effected without there existing a bond of union between the separate fibres, is a most interesting question; and further, the nature of the cleavage of the fossil, some other circumstances connected with it, and the ease with which it can be examined, may be expected to add much to what is already known of the physiology of trees, their growth and developement."*

* "Tasmanian Journal of Natural Science," &c. No. I. p. 25.

The tree described by Dr. Hooker is found at Rose Garland, the property of Mr. Barker, to whom great credit is due, not only for having discovered this relic, but for the pains he has taken to preserve it from the injury of Vandal collectors. His unremitting exertions have led to the discovery of some other most interesting fossils, particularly of casts, in basalt, of consumed trees, which throw light upon the state of the forest at the time of the irruption.

Not less wonderful than these fossil trees, and equally interesting, are the erratic blocks or boulders found in the same valley of the Derwent. The masses are composed of cylindrical, somewhat flattened, columns of basalt, confusedly heaped together, with a detritus of pebbles mixed with spheroid boulders of greenstone rocks, all lodged against an escarpment situated at the bottom of the valley, and on the right bank of the Derwent.

This escarpment belongs to the carboniferous strata, and was once connected with another escarpment running across the bed of the river, so as to dam up the present outlet of the waters, and thus to form, in conjunction with the other lines yet existing, the perfect and continuous margin of a basin. The violence with which this embankment was burst asunder is obvious, as is also the action of the water upon it. The position of the detritus, and the direction of the axes of the columns, which lie in position corresponding to the present fall of the country, that is at the lowest level of the valley, prove that the disturbing forces acted from within the basin.

This is corroborated further by the evidences of the basaltic and trachytic irruption which occurred after the deposition of the variegated sandstones in Van Diemen's Land. That irruption seems to have appeared first about Rose Garland, which is the centre of the valley. The trees there, which had been fos-

silised, withstood the intensity of the incandescent matter: other trees, placed in circumstances less favourable to their previous fossilisation, were consumed; but being either saturated with water, or still green, they resisted in some measure the process of combustion, and have left behind longitudinal moulds in the basaltic scoriæ, with parietal cavities and impressions, similar to the rugged appearance which the carbonisation of a tree assumes externally. Into some of these moulds, a second irruptive force appears to have injected fresh lava, thus forming casts of the consumed trees, and records of the succession of volcanic agencies.

This irruption was followed by that of greenstone in the upper part of the valley; which, accompanied as it was by a sudden upward movement of the bottom, must have precipitated the waters from one side of the basin to the other, by which, the barrier being ruptured at the place where the present escarpment is seen, the drainage of the valley was effected.

In this movement an area of 1200 square miles seem to have been raised to the height of 4000 feet, and the valley to have been overflowed by streams of greenstone and basalt issuing from five mouths — the present lakes of the so-called upper country of the Derwent. (Pl. V. fig. 2.)

CONCLUSION.

In our attempt to sketch the general physical aspect of New South Wales and Van Diemen's Land, we have followed a continuous chain of mountains for upwards of 1500 miles — first along the eastern coast of New Holland to Wilson's Promontory; thence to Bass's Straits; thence again, in zigzag direction, through Van Diemen's Land; beholding it every

where towering above the country through which it winds its course.

The lithological character of this chain, and that of the spurs which belong to it, has been found to be chiefly due to the presence of crystalline rocks; the irruption of some, being confined to particular epochs, while that of others has extended itself to all the geological eras — into the newest, with which our inquiry has closed.

Thus the irruption of granite, sienite, hyalomicte, and protogene was stated to have taken place only at the beginning of the first epoch; that of quartz rock and porphyries, during the first two epochs; that of basalt and its varieties, during the last two; while that of the greenstone operated continually throughout all the four.

These facts tend to the following conclusions:—

1. That the continuity of the chain in the mean direction of N. E. to S. W., connected as it is by the islands of the Straits, shows that the action of the force which up-heaved it was *uniform in direction.*
2. But although uniform, the movement was not *synchronous*, on the whole line, but was exerted during four different and distinct epochs.
3. That the difference in the height of the peaks, which range between 6500 and 1000 feet above the sea-level, proves that the uplifting movement was exerted with different degrees of intensity.
4. That the position and the character of the foci of the maximum and minimum of that intensity is such as to lead to the connection of the origin of the chain of mountains with a series of volcanoes of "*elevation*," operating along a longitudinal fissure of the earth ranging from N. E. to S. W.

5. Lastly, that from the lithological character, and from the geological phenomena which have been found grouped along its course, the above mountain chain may be looked upon as the Australian Eastern Axis of Perturbation.

The sedimentary rocks which we have seen divided by that axis, and at present incumbent upon it, have been traced to four different epochs.

The FIRST is characterised by the presence of mica-slate, argillaceous and siliceous slate, and the *absence of gneiss.*

The SECOND, by the arenaceous, calcareous, and argillaceous stratified deposits, and by the following organic remains which pervade them: —

POLYPARIA.

Stenopora informis (Lonsdale).
——— *tasmaniensis* (Lonsdale).
——— *ovata* (Lonsdale).
——— *crinita* (Lonsdale).
Fenestella ampla (Lonsdale).
——— *internata* (Lonsdale).
——— *fossula* (Lonsdale).
Amplexus arundinaceus (Lonsdale).
Hemitrypa sexangula (Lonsdale).
Favosites gothlandica (Lamarck).

CRINOIDEA.

Crinoidal columns or stems.

CONCHIFERA.

Allorisma curvatum (Morris).
Orthonota compressa (Morris).
——— *costata* (Morris).
Pachydomus antiquatus (Morris).
——— *globosus*
——— *cuneatus* (Morris).
——— *lævis* (Morris).
——— *carinatus* (Morris).
Eurydesma cordata (Morris).
Pecten illawarensis (Morris).
——— *Fittoni* (Morris).
——— *squamuliferus* (Morris).
——— *limæformis* (Morris).
Pterinea macroptera (Morris).

BRACHIOPODA.

Terebratula cymbæformis (Morris).
——— *hastata* (Sowerby).
Spirifer crebristria (Morris).
——— *Darwinii* (Morris).
——— *Stokesii* (König).
——— *subradiatus* (G. Sowerby).
——— *avicula* (G. Sowerby).
——— *vespertilio* (G. Sowerby).
——— *tasmaniensis* (Morris).
Productus brachythærus (G. Sowerby).
——— *subquadratus* (Morris).

GASTEROPODA.

Littorina filosa (J. Sowerby).
Turritella tricincta (Morris).
Platyschisma oculus (Morris).
——— *rotundatum* (Morris).
Pleurotomaria Strzeleckiana (Morris).
——— *cancellata* (Morris).
——— *nov. spec.* (Morris).

HETEROPODA.

Bellerophon micromphalus (Morris).

PTEROPODA.

Theca lanceolata (Morris).
Conularia levigata (Morris).

CEPHALOPODA.

Orthoceras—(Much damaged, and not determined).

CRUSTACEA.

Bairdia affinis (Morris).
Cythere, species of (Morris).
Trilobites—(Small impressions of, not exceeding half an inch).

PISCES.

Icthyodorulite.

The THIRD EPOCH includes coal deposits, with their intervening shales and sandstones, in which were found—

Sphenopteris.
———— *lobifolia* (Morris).
———— *alata* (Brongniart).
Glossopteris Browniana (Brongniart).
Pecopteris australis (Morris).
———— *odontopteroides* (Morris).
Zeugophyllites elongatus (Morris).
Phyllotheca australis (Brongniart).

The FOURTH and last EPOCH is marked by the occurrence of elevated beaches, in which are found, —

Dentalium.
Venus.
Turritella.
Tellina.
Anomia.

And by the organic remains of land animals, occurring in the limestone, caves, or alluvial deposits, and which are identified with —

Diprotodon.
Nototherium.
Macropus.
Hypsiprymnus.
Phascolomys.
Dasyurus.
Thylacinus.

The evidence above referred to shows, —

1. That the stratified rocks of New South Wales and Van Diemen's Land, from mica-slate upwards, reach only to the variegated sandstone inclusively, that sandstone being incumbent upon the coal deposits in New South Wales and Van Diemen's Land.
2. That their thickness does not exceed 2200 feet, in which sandstone alone is 1400 feet; — and, lastly,
3. That, though inconsiderable in thickness, and limited in the number of the organic remains which they contain, the sedimentary rocks of New South Wales and Van Diemen's Land furnish, nevertheless, new evidence in support

of those geological laws, which have been derived from the examination of Europe.

Comparing now the area of the crystalline with that of the sedimentary rocks, it is found, —

1. That in New South Wales the space occupied by the crystalline is to that of the sedimentary rocks as 3 : 1.
2. That in Van Diemen's Land it is as 7 : 1.

A classification of all the mineral masses, whether unstratified or stratified, into two divisions, the one including rocks having more than sixty per cent. of silica, the other less than the above per centage, shows, —

1. That in New South Wales the area of granite, protogene, hyalomicte, quartz rock, sienite, siliceous breccia, quartzose porphyry, siliceous slate, sandstone, and conglomerate, all containing above sixty per cent. of silica, is, to the area of eurite, felspathic porphyry, greenstone and basalt rocks, containing less than 60 per cent., as 4·1 : 1.
2. That in Van Diemen's Land, on the contrary, the area of the first division is to that of the second as 1 : 3.

This *inverse ratio* of siliceous to non-siliceous rocks in the two colonies, while it decides the question of the relative agricultural character of soils of each colony, shows, in the mean time, the effects of the volcanic agencies, which appear to have operated on a more extensive scale in Van Diemen's Land than in New South Wales.

Indeed, the torn, rugged, furrowed, and contorted surface of the former colony, bears ample witness to the formidable revolutions produced by the eruptive

greenstone and basalt, overwhelming, in succession, different members of the series, which then composed the consolidated crust, and sweeping away and burying a vegetation, of which no living traces are now left on the island.

But these changes have served only to render this island one of the most eligible spots on the face of the globe for the pursuits of agriculture: the irrupted greenstone yields an excellent soil, and the zigzag course of the chain of mountains forms naturally flat-bottomed valleys, between which rises a table-land about 3800 feet, enclosing in crateriform lakes five reservoirs of water, covering, if the surface were united, an area of 200 square miles, and capable of irrigating all the adjacent lands available to cultivation.

New South Wales exhibits few records of irruptive igneous rocks, and preserves all its crystalline siliceous rocks in addition to the siliceous sedimentary ones, which in the course of ages have accumulated upon its surface.

This difference in the predominant kind of rocks, and in the configuration of the surface, will probably assign to each colony a different form of future prosperity.

New South Wales, by the nature of its soils, seems destined apparently to become a pastoral, Van Diemen's Land an agricultural country.

To hasten the development of that destiny, to pave the way, not only for a successful investigation of other branches of physical science, but to lead directly to the improvement of agriculture, and the success of commercial projects in various departments, a regular geological survey of the two colonies cannot be too strongly recommended; and such a survey as the science of the present day requires can only be accomplished by the aid of the Government, and by the

pursuit of the same liberal system, which has already organised the Geological Ordnance Survey in the United Kingdom.

The "Economic Geology" might thus become the centre of a geological survey, not only of the British islands, but of the British empire; and might include, within its already valuable museum, all the specimens relative to the colonies; thus concentrating within its walls the information which now must be sought for in remote and widely distant regions.

To achieve any complete geological survey of such countries—as, *e. g.*, New South Wales and Van Diemen's Land—by private enterprise, is out of the question. Besides the expense, time, and labour, which such a task requires, and the necessary means of publishing the results which it needs, there is one insuperable difficulty in the way of a private individual, from the simple fact of his entering on the field of his researches in *a private capacity*. His functions ought to be *official;* not because an official character would carry, in matter of science, greater weight and authority than private and well-known skill, but because the official geologist would find unrestrained access to every nook of the country to which his inquiry would lead him, and would be placed at once above that suspicion, by which the inhabitants of every new country are inclined to question the purity of the intentions that actuate the naturalist, often rendering his progress unpleasant, and sometimes dangerous.

The present geological outline, thus constructed, as it has been, from materials comparatively scanty, and gathered under many disadvantages, cannot be better concluded than by borrowing a passage from an admirable essay, on a subject of the highest importance.*

* Essay towards a First Approximation to a Map of Cotidal Lines, by Professor Whewell.

"I should regret its publication, if I supposed it likely that any intelligent person would consider it otherwise than *an attempt to combine such information as we have, and to point out the want, and the use of more;* I shall neither be surprised, then, nor mortified, if the outline which I have drawn turns out to be in many instances widely erroneous."

SECTION IV.

CLIMATOLOGY OF NEW SOUTH WALES AND VAN DIEMEN'S LAND.

INTRODUCTION.

NEXT to the science of geology, there is no part of physical geography which ranks higher, or claims greater attention than meteorology; though as yet, notwithstanding its connection with the most essential studies of natural philosophy, and with the most vital concerns of mankind, the state of this science is such, that, beyond a mere collection of simple facts, and of registers recorded patiently, yet without the guidance of any satisfactory theory, no contribution of superior character, tending to any deductive reasoning, can legitimately be made to it. The mode even of exhibiting such facts, so that they may be placed in harmony with the general laws of physics, and in the pre-eminence corresponding to their climatic agencies and influences, is still attended with considerable difficulty.

In the following disquisition on the climate of New South Wales, and Van Diemen's Land, the plan adopted has been, to trace that climate to its proper attendant causes; to analyse separately, so far as is possible, these causes and their effects, together with their mutual dependence on each other, and the share each of them bears in the economy of nature. Thus, atmospheric currents, winds, atmospheric pressure, calorific effect of solar rays, terrestrial absorption, and radiation of heat, diaphaneity of the atmosphere, evaporation, rain, and temperature, have

all been alternately reviewed, and their respective and collective agencies investigated.

An attempt has next been made to link the isolated effects into one expressive or connected group, and to give, if possible, an approximate general idea or picture of that bountiful climate with which the two colonies have been gifted.

The numerical elements which have guided the writer in this investigation were obtained during five years, ending with 1842 inclusive. They were derived, —

1st. From the meteorological register of the barometer, thermometer, rain and wind, kept by the assistant commissary, Mr. Lempriere, in Port Arthur, Van Diemen's Land; the number of observations being - -	21·600
2dly. From two separate registers, one kept at Circular Head and the other at Woolnorth, the estate of the Van Diemen's Land Company, and embracing observations similar to those of Port Arthur, to the number of -	43·200
3dly. From three separate registers kept at Port Macquarie, Port Jackson, and Port Philip (New South Wales), by order of the Colonial Government, and including observations of the barometer, thermometer, hygrometer, wind and rain, to the number of - - - -	25·900
4thly. From my own register of the barometer, hygrometer, thermometer, solar and terrestrial radiation, evaporation, diaphaneity, rain, winds and currents, of which the observations amounted to - - - -	17·280
Total - - -	107·980

To the above 107·980 numerical elements must be added those which resulted from simultaneous observations of phenomena made in different localities of the two colonies, and in which I was aided and assisted by some friends, and by none more than my enlightened and valued friend, Capt. P. P. King, R. N., who not only took his share in these labours, but gave me free access to his own meteorological register, kept for years in New South Wales; and, which was not less important, kindly condescended to give his opinion on the section when it was com-

pleted. I may add, that the approval of it by that able judge and keen observer, in April, 1843, has operated as one of the leading motives for its present publication.

ATMOSPHERIC WINDS AND CURRENTS.

To the facts connected with winds and currents, so admirably collected and reasoned upon by Dove, in his *Meteorologishe Untersuchungen;* by Schouw, *Beiträge zur Vergleichenden Klimatologie;* by Redfield, in his valuable observations *On Hurricanes;* and by Colonel Reid, in his not less valuable work *On Storms,*—a few additional data, derived from personal observations, in different parts of the world, are here added; some, as corroborating what the above-named eminent meteorologists have already noted; some, as new phenomena, tending to extend our still limited knowledge of the subject.

Considered merely in relation to New South Wales and Van Diemen's Land, and to the influence they exercise upon the climate, the atmospheric winds and currents present themselves to the observer as foremost in rank amongst climatic agencies.

Their respective actions, manifestly of various character and various intensity, appear in some instances to be mere expressions of an accidental perturbation in the atmospheric circulation; in some others, their periodical return, and uniform course, direction, force, and succession, show that they are governed by a law as immutable as that which regulates the course of seasons; while in other instances, again, their movements is of a subordinate character, like that of an eddy, depending upon the direction and intensity of a stronger current.

In all cases, however, their action on the climatic changes is so ramified and complicated in its agency

and influence, that the atmospheric pressure, the hygrometrical, thermometrical, and diaphanic state of the ambient air, the calorific effects of solar rays, and, lastly, the animal and vegetable life, are all affected by their presence and action.

Both currents and winds disclose, through the courses of clouds, that the number of superposed belts or strata of circulation, their respective direction and velocity, are subject to infinite variation*, but that their movement with respect to our planet is constant, being, so far as the evidence has gone, either parallel to the earth's surface, or at low angles of inclination to it. To this may be added, that a calm in one region of the atmosphere, and a strong agitation and circulation in another, whether below or above it, is of common occurrence, as is also a diametrically opposed movement between that circulation and the surface winds.

The register of currents and surface winds kept during four years, and condensed in the following table (p. 163.), leads to the belief that, as regards the difference between their respective directions, the *ratio* of that difference follows the increase and decrease of the sun's declination.

The observations collected in ascending high mountains tend to establish the general fact, that the thermometrical condition of these currents is as variable as their direction; and that, contrary to the

* "It is obvious, from the courses of clouds and other light bodies which sometimes float in the atmosphere, that the movements of the latter are mainly horizontal, or parallel to the earth's surface. Notwithstanding this, the common theory of winds supposes a constant rising of the atmosphere in the equatorial regions, connected with a flow in the higher atmosphere towards the polar regions, and a counter flow at the surface towards the equator, to supply the ascending current. This movement, however, has never yet been discovered; and it is easy to perceive that, if it existed in the manner supposed, its magnitude and velocity must be altogether too great to have eluded observation."— *Meteorological Sketches.*

TABLE I.—*Showing the Monthly Number of Currents, contrary in Direction to Surface Winds.*

Time of the Year.		Number of Contrary Currents.			
		1839.	1840.	1841.	1842.
Decl. ☉ S.	January	29	24	27	20
	February	24	18	26	27
	March	20	27	29	26
Decl. ☉ N.	April	15	10	9	12
	May	10	8	10	7
	June	4	3	8	2
	July	6	5	1	3
	August	9	15	13	8
	September	9	17	12	15
Decl. ☉ S.	October	18	28	17	27
	November	25	25	20	24
	December	28	22	23	26

law of hydrostatics, the *colder current moves between two warmer, entirely by virtue of its volume.* Thus, on ascending Mouna Roa (Sandwich Islands), I noted, within the elevation even of 6000 feet, three currents, of different directions, intensity, and thermometrical condition. That of Hilo (Byron's Bay) was a very light S.E. current, with a temperature of 86°; that at an elevation of 6000 feet was a brisk N.W. wind, temperature 67°; while, as an intermediate between these, at an elevation of 4000 feet, a strong westerly wind moved in the temperature of 55°. On Mount Kosciuszko, New South Wales, the stratum of air at 3000 feet was considerably colder, during the day-time, than at the elevation of 6500; and in ascending Ben Lomond (Van Diemen's Land) a similar fact was observed. Moreover, on the last-named mountain, 5002 feet above the level of the sea, I encountered, on the 28th of November, 1841, before noon, a thunder storm, coming from the equatorial region, and attended with copious rain, and a temperature of 56°. On the same day, about four o'clock in the afternoon, it became calm and clear above, misty around, and densely clouded below; while at Avoca Vale, 4200 feet lower down, to the leeward of

Ben Lomond, there fell at the same hour (four o'clock) a hail storm, which thus must have originated in a stratum of air far below the point of congelation, and moving between 5002 feet and 800 feet of elevation, and between the 56° temperature of Ben Lomond and the 80° which was the temperature of Avoca Vale before the outbreak of the storm. This storm was in both places succeeded by a polar wind.

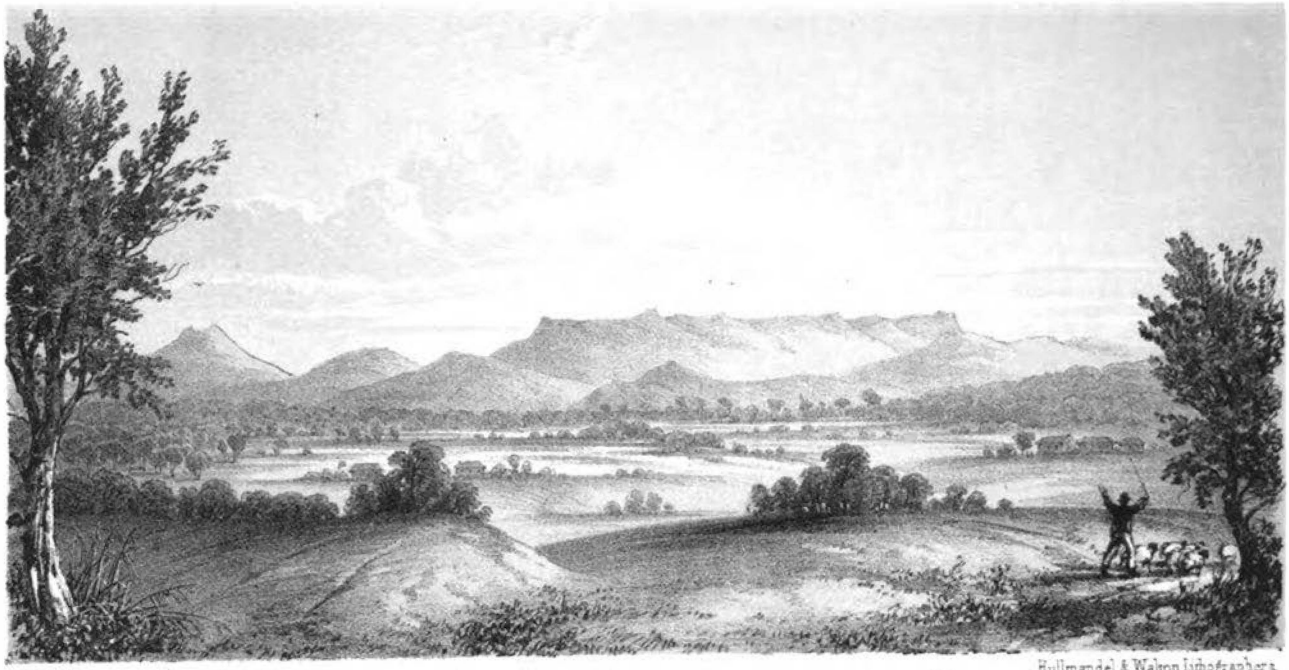
To these facts may be added that of rain being often observed to fall in Van Diemen's Land, on a winter's morning, when the temperature is below the freezing point; and that also of the melting snows which I witnessed on the crest of the Cordillieras in Chili, at an elevation of 15,000 feet, while the snow lower down, at the elevation of 10,000 feet, was found unaltered.

Independently of these thermometrical phenomena, the currents are attended by some extraordinary ones, as exemplified in their respective oscillations from one region to another. Thus, an upper current of a lower temperature than the surface wind has been observed to dislodge that wind, and to take its place, as was most probably the case in the above reported phenomenon of hail, in which the equatorial wind that accompanied the storm on Ben Lomond, was succeeded by the polar wind, after the latter had discharged its elements of hail on Avoca Vale.

In the action of the one current upon the other, a gradual commingling of the two currents not unfrequently takes place; sometimes that action is abrupt; and, in that case, the deflection of the lower current is immediately followed by an increase of atmospheric pressure.

This is well exemplified in both New South Wales and Van Diemen's Land, where the sudden southerly squall rapidly succeeds a N. W. or W. wind, and produces a rise in the barometer.

The only laws, however, that can be detected as governing the circulation of these currents, so little



James M.c Arthur del.t

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VIEW OF BEN NEVIS AND BEN LOMOND:
VAN DIEMEN'S LAND