one or two others, the vast and almost innumerable multitude of islands scattered throughout the Pacific, the Indian, and the Atlantic Oceans are all composed either of volcanic or of modern coral rocks (p. 125). This fact, singular as it is, is a manifest extension of that law and the effect of the same causes, whether chemical or mechanical, from which it results that a vast majority of the volcanoes now in action either stand as islands in the sea or are near its shores.

"This fact of the Ocean islands being so generally volcanic is also interesting in relation to the nature of the mountain chains on our continents, which are comparatively seldom volcanic, and yet we are led to suppose that where our continents now stand, an ocean once extended. Do volcanic eruptions, we may ask, reach the surface more readily through fissures formed during the first stages of the conversion of the bed of the ocean into a tract of land?" (p. 126.)

In the volcanic archipelagos the islands are generally arranged either in single, double, or treble rows in lines which are frequently curved in a slight degree. This arrangement in lines seems to exist in a perfect series from a few volcanic islands placed in a row, to a train of linear archipelagos following each other in a straight line, and so on to a great wall, like the Cordilleras of America. Along the shores of great continents also there exist islands forming small volcanic groups, indicating, it would seem, a relation, not only by proximity but in the direction of the fissures of eruption, to the neighbouring continents, and in some cases affected by the same volcanic disturbances. The lines of intersection at the Galapagos, at the Cape de Verde archipelagos, and the best marked line of the Canary Islands, are examples of this relation, and in some of these cases eruptions have taken place within the historical period on more than one of these parallel lines of fissure. "Believing," says Mr. Darwin, "that a mountain axis differs essentially from a volcano, only in plutonic rocks having been injected instead of volcanic matter having been ejected, this appears to me an interesting circumstance; for we may infer from it as probable, that in the elevation of a mountain chain, two or more of the parallel lines forming it may be upraised and injected within the same geological period." (p. 129.)

D. T. A.

II. *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. 8vo. pp. 462.

THIS work by the Count de Strzelecki is the result of five years of continual labour occupied in travelling, on foot, for a distance of as much as 7000 miles, through various parts of the eastern shores of the vast island-continent of Australia and in the island of Van Diemen's Land. The main object of the author's visit to New South Wales, he states to have been to examine its

mineralogy; but the materials he met with for this purpose were too few and too little important to satisfy his curiosity, and he turned therefore to the wider field of investigation presented by its geological structure, and has endeavoured by a map, coloured in a certain sense geologically, by a number of sections, and by description, to communicate information on this subject. The map includes a district of about 150 miles in New South Wales, measuring inland from the sea-coast from the 30th to the 39th degrees of south latitude, and the whole of Van Diemen's Land, the author stating that he was induced to continue his investigations southwards into that island, and include it in his geological survey, in consequence of the great similarity of its general structure to that of the main land.—We shall endeavour in the present article to deduce a general account of the geology of the district without confining ourselves to the exact order of arrangement adopted by the author.

The physical features of the eastern coast of Australia appear to be derived from a great number of sharply-defined elevations, producing a multitude of ridges which have a general direction from N. E. to S. W., and which are sometimes broken through and occasionally connected by transverse ridges. Very numerous and prominent spurs project as it were on the eastern face of these principal lines of elevated ridges, and the natural result of a conformation so peculiar is the existence of many yawning chasms, deep winding gorges and frightful precipices, forming an endless labyrinth of almost subterranean gullies, exceedingly difficult to penetrate, and rendering the whole tract intricate and broken. A similar structure is said to extend also to the west of the mountain range.

The altitudes of the higher points of these ridges, which are for the most part peaks of striking shape and lofty elevation, range in the more northern district, as in latitude 30°, from 2400 to 4700 feet. Towards the south, in the district known as the Australian Alps, one peak called Mount Kosciuszko attains the height of 6500 feet, and the chain there trends greatly towards the west until it turns again southwards and terminates in the sea at Wilson's Promontory. The same structure is however continued across Bass's Straits, by a chain of islands, and forms a lofty and picturesque mountain district in the north-eastern extremity of Van Diemen's Land.

The central axis of the whole district thus remarkably characterised consists, it would appear, invariably of igneous rocks, and chiefly of granite, syenite, and quartz rock. Of these granite is described as constituting "nearly the entire floor of the western portion of New South Wales, to the complete exclusion of mica slate and gneiss, and extending far into the interior of New Holland, in masses of mammillary, tuberos, globular or botryoidal form." (p. 85.)

The forms of the mountain summits mark by their deep, jagged, dentated, and serrated outline the nature of the rocks which crown

the different ranges; and the condition of the granitic and porphyritic rocks, as they appear in Van Diemen's Land, is picturesquely illustrated by the following description of the mountain scenery viewed 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 metamorphic rocks of the district described by M. de Strzelecky consist of a small development of mica schist and siliceous slate, together with a little clay-slate, all of which occur in vertical strata, and occasionally flank the igneous rocks, the mica slate being the undermost and being succeeded first by the siliceous and then by clay-slate. Besides these many parts of New South Wales exhibit metamorphic rocks consisting of different kinds of granular marble and limestone, some of which are very beautiful, and are available for statuary and other ornamental purposes.

The fossiliferous stratified rocks of New South Wales and Van Diemen's Land appear to be chiefly referable to the Palæozoic period. They form two groups, the lower including the middle and perhaps the older Palæozoic rocks of other parts of the world, and the upper those of the carboniferous or newer Palæozoic period. The subdivisions have not been very minutely traced; and although of the main facts there can be little doubt, it is somewhat to be lamented that the descriptive geology of the older of these groups has not been hitherto so far worked out as to render it possible to trace with any degree of accuracy even the position of the beds at the surface.*

* So far as one can judge, the rocks on the eastern flanks of the syenitic chain occupying the western district of Van Diemen's Land, and those at Yass Plains and Shoalhaven, in New South Wales, would seem to belong to the older period; but in these, and in most of the localities mentioned by the author, fossils of the carboniferous series are chiefly prevalent. — ED.

Viewing, however, the Palæozoic rocks of New South Wales and Van Diemen's Land as a whole, and with reference to the fossil fauna, so far as it is hitherto known, we may remark, first, the extreme poverty of the different beds in this respect, in so far as species are concerned—the whole number hitherto determined not exceeding 48—and, next, the mode of their distribution and the relative proportion referable to the various natural families. We learn from the work before us that of the whole number of species there are 10 *Polyparia*, 14 *Conchifera*, 12 *Brachiopoda*, 7 *Gasteropoda*, 1 *Heteropod*, 2 *Pteropoda*, and 2 *Crustacea*, besides some remains of fishes. Considered locally there is a preponderance of bivalve mollusca and Gasteropods in the Illawarra district (N. S. Wales), leading us to suppose that the deposits there may have been littoral or accumulated at no great distance from the ancient shore. On the other hand, the coarse sand rock of Raymond Terrace appears to have been rather unfavourable to the existence of animal life, while the Booral deposit is interesting as pointing to a different state of things. This latter is a dark flaggy rock, a bituminous limestone, containing numerous remains of species referred to *Littorina* and *Turritella*, with fragments of *Ichthyodorulites* and abundant traces of the minute crustacean genera *Bairdia* and *Cithere*; the latter forming regular layers in the limestone, just as they are found deposited in the carboniferous shales near Halifax, in Yorkshire, in other parts of England and in Ireland.

"In Van Diemen's Land, where the strata are extremely variable, the chief fossiliferous deposit appears to be Mount Wellington and some adjacent localities: in these we find the different species of *Brachiopoda* attaining a much greater numerical development than in the corresponding series on the Australian continent; the *Productus brachythærus*, *Spirifer avicula*, *S. vespertilio*, and other species, are extremely abundant, some of them being of considerable size. Associated with these are numerous traces of fine and large specimens (in some places filling the rock in every direction) of the different species of *Polyparia*, as *Stenopora ovata* and *S. Tasmaniensis*, *Fenestella ampla*, *F. internata*, *F. fossula*, &c.; while the remains of *Conchifera* and *Gasteropoda* are but rarely to be discovered; the locality at Spring Hill containing the largest proportion, with one species of *Polyparia*, the *Stenopora informis* (Lonsdale).

"In comparing these forms with those from the Palæozoic series of other countries, we find some of them to be identical, and others to be representative species: the *Terebratula hastata* is the same as the English species; there is a *Spirifer* near to *S. glaber* (Mart.); the *Littorina filosa* is very closely allied to, if not identical with *Loxonema sulcatula* (McCoy); and the *Turritella tricineta* approximates to *T. acicula* (Phillips). Of representative forms, we have the *Spirifer crebristrius*, allied to *S. glabristrius* (Phil.) and *Athyris depressa* (McCoy); the *Sp. Tasmaniensis*, to the *S. Pentlandi* (D'Orb.), from the carboniferous limestone of Bolivia; and the *Sp. Stokesii*, near to a Kendal species. Of the winged Spirifers, the *S. avicula* and *S. vespertilio* belong to the group of *S. convoluta* (Phil.), and *S. extensa* (Sow.); and a variety of the *S. vespertilio* is very near to the *S. condor* (D'Orb.), from the carboniferous deposit of Bolivia; and another to the *S. Lyellii* (De Verneuil). The Australian *Productæ* are allied to the English forms of that genus. Of the *Polyparia*, the *Fenestella* generally appear to be the representatives of some English and Irish species.

"Having thus briefly alluded to the local distribution and general resemblances of the Australian Palæozoic fauna, it is important to remark the absence

of certain genera (so far at least as our observations on different collections have extended) which are abundantly distributed in the equivalent deposits of northern Europe. Of the family *Cephalopoda*, no traces of the *Nautilus*, *Clymenia*, or *Goniatites* have hitherto been detected; nor have there been found any remains of the true *Leptæna*, or scarcely of *Orthidæ* (one doubtful fragment from Booral excepted), genera so characteristic of the Devonian and carboniferous strata of other countries. *Trilobites* appear to have been equally rare; and the Crustacean family is represented by two or three species belonging to Cypridiform genera. On the other hand, the presence of a species of *Bellerophon* and *Conularia*, seven or eight of *Spirifer*, and two or three belonging to the gibbous species of *Productus*, — the latter being forms generally found in the carboniferous limestone, — and these associated with carboniferous types of *Polyparia* and a few allied forms of *Conchifera* and *Gasteropoda*, — lead us to believe that the deposits containing them may probably belong to that division of the Palæozoic series usually termed carboniferous.

"The above observations apply chiefly to the great mass of ancient fossiliferous strata of these countries; but it also appears, from the evidence of superposition brought forth in the geological section, as well as by the fossil remains contained therein, that the deposits at Yass Plains and Shoalhaven, in New South Wales, are anterior to the other strata, and may probably be considered the equivalent of the Devonian system of Europe. The fossil species from these deposits are but imperfectly known: *Favosites Gothlandica*, another species of *Favosites*, and *Amplexus arundinaceus* (Lonsdale), fragments of *Orthoceras* and remains of *Trilobites*, have only at present been noticed. Thus, the Palæozoic series of Australia and Tasmania may be regarded as partly the equivalent of the Devonian and carboniferous system of other countries.

"I cannot conclude these brief notes without remarking that many forms in these deposits may have been obliterated; and others so considerably altered, that it is rather difficult to institute careful comparisons, from the metamorphic action that has been induced on many of the strata by the intrusion of trappean dykes, which appear to have been more frequent in Van Diemen's Land than in the corresponding series on the Australian continent."

The rocks of the carboniferous period, characterised by the presence of coal and occurring in New South Wales and Van Diemen's Land, are considered by the author as belonging to a period somewhat more recent than that just described. However this may be, the coal-bearing deposits are sufficiently important in themselves to demand careful attention.

There appear to be three basin-shaped deposits of this kind which are described by M. de Strzelecky under the names of the Newcastle, the South Esk, and the Jerusalem Basins respectively. Of these the first mentioned is in New South Wales, and the two latter in Van Diemen's Land.

The Newcastle (N. S. W.) coal field occupies a tract, of which the dimensions are not given, extending for some distance on both sides the stream in the basin of the Hunter River near its mouth, in about 33° S. lat. The northern limits of this basin consist of a coarse sandstone, containing *Conulariæ*, *Spirifers*, and *Productæ*, having a southerly dip and resting on a conglomerate. The southern limits are composed of masses of fine-grained sandstone of a different kind, containing mica and iron glance, interspersed with very thin seams of coal. Still further to the south, at Lake Macquarie, coal crops out from beneath this sandstone.

The coast line from Lake Macquarie northward gives a con-

tinuous section of the sequence of the coal-bearing beds in a cliff about 200 feet high, and along a distance of nearly half a mile. The beds are affected by numerous faults. The coal is worked between this point and Lake Macquarie, and the author gives the following as the shaft section not far from the cliff:—

	Feet
1. Conglomerate - - - - -	23
2. Coal - - - - -	3
3. Cherts and gritstones with angular fragments of flint intermixed with thin veins of coal - - - - -	44
4. Coal - - - - -	5
5. Clay rock of greyish colour and bluish shale with impressions of ferns - - - - -	43
6. Coal - - - - -	5
7. Greenish sandstone with blue veins - - - - -	25
8. Coal - - - - -	3
9. Greenish sandstone - - - - -	50
10. Coal - - - - -	3

Inland and southwards the upper beds are seen to dip westward under masses of variegated and fine-grained sandstone, conformable with the coal deposits.

The South Esk Basin (V. D. Land), although much broken and apparently very limited in extent, agrees with that of Newcastle (N. S. W.) in its general geological characters. A variegated sandstone overlies the regular coal measures.

The Jerusalem Basin (V. D. Land) is situated not far from Hobart Town to the east. The underlying bed is a limestone, containing *Productæ* and *Spirifers*, succeeded by a conglomerate, on which the coal-measures repose. The beds dip to the south, and the following is given as the shaft section of the Jerusalem pits:—

	Feet
1. Sandstone with impressions of ferns - - - - -	13
2. Greenish sandstone - - - - -	3
3. Clay slate (? shale) - - - - -	1
4. Grey clay - - - - -	2
5. Blackish clay with impressions of ferns - - - - -	2
6. Coal - - - - -	3
7. Greyish clay - - - - -	12
8. Blackish clay with ferns - - - - -	3
9. Greyish clay - - - - -	11
10. Blackish clay with ferns - - - - -	6
11. Coal - - - - -	2

Some of the coal in the Jerusalem Basin is described as anthracitic.

Besides these localities the existence of coal is known at Port Western (N. S. W.), (lat. 38°30' S., long. 145° W.), at Moreton Bay, and at the head of the rivers Hastings and Mac Leay, north of Newcastle. Partial outcrops have been also observed in the Vale of Clywd, north of Mount York, and east of Mount Clarence. These possibly belong to the Newcastle Basin.

The fossil plants obtained from these coal-measures, and de-

scribed in the work before us, are but few. They are referred by Mr. Morris (who has assisted the author in this part of his work) to three species of *Sphenopteris*, one *Glossopteris*, two *Pecopteris*, one *Zeugophyllites*, and one *Phyllothea*.

"In reviewing the few species of the ancient flora that have been hitherto collected from the carboniferous deposits of Australia, including therein the fossil plants from the basin of the Hunter, in New South Wales, and those from the Jerusalem basin, in Van Diemen's Land, we at once perceive the interesting fact, that although limited as the species are in number, there is no trace of any of those remarkable genera so characteristic of, and so abundant in, the strata of the European and American coal-fields, such as *Lepidodendron*, *Sigillaria*, *Stigmaria*, *Calamites*, or *Conifera*.

"The basins themselves, if indeed contemporaneous, appear to be characterised by a distinctly localised flora; no species, as far at least as our observations have extended, being found common to the two deposits. The basin of the Hunter contains *Phyllothea australis*, *Glossopteris Browniana*, and some other species; in that of Jerusalem, in Van Diemen's Land, are found three or four species belonging to the genera *Sphenopteris* and *Pecopteris*, and one to *Zeugophyllites*, these being associated with some large fragments of stems, too imperfect to be defined.

"In comparing, therefore, the whole of the species at present known, from these deposits, with the coal plants of Europe, there appears, indeed, to be but few, if any, analogical forms, although the equisetoid-looking *Phyllothea* may probably be considered as the representative of the *Calamites* of the northern deposits; while, on the other hand, its congener, the *Glossopteris Browniana*, is a fern so entirely different from any of those that are found in the carboniferous periods of the northern hemisphere.

"Among the fossil plants collected from the Jerusalem basin, we find the interesting genus *Zeugophyllites*, and certain forms of *Pecopteris*, one of which is closely allied to an oolitic species, and another having strong resemblances to an *Odontopteris* from the Permian system of Russia.

"These few observations partly lead us to infer that the flora of the southern hemisphere was perfectly distinct in its facies from the northern, at the carboniferous period; just as, at the present time, the modern flora of the same continent presents a striking difference to that of other portions of the globe; and this appears to be the more remarkable, as the species constituting the fauna of the Australian ocean, anterior to that period, contain many forms which, if not perfectly identical, are at least the representative ones of those of the northern region.

"In instituting a comparison between the species collected from the Australian deposits, and those described from the Burdwan coal-field by Professor Royle, we observe both the remarkable analogy of form of some species and the actual identity of others; from which we may probably be led to infer that the deposition of the strata containing them was not only contemporaneous, but that the conditions of the flora of some portions of the Indian and Australian continents, at that epoch, were not very dissimilar. In the Burdwan coal-field we find the *Pecopteris Lindleyana*, *Glossopteris danæoides*, *G. Browniana*, and other plants associated with two species of a very curious form, *Vertebraria indica* and *V. radiata*. The Australian deposit also contains *Glossopteris Browniana*, two or three species of *Sphenopteris*, and the same species of *Vertebraria* above noticed. The *Pecopteris australis* of the Jerusalem basin is closely allied to, if not identical with, the *P. Lindleyana* from Burdwan. The *Glossopteris danæoides* of the Burdwan deposit apparently belongs to the genus *Tæniopteris*, the veins being perfectly horizontal, and not anastomosed, as in the typical species of *Glossopteris*. We have previously remarked upon the absence of certain carboniferous forms in these deposits; on the other hand, if we compare some of the species with certain others, from the oolitic series of England, a striking analogy of form is at once perceptible; the *Pecopteris Murrayana*, *P. Whitbiensis*, and *Glossopteris Phillipsii* representing as it were the *Pecopteris (Sphenopteris) alata*, *P. australis*, and *Glossopteris Browniana* of the Australian strata."

It would seem that in those parts of Australia described by the author there is no appearance of any rocks of the secondary period, or even of the early or middle part of the tertiary period. Of the newer tertiary, and perhaps almost the recent period we find some interesting marks in the raised beaches disposed at intervals along the present coast line, in the osseous breccia of the caverns, and in the remarkable fossil trees spread over the surface in some of the valleys, especially in Derwent valley (Van Diemen's Land). The raised beaches contain shells of species still common on the coast: the breccia have supplied Professor Owen with the materials of a Report on the extinct mammalia of Australia and a supplement to that Report, both published in the volumes of the Proceedings of the British Association (1844, 1845), and the remarkable opalized trees have been recently described by Dr. Hooker, the naturalist in the expedition of H. M. S. Erebus.

The gravel of the valley of the Derwent is however hardly less striking than these fossil trees. It consists of a multitude of "boulders composed of cylindrical, somewhat flattened columns of basalt confusedly heaped together with detritus of pebbles mixed with spheroid boulders of greenstone rock, all lodged against an escarpment situated at the bottom of the valley, and on the right bank of the Derwent." (p. 148.) The escarpment is formed of carboniferous rocks, and has been violently rent asunder probably by volcanic disturbance of no very ancient date.

Much still remains to be effected by careful and minute observation, and much also in the way of generalisation, before the geological structure of the eastern portion of Australia can be brought into relation with that of districts at present more minutely and clearly made out. . . Meanwhile, the gradual development of facts bearing on the condition of the eastern and southern continents during the secondary and early tertiary period cannot fail to suggest hypotheses with regard to the condition of the land in these parts of the world, the determination of which may greatly influence the views of geologists concerning European and American geology.

D. T. A.