**Geological of the Main Northern Line**

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THE GEOLOGY OF THE MAIN NORTHERN LINE, NEW SOUTH WALES.

By T. Griffith Taylor, B.Sc.

First Part— General Geology.

Although it may seem a rash statement, yet it is nevertheless true, that a good deal of geology may be learnt from the windows of a railway train. Indeed, cuttings along railways are second onIy to quarries in their interest for geologists. Added to this Is the fact that surveys of railways are usually made with great care and detail, and as a natural result, the geological features along such lines can be in general better worked out and more thoroughly understood than elsewhere.

A journey along the Great Northern Line Is especially suitable in this connection, since the traveller crosses deep gorges— such as at Broken Bay and the Deepwater, over ranges as in the New England District and near Murrurundl, while the train passes through the heart of our most productive mining centre - the Newcastle District.

It Is in the hope of stimulating the interest of the layman in the fundamental structure of the earth's surface in this portion of the State that the following brief account has been written. The accompanying sketch map is “hatched” so as to indicate the age or structure of the various geological formations. A reference to the Index appended will show that the rocks may be divided into four main classes.

A.— Wianamatta Shales and Hawkesbury Sandstones.

B.— Coal Measures.

C— Early Paleozoic Rocks.

D.— Granite (about same age as B).

General Information.

In early Paleozoic times (perhaps about 5,000,000 or 10,000,000 years ago) there were no coal beds occupying the area indicated in black on the sketch. Possibly this was occupied by a large estuary, which received sand and mud poured in by numerous large rivers from north and south. Many animals and plants were washed down also, and, becoming buried by later deposits, gave rise to the fossils which are now found in the rocks which the sand, etc., formed.

Probably the bottom of the estuary was undergoing a slow subsidence until some 5,000 feet of sediment had been piled into the bay. One especially characteristic fossil found in these lowermost beds is a huge bivalve with very thick shells, known as *Eurydesma cordata*.

A period of rest, or slight uplift, next affected the coal measure estuary. Plants, especially ferns, grew in the comparatively fresh waters; various trees also flourished for centuries in the marshes of that period. Probably peaty bogs and mosses were formed, as one may see along the coast at present, perhaps several hundred feet deep.

Then a grand movement of subsidence again took place. The sea made fresh Inroads into the former lake, and more river sand and mud were washed on top of the ancient peat bogs. As much as 5,000 feet of these “Upper Marine” sediments are found overlying the layers of ferns and other organic material. The latter has been so compressed and so chemically altered (losing water and hydrocarbon gases) that it has become turned into a series of coal seams aggregating 20 feet in thickness. This seam is extensively worked near Greta, near Maitland, and is, therefore, known as the Greta seam.

Certain fossils are characteristic of the marine deposits above the Greta seam, just as *Eurydesma* was of those below the coal. It would, hence, be useless to bore for coal below a layer of rock containing *Eurydesma* as a fossil; but another shell, *Productus brachythereus*, tells the geologist that the bed Is newer than productive coal measures, and there is a good chance of the latter being found below the fossil bed in question. This Is a good example of the economic value of the study of fossils, and such methods have been used extensively in the Newcastle district when surveying and mapping in coal seams.

In some portions of the large bay of the coal age, further areas of ferns and peat were buried, after the Upper Marine sediments had been deposited, and gave rise to workable seams, at East Maitland.

Finally some thousand feet of coal measures were deposited, containing layers of organic material aggregating 100 feet of coal. This band of coal extends apparently from Newcastle to Lithgow, and south to Clifton and Wollongong — an enormous area. Messrs. Pittman and others have calculated that possibly 115,000 million tons remain available.

Unfortunately, in some respects, the Paleozoic estuary we have been considering, continued to subside, and more mud and sand was washed over the huge area of potential coal mentioned above.

These upper deposits contain ferns and animals of a different kind from those of the coal measures, and have accordingly been referred to a different geological period known as the Triassic Age. They constitute the uppermost layer, and form the present land surface round Sydney. The lower layers of these Triassic deposits were sandy, and have given rise to the pale-yellow sandstone, of which the City of Sydney is built. Since this sandstone occurs very abundantly in the basin of the Hawkesbury River, it Is known as the Hawkesbury Sandstone. A geological name of this kind does not mean that our Sydney sandstones have a different composition or appearance from that of other far distant localities, but that it is of a definite geological age, with very definite and characteristic fossils.

Finally, within the last half-million years, folding on a grand scale has resulted in the formation of the eastern slope of the Blue Mountains (Lapstone Hill is a typical locality), and led to a depression of the great coal layer below. Sydney to a depth of nearly 3,000 feet: Let us now consider briefly the structure of the northern portion of the area under discussion. Somewhere about the same age that the coal measures were being formed in the Newcastle-Bulli Basin, a vastly different condition of affairs obtained in the New England district.

Here there was probably situated a somewhat shallow central sea, surrounded by folded rocks of a nature similar to those forming the northern shore of the Coal-measure Bay. A huge series of volcanoes belched forth ashy material and lava, and formed deposits of submarine “tuff” — an ashy sandstone. Somewhat later in the world's history the lavas contained a higher percentage of silica (quartz), and there resulted on subsequent erosion, the huge masses of granite which possibly constituted the subterranean supply of the volcanoes aforesaid.

Before proceeding to consider the detailed geology of the northern line, it will be well to understand clearly the meaning of a geological map, and a geological, section.

We may imagine a large saucer to represent the lower marine series below our productive coal. This saucer encloses a series of smaller saucers representing the sediments deposited above the lower marine strata.

Referring to the figure, we see a perspective view of such a pile of saucers with the eastern side sheared off, as the present coast line cuts across the coal basin to-day.

A geological map shows the horizontal appearance of an area of country, with the various “outcrops” suitably indicated. If we imagine that the eastern truncated edge of the basin is a vertical face, this will give one section through the area. Obviously a section in a different direction would differ somewhat in appearance.



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GEOLOGY OF THE NORTHERN RAILWAY LINE.

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Second Part — Detailed Geology.

Sydney lies almost in the centre of the coal basin, and the chief formation is the Wianamatta Shale. This occurs up to 300 or 400 feet thick. Just south of Redfern are huge brick pits of St. Peters in these shales. In hard nodules in the clay, fossil fish and plates of the *Labytinthodont* (a frog-like reptile) have been found.

In gullies round Sydney the underlying Hawkesbury sandstone has been exposed, and as one gets nearer the edge of the “W.S. Saucer,” the shale is naturally thinner and more readily eroded. Most of the fruit trees to the north-west of Sydney are grown on Wianamatta shales. The latter gives rise to the rounded undulating low hills round Sydney; and a quite different scenery obtains when we leave the shales and reach the next “saucer” — the Hawkesbury sandstones. Some deep cuttings just north of Hyde show the typical blue colour of the undecomposed shale, which weathers into a yellowish clay In a very short space of time on exposure.

Near **Beecroft** the railway begins to travel through sandstone country. At the junction between the shale and sandstones one sees “passage beds,” or narrow layers of a sandy shale partaking of the characteristic of both rocks.

The vegetation on the shale is more vigorous than on the sandstone, as can readily be perceived.

Although these sediments have not been tilted appreciably since they were deposited, yet in some places as near **Beecroft** one can see layers apparently steeply tilted. This is “false bedding,” and is due to the sand, etc., having been pushed along over the original delta, much as the layers of a railway embankment exhibit tilted layers, as each load is tipped at the front.

After leaving Hornsby the train travels on the ridge with deep gorges cut through the rugged Hawkesbury sandstone on either side. These Immense valleys are entirely due to the notion of rivers and rain, extending over incalculable ages.

Broken Bay is a good example of the earth's subsidence. If one sees a map of a river valley across which a dam has been thrown (i.e., Cataract Dam), forming a reservoir, the lake thus formed - which has buried the valley - presents just the same features of long, narrow tongues of water and steep slopes as does the similar drowned valley of Broken Bay. Undoubtedly the fresh water of the ancient Hawkesbury flowed into the sea much further to the east than at present, but owing to a slow subsidence of the coast the old mouth is now fathoms deep, and covered by the salt waters of the Pacific.

Hence the steep cliffs of Broken Bay are due to the river, and not marine erosion.

On the other hand, the flats around Woy Woy may be due to an “oscillation” in the other direction— a slight uplift raising some of the mud and sand above high-water mark.

The train soon reaches Gosford, which is very interesting to the Sydney geologist. The Hawkesbury sandstones are among the most barren deposits in the world, as regards fossils. Yet In a small layer in the railway cutting just south of Gosford railway station, a splendid find of fossil fish was made. The latter seemed to have been killed suddenly in a shallow pool.

This deposit is practically the only one which has yielded well preserved specimens of vertebrate animals. The specimens are to be seen In the Mining Museum in the Domain.

To the north of Gosford the character of the vegetation alters, a sign that we are leaving the barren sandstones, and approaching the shales overlying the coal measures.

Cabbage-tree palms and tea-tree scrubs occur here just as at Clifton and Bulli, and for the same reason the latter localities lying beyond the Hawkesbury sandstone (and on the edge of the “saucer” below), showing the same brownish shales which obtain near Wyong and Tuggerah.

The huge flat (Blue Gum Flat) on both sides of the line, and extending to Tuggerah Lakes, may represent an old disused mouth of the ancient Hawkesbury River; but the matter has not been investigated yet.

Near Awaba and Fassifern we reach the true coal measures. There is no very apparent difference between the shales and sandstones of this formation and those of the newer series over which we have been journeying. Perhaps the soil is somewhat yellower, and contains relics of the conglomerate beds, which are a feature of the upper coal measures near Fassifern.

We may briefly recapitulate here the position of the coal seams, which render the coal measures of such interest. At Sydney the coal is some 3,000 feet deep, and is worked In the Balmain shaft. As we journey northward the same seam is probably under us, but gradually nearing the surface until at Lake Macquarie it “outcrops” on the surface. The coal may be likened to a layer of black enamel on the upper surface of the “saucer” representing the Upper Marine Series.

At Fassifern a private tram connects with Lake Macquarie. About 1 mile from the main line, near the tramline, the relics of a coal-measure forest are preserved. On the muddy shores of the lake huge petrified tree stumps some 2 feet in diameter can be seen. Cross joints have caused many of those trunks to break into flat slabs just the shape of a slice of bread cut from a roll. The medullary rays and bark are wonderfully preserved in stone.

This same Lake Macquarie Is destined to be one of the most thickly populated portions of the State. We have only to notice the tremendous increase in population in the Cessnock district, due to extensive and easily available coal seams, to predict a similar prosperity for the former area, if a convenient and accessible entry to the Lake can be maintained.

At Cockle Creek one of the largest smelting works in Australia Is passed. The destructive efforts of the chemical fumes are very evident, acres of dead trees on the leeward side bearing evidence in this connection. On the huge slag dump of these works structures, exactly resembling that of volcanic lava, have resulted from the flow of the slag from top to bottom.

We are now in the heart of the coalmining district. There are several seams worked in the mines, of which the Wallarah and Great Northern are, perhaps, the most important, At Nobbys, a rounded hill forming the southern head of Port Hunter, several of these coal seams can be seen as black bands of the dirty shale, into which coal Is changed on exposure to weather.

From Newcastle to Singleton the railway traverses fairly flat country belonging to the coal measures. Just beyond West Maitland, at Farley, the train passes a road cutting, which is famous for the fossils contained in Its banks. They consist chiefly of shells known as *Spirifers*, so named because the breathing apparatus was carried on a delicate calcareous spiral, which Is still preserved in the fossil specimens. Just to the west of Farley the rocks are seen to be sloping to the east, while at Allandale, some distance on, we note, they slope to the

west. This is an example of an upward bulging (anticline) of the earth's crust, the rock layers dipping (the same way as the roof of a house) from a central ridge, which was situated near Lochinvar, but is now removed by erosion.

In a cutting just before Alandale is reached large bivalves, characteristic of the lower marine series of rocks, are very plentiful.

To the north of Singleton the railway traverses a series of sediments of coal-measure age, situated above the Greta seam.

Near Muswellbrook, in the cuttings, large boulders and much river wash seem to point to a change in the bed of the Upper Hunter within recent geological times, since these boulders are undoubtedly relics of a prehistoric river.

Near Wingen the Greta seam comes to the surface again, and is burning “in situ.” The coal is poor in quality, as is shown by the large quantity of sulphur which is distilled from the burning coal.

We have now reached the northern boundary of that huge ancient estuary in which the coal measures (enclosing the later Hawkesbury series) were deposited — these two groups of sediments being compared to a series of saucers enclosed in a surrounding mass of much older rock of Paleozoic age.

Tamworth is situated on rocks containing certain fossils of the same age as those found in the rocks of Devonshire, hence known as of Devonian age. A series of hills to the north of the railway line consist of claystones and limestones. The latter contain some rare fossils not found in such abundance anywhere else in the world. Some of the hardened claystones contain relics of minute organisms known as *radiolaria.* This microscopic animal (one of the lowest in the scale of life) formed a shell of silica, in the form of a sphere of delicate net-like structure, with sharp radiating spines. With a microscope these shells are still visible in the rock after the lapse of many millions of years.

The broad valley of the Peel consists of a series of alluvials and gravels laid on the top of the very old and highly tilled Paleozoic claystones. In many places in the valley permanent water is obtained by sinking wells on to the claystones. The water soaks along the surface of the latter, which forms an impervious floor. Here we have an artesian basin in miniature, though the water does not, of course, rise in a “spout,” as the supply is quite local.

Moore Creek, about 6 miles north of Tamworth, has a reptation for Devonian corals, papers on the geology of this area having been communicated to the Geological Society of London. From Tamworth to the Queensland border the train travels along the ridge of the huge New England Plateau. This landform owes its existence to the fact that it consists largely of granite. Mr. E. C. Andrews, one of our best-known geologists, considers that the various granites are of very different dates. Some varieties containing a bluish-tinted felspar known as “blue granite” were probably extruded through the Paleozoic rocks before the coal measures were deposited. After these last sediments had been laid down, a period of earth-folding and mountain-building arose, accompanied by a “squeezing-out” of granites containing more silica than the blue granite. These later granites are of great economic importance, since they are associated with tin and bismuth minerals, for which New Zealand Is noted.

From the railway train one would not be able to distinguish the various kinds of granite. Still, the granite itself can be distinguished from other rocks by its habit of forming “tors.” This is due to the fact that granite tends to crack into cubical blocks along definite 'joints.' The corners of these blocks are the more rapidly attacked and weathered, and hence one may see three more or less spherical lumps of granite forming a “tor,” which simply consisted originally of a jointed column. Near Stonehenge many of these rounded monoliths and tors may be seen.

Of much later date than any of the above-mentioned rocks are the basalts (“blue metal”), which form the highest portions of New England. These are flows of lava of a very dark colour, containing much more iron and less silica than the granites. Most eruptions in late geological times consist of basic lavas approaching basalt in composition, while the most ancient volcanoes seem to have produced rocks of a more acid character allied to granite.

**Glossary.**

**Alluvial**. - Recent deposits of silt mud, gravel, etc., deposited by rivers of fairly recent date.

**Eurydesma**. - A huge bivalve like a large cockle, which is characteristic of the deposits below the Greta seam.

**Granite**. - A coarse crystalline rock composed of colourless quartz, milky white (or reddish or bluish) felspar and mica. Of eruptive origin.

**Basalt**. – a fine-grained blue-black rock, composed of felspar and iron minerals, of volcanic origin.

**Measures**. - A series of beds belonging to a single geological period of coal measures.

**Outcrop**. - That portion of a bed or mass of rock which is exposed at the earth's surface.

**Paleozoic**. - The great interval of time extending from the Dawn of Life to the close of the coal age.

**Productus**. - An extinct shell characteristic of the beds between the Greta and Newcastle coal seams.

**Triassic**. - The name given to the sediments Immediately newer than the Paleozoic (e.g., Hawkesbury sandstones),

**Section**. - A hypothetical view of a vertical face cut through the earth's crust. These geological sections are determined by boring and by noting tilting of the strata at the surface.

**Upper Marine**. - A series of sediments lying above the Greta seam.