The Open-Cut Era (Late 1940s – Mid 1960s) in the Western Coalfield of New South Wales: including some autobiographical memories

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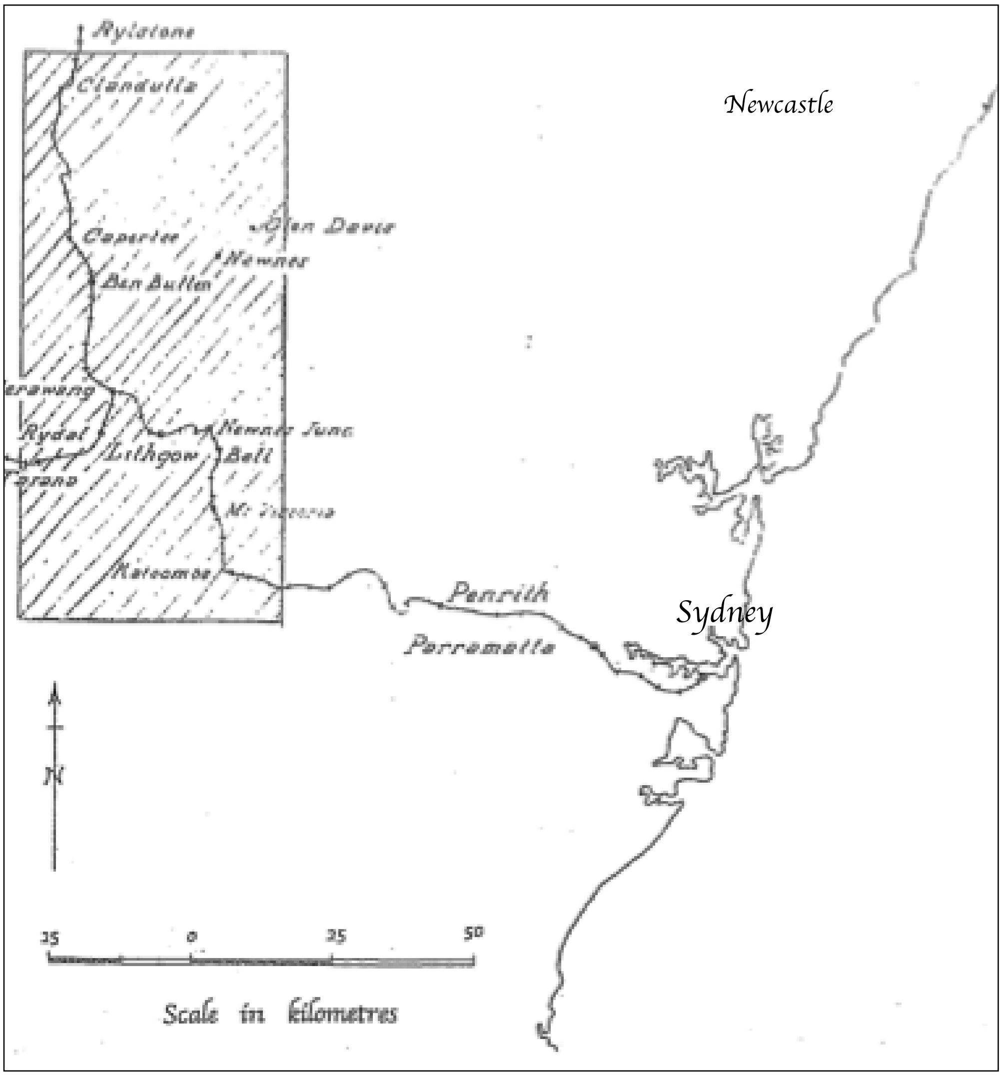
The term 'Western Coalfield' refers to that part of the Sydney Basin of New South Wales extending from about Katoomba in the south to Ulan (near Rylstone) in the north, where coal has been located and mined since the mid nineteenth century (Fig. 1).

Figure 1: *Western Coalfield Locality Map*



Source: D. Branagan

The occurrence of coal in that region was first hinted at by George Bass (1771 - 1803), as early as 1797, following his examination of the coal seams exposed on the coast near Coal Cliff, south of Sydney.[1] The first proper evidence of coal deposits west of Sydney was given by the discovery of coal fragments near the mouth of the Grose River by Captain William Paterson about 1795, and documented by Governor Hunter in a letter (20 August 1796) to Sir Joseph Banks.[2] In 1802 a similar, better-publicised discovery, was made at the same locality by the French naturalists Bailly and Depuch,[3] and the first in-situ discovery was probably made by Lt. William Lawson in 1817.

Settlers, including Andrew Brown (from 1822) in the vicinity of Lithgow/Wallerawang first realized the extent of some of the coal seams, and there was undoubtedly small local mining and use, perhaps as early as the late 1830s for 'burning' limestone. The Reverend W.B. Clarke (1798 - 1878), reporting to the Coal Enquiry of 1847, indicated the basin-like structure of the Sydney-Blue Mountains region, and said that there were extensive coal seams in the western Blue Mountains. However mining only became firmly established in the 1860s, with oil shale in particular, being mined at Hartley in 1865. By 1870 the term Western Coalfield seems to have been firmly established, with specimens of coal, oil shale and clay exhibited under that locality name at the 1870 Intercolonial Exhibition in Sydney.

Direct observations of the geology of the Western Coalfields region were made by the early explorers and particularly by naturalists such as the French J.R.C. Quoy on the Freycinet Expedition (1817 - 1820)[4] and R.P. Lesson on the Duperrey Expedition 1822 - 25.[5] More systematic recording of the geology began with the work of W.B. Clarke, as early as 1841, when he visited the Lithgow area and collected specimens of *Glossopteris,* the important Coal Measures fossil, at Hassan's Walls, near Lithgow.[6] His interests continued over the next thirty years. His map of the region, first published in 1867, outlined the exposures of the western coalfield, and specified occurrences of 'Oil Shale'.

Shortly after his appointment as Government Geological Surveyor, C.S. Wilkinson (1843 - 1891) carried out mapping in the Wallerawang area, preparing the first detailed map showing the unconformable relationship between the older Palaeozoic metamorphic and igneous rocks, overlain by Permian marine sedimentary rocks and then conformably by coal measures.[7] Between 1874 and 1880 Professor A. Liversidge (1846 - 1927) of Sydney University examined coal seams (and iron occurrences) for the newly established Irondale Iron and Coal Company, and for the Colonial government, near Wallerawang.[8] Professor W.J. Stephens (1829 - 1890), also of Sydney University, studied the region through the 1880s, publishing several papers on the stratigraphy.[9] T.W. Edgeworth David (1858 - 1934), working under Wilkinson in the Geological Survey, carried out surveys in the region during the late 1880s, notably on the coal and oil shale occurrences in the Megalong Valley.[10] This was at a time when oil-shale mining was probably economically more important than coal mining. John Lucas reported that in 1873, the ‘New South Wales Shale and Oil Company Petroleum’ produced 15,000 tons of 'oil cannel coal, used for oil and sold for gas purposes'.[11] There was coal production (18,000 tons) from Lithgow Valley Colliery; the Eskbank Colliery of Thomas Brown, Esq. M.L.A. produced 8, 600 tons; Bowenfels Colliery 8,500 tons; Hartley (Vale of Clywdd Colliery) 50 tons; and on the Mudgee Road, Bulkeley's mine at Blackman's Flat produced 50 tons.

While considerable local knowledge had accumulated from the above work, no systematic mapping was undertaken until J.E. Carne (1855 - 1922) of the NSW Geological Survey began his work about 1900. Carne's extraordinary achievements in this region are recorded in his two classic publications[12] and in his unpublished field notebooks (NSW State Archives). Carne mapped the boundaries and extent of the Coal Measures from near Wentworth Falls to Rylstone and beyond, covering the Capertee Valley and the very rough country east of Newnes and Glen Davis. His map of colliery holdings shows scattered sites from the Kedumba Valley to north of Capertee.

Figure 2: *Kerosene Vale Open-Cut, Lidsdale, ca. 1960, showing unworked Lidsdale Seam exposed in the highwall. The flooded pit covers the mined Lithgow Seam area. D.K. Tompkins (dec'd) in foreground.*

Source: Photo D. Branagan

Carne recorded coal seams named as the Lithgow, Irondale (also known as Black Diamond), and Katoomba, and other rock units, although there was at the time no firm stratigraphic nomenclature established. He referred to the coal-bearing sequence as the 'Upper Coal Measures', correlating them with the coal beds at Newcastle, and separated from the 'Lower Coal Measures' of the Hunter region, as mapped by Wilkinson and Edgeworth David in the Hunter region. This Hunter region work, from the 1880s, is encapsulated in David's 1907 publication.[13] The coal measures in the west became known as the Lithgow Coal Measures until continuity was established through the Southwestern Coalfield[14] with the earlier named Illawarra Coal Measures. Being mapped on the South Coast, the latter term was applied, and is now used to refer to the coal measures in the southern, southwestern and western coalfields.[15]

Open-Cut coal mining history

The real spur for the development of open cut mining in New South Wales, and particularly in the Western Coalfield, occurred in the early post-WW2 period. It was a time in Australia marked by serious coal shortages that caused frequent disruption to electricity supplies. The shortages were the result of poor planning, out-of-date equipment, inefficient underground methods, and an anarchic labour force, which seemed immune from the rule of law.[16] Consequently many small operations sprang up, mining virtually any substance which had a vague resemblance to coal.

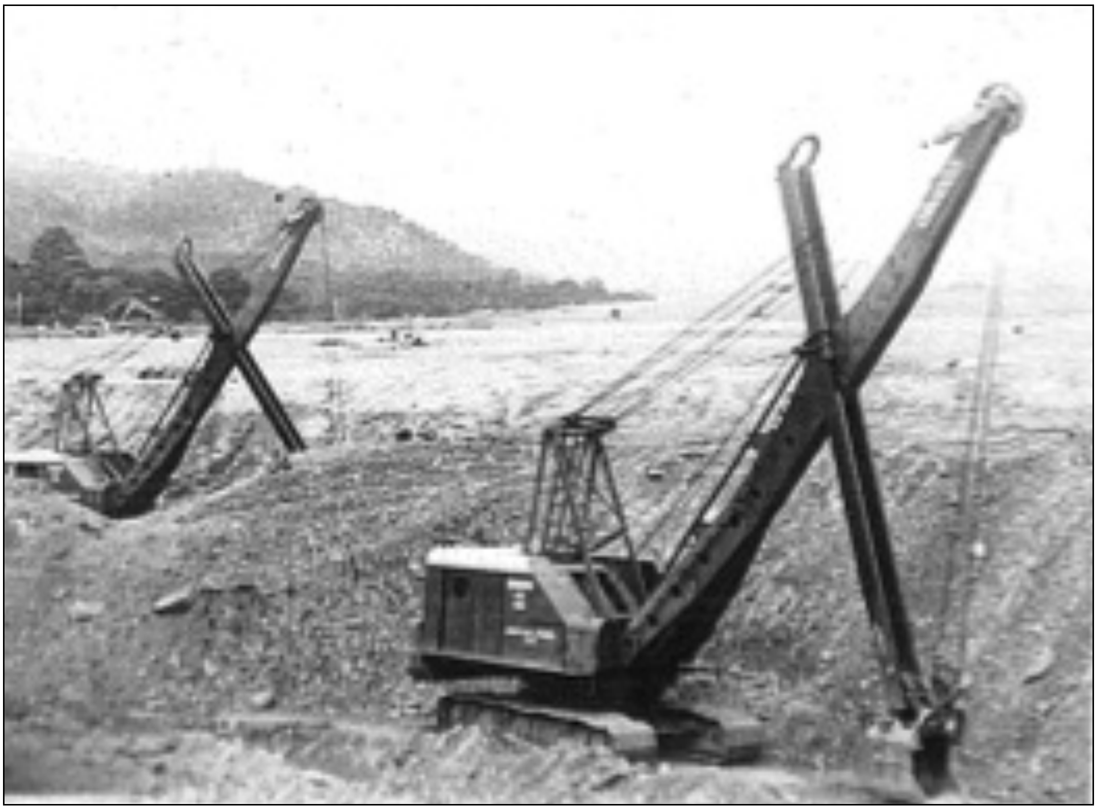
By 1946 it was clear that the coal industry needed radical changes, and moves were made on a variety of fronts, such as legal reforms concerning the mining unions (which will not be dealt with in this paper). In New South Wales an Electricity Commission was established, as was, in December 1946, the Joint Coal Board, a co-operative Commonwealth- and New South Wales- funded body to improve the productivity and safety of coal mining in that state, which at the time was by far the largest producer. The inaugural Chairman was Keith Cameron (1902 - 1967), by training a hard-rock mining engineer, who accepted the job, although 'other men had shied away from a task that was bound to prove thankless, even heartbreaking'. While the press was often critical of Cameron's approach to problems, and he did not at times please either the miners' union or the mine owners, after his death a former colleague commented that Cameron 'must be given the most credit for the resuscitation of the very sick coal industry, not only in New South Wales but in Australia. He made great progress in the face of often passive and at times active resistance from many coal owners, employers and employees'.[17] It was Cameron who pushed for mechanization and open-cut mining.

The first brief open cut activity in the State had taken place in the Western Coalfield at Kerosene Vale, near Lidsdale, in 1932, mining the Lidsdale Seam (for which see later). Apart from this short-lived attempt, coal production came essentially from underground mines prior to WW2. Thanks to the stimulus of the post-War requirements, open cut mining recommenced at Commonwealth Colliery, at Lidsdale, in 1945. although Marshall[18] suggests there was some open cutting attempted there in 1940. Then similar mining began at Western Main in 1945-46. A serious attempt to mine by open cut also began in the Hunter Valley about 1945, and despite inadequate equipment it seemed that there was a possibility of economic production by this method. Over the next few years the search began in earnest for possible sites, in the Hunter Valley, near Swansea south of Newcastle, and in the Western Coalfield, the Southern Coalfield offering no such opportunities.

All these developments used unsuitable equipment, and there was inadequate prospecting and no proving of coal thickness and quality by drilling. On the Western Coalfield the only equipment available was (a) one 4 cubic yard steam shovel (30 years old), and (b) several 2.5 cu. yard excavators.[19]

In late 1948 newer, larger equipment became available from the USA. In the process it provided a nightmare for transport over the Blue Mountains, as most such equipment was very large in terms of the standards of the time, and could not be carried by rail. The logistics of getting this equipment from the coast to the west took some solving, as the machinery could only be brought by road, and the 'Great Western Highway', the only sealed road (of two routes over the mountains, the other being Bell's Line of Road) was not built for such traffic, so there were some very long traffic jams. However, soon there were about ten 2.5 cubic yard high-lift shovels, some 6 cubic yard electric power shovels, 175ft boom walking draglines, and bulldozers. These enabled the first modern methods of overburden removal.

Figure 3: *Electric Osgood Power Shovels, Western Mail opencut,*



Source: Photo courtesy J.A. Dulhunty

Apart from the initial lack of suitable equipment, a major problem for the open cut program was that there was almost no experience of near-surface coal mining; industry conditions, and the general instability of coal mining did not attract appropriately experienced metalliferous miners, so road engineers, quarry operators and enthusiastic locals 'had a go'. As Marshall noted: 'the apparent simplicity of surface mining has been the downfall of many a highly placed executive'.[20]

In 1947 systematic testing began at Kerosene Vale; and the following year at Baal Bone, often called Ben Bullen, although it is several kilometres southeast of that 'village'. Open cut mining began at Baal Bone soon after. This site had been one of interest for coal mining in the early 1920s, when a State-run cement works was proposed near Baal Bone Gap, using limestone from Blue Rocks, a deposit close by in the Capertee Valley,[21] but it was abandoned in face of the opening of works at Kandos, some kilometres north, where the limestone was more accessible.

The Western Coalfield open cut geology story begins in earnest

The first post - Carne geological work in the Western Coal region consisted of brief surveys carried out by NSW Geological Survey members E.J. Kenny,[22] and F.W. Booker.[23] In 1948 a systematic, detailed geological study to determine open cut possibilities was established under the charge of E.O. Rayner of the Survey[24] (Fig. 4), assisted by L.R. Hall and J.V. McAuliffe. Carne's basic work, carried out at the turn of the twentieth century, formed a very useful basis for Rayner's project. In conjunction with the detailed geological mapping, prospecting of specifically chosen areas was undertaken by the Joint Coal Board; scout drilling ahead of detailed testing was undertaken by the Commonwealth Bureau of Mineral Resources, and detailed proving by the Joint Coal Board.

Figure 4: *E.O. Rayner with plane table, for use with the alidade instrument.*

Source: Photo courtesy of E.O. Rayner

The requirements for likely open cuts were to avoid nearby underground workings, the cover rocks (overburden) had to be ideally less than 20m thick, but cover thickness might, in suitable circumstances (such as soft rocks, and thick seams), be up to 45m, and the overburden ratio from as low as 2 to 1, to as high as 15 to 1.

Although the equipment available at that time for open cut operation was a great improvement on what had been used earlier, there were still limitations, such that the thickness and hardness of the overburden on any particular coal seam placed limitations on what could be economically mined, and thus limited what sites could be made operational.

Rayner's first task was to refine Carne's earlier work on the stratigraphy of the coal measures succession, thanks to better exposures of parts of the succession, and the new information available from mining company records and drilling. Rayner's work identified particular rock units in the coal measures succession, which enabled correlation to be carried out over considerable distances in the Western Coalfield (Figure 5).[25]

A particular problem arose in that there was some confusion from records covering the stratigraphy of the lowest, and most productive, part of the coal measure succession. In most locations there seemed clear evidence that the basal bed of the coal measures was a conglomerate of variable thickness, known locally as the Marrangaroo Conglomerate, overlain by the most commercially workable seam, the Lithgow Seam. However in the Lidsdale area the position seemed to be reversed, in that the coal seam had insignificant shaley sandstone below, but was overlain by a thick conglomerate bed.

***Figure 5**: Western Coalfield Sedimentary Sequence*

TRIASSIC Narrabeen Group

Cliff-forming sandstones, with red claystones

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PERMIAN SUCCESSION

ILLAWARRA COAL MEASURES (Western Coalfield)

KATOOMBA SEAM, maximum 2.4m

shale and claystone
WOODFORD SEAM, max. 1.2m
shale and claystone
BURRAGORANG CLAYSTONE (Chert), max. 6m

claystone, shale

MIDDLE RIVER SEAM, include shales etc., max 43M
sandstone, mudstone, shales, max. 43m
IVANHOE SANDSTONE, max 1.2m
IRONDALE SEAM, max. 2.6m
BUNNYONG SANDSTONE, max. 3m
shale, sandstone, claystone, max. 25m
LIDSDALE SEAM, max. 3m
BLACKMANS FLAT CONGLOMERATE wedge 0 – 21m
LITHGOW SEAM, max 6.9m (combined with Lidsdale Seam)
MARRANGAROO CONGLOMERATE, max. 21m

SHOALHAVEN GROUP
(fossiliferous marine sedimentary rocks)
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######## UNCONFORMITY ########
DEVONIAN SUCCESSION (folded)

Source: After E.O. Rayner

Was it the same conglomerate, or could there be two different seams? In the event Rayner was able to use several key outcrops exposed in the early open cuts, combined with information from the scout drilling, to establish the true story. This was that, while the basal conglomerate was generally a thick conglomerate, it did grade laterally into a finer-grained sandstone in some localities, and interestingly, where this happened, the overlying Lithgow coal was better quality (that is, had lower ash content). However this did not solve the problem of the thick, apparently overlying conglomerate. Rayner showed that, on a regional scale, coal deposition was interrupted over some distance and that a second quite extensive conglomerate 'lens' had been deposited. Coal formation then resumed over this lens, though where the lens of conglomerate was absent coal formation had been continuous. In geological terms the coal seam had been 'split' in two. Thus survey results depended where one inspected the coal/conglomerate occurrence. Many exposures would show (a) conglomerate overlain by coal, other sites (b) a coal seam overlain by conglomerate, others (c) conglomerate then coal another conglomerate and a second coal seam above. This higher seam was called the Lidsdale seam, but where the 'upper conglomerate 'lens' (named Blackmans Flat Conglomerate) thinned out there was only a single, thicker occurrence of the 'combined Lithgow-Lidsdale Seam **(**Fig. 6**)**.

Figure 6: *modern Tyldesley Open-Cut (2010) mining multiple seams, including Irondale and Middle River Seams, and the intervening strata* **.**

Source: Photo D. Branagan

(b) The plane table-alidade mapping method

Some detailed geological mapping was attempted using aerial photographs, but the quality and scale of these WW2 photographs left much to be desired. Also, the military maps of the area then available were not at a scale to provide accurate close-spaced contours needed to give a good indication of rock bed thickness and other geological details.

The only solution for obtaining good useful data for determining open cut potential was by mapping, using fairly detailed survey techniques combined with drilling to assess the coal quality of any suitable site. A team led by Rayner, and assisted variably by Hall, W.E. Foskett, J.V. McAuliffe, R.E. Relph, C.T. McElroy, D. Wynne, A.J. Gourlay, R. Griffin and D.F. Branagan worked over a few years to conduct the mapping.

The method chosen for the geological work was what is known as plane-table, alidade and staff. This method had the advantage that both the geology and topography could be plotted directly onto a map drawn on mapping paper attached to the flat surface of the plane table as the survey progressed. The geologist/staff (or 'rod') man walked along the outcrop of a coal seam and his various positions were recorded by the instrument man (and they were all men in those days), the base and top of each bed could be noted and variations in thickness calculated, while the beds above and below the seam were also noted, as they determined how easily a seam could be mined. While the basic aspects of the map could be recorded as the work progressed during each day, calculations later at the campsite enabled the necessary corrections for elevation and thickness variations.

To be regionally useful each alidade-mapping project required ties to established trigonometrical (trig) stations, or to Parish and portion boundary corners. However, establishing the basic datum elevations for the region turned out to be no easy task. We assumed rather naively that trig station values established by the NSW Lands Department over more than a century would give us all we needed. Unfortunately most of these sites were not easily accessible for us, and portion boundary corners were not always easily located, so we had recourse to datum points established by the then Departments of Main Roads, Railways, Forestry and even, occasionally, local Shire mapping. To our surprise we found that rather than being tied to the basic Lands Department network, each body had established its own height datum system! Trying to link them and our own work proved a nightmare, as did our attempts to use barometric pressure readings at sites returned to regularly on a daily basis, notably the railway station at Ben Bullen, now largely abandoned.

Despite these difficulties the survey team mapped the detail of the lower part of the Lithgow Coal Measures (now known to be continuous with the Illawarra Coal Measures) from near Portland almost to Ben Bullen, a distance of more than 12 km at a scale of 8 inches = I mile, together with more detailed mapping at selected localities (Marrangaroo, Western Main, Blackmans Flat, Portland, and Kirbys Hill (Fig. 7). The presence of Older Palaeozoic rocks at higher elevations just to the west of Portland indicated that these coal measures had been formed close to the original border of the Sydney Basin.

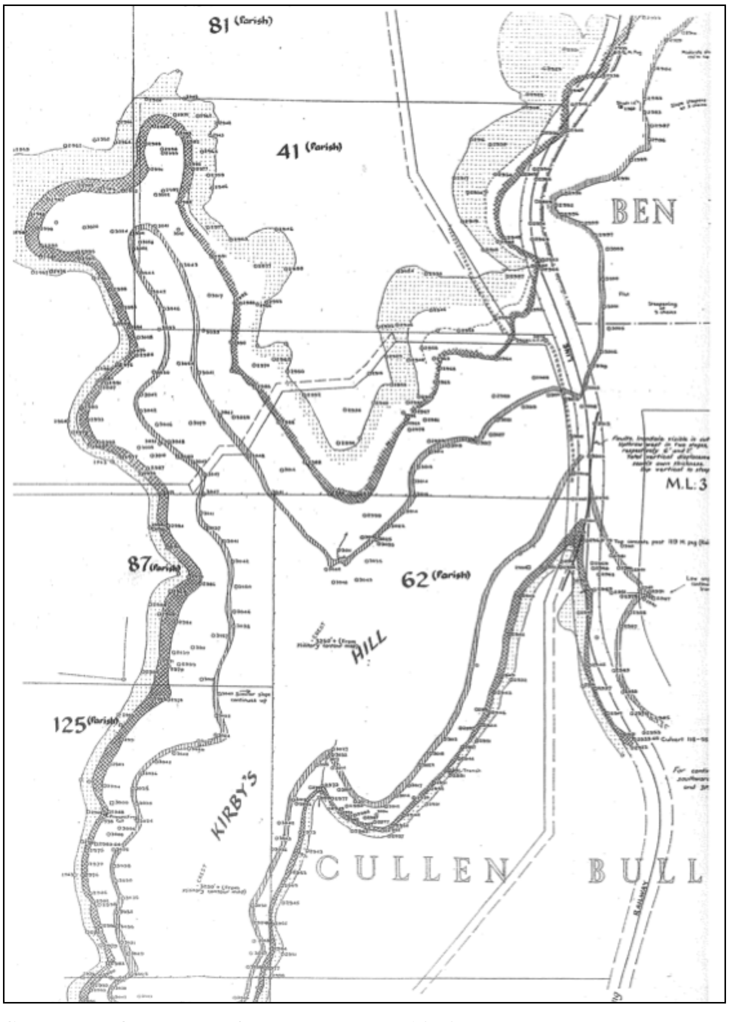
In addition to our mapping of the geology, a railway spur line from the main Mudgee line was surveyed across the basal Marrangaroo Conglomerate, south of Jews Creek, into the Ben Bullen (Baal Bone) open cut area, but the line was not constructed at that time, and coal was transported by road for some years. However the line was later put in, when the colliery went underground, as mining followed the easterly dip of the Lithgow Seam, under an increasing overburden.

(c) Coal endpoint, political interest and improved drilling

A major endpoint for the coal was the Wallerawang Power Station, constructed in 1954. Part of our task, prior to construction, was to check the geological footing conditions for the proposed power station. From the viewpoint of present-day engineering geology practice it must be admitted that our work would probably be regarded as cursory in the extreme! Much later (1980s) a second power station was constructed near Piper's Flat, supplied with coal from both open cut and underground mines.

The political nature of the changes in mining operations in the early 1950s meant that some politicians, Federal and State, were interested enough to visit the Western Coalfield and see the problems and developments for themselves. Prominent among these was the notable W.C. (‘Billy’) Wentworth (1908 - 2003), who took the trouble to come and see what the geologists were doing. He wasn't afraid to plunge into the bush to look at an outcrop, and to ask questions. We were lucky also to have the enthusiastic co-operation of Ken Mosher (1913 - 1990), the Joint Coal Board's chief geologist and a good friend, who clearly enjoyed the opportunity to get back into the field, rather than being stuck in the office. Mosher, together with his then assistant Brian Vitnell (d. 2010), designed the inner split core barrel, used for core - drilling, which ensured much higher core recovery of soft rocks, thus ensuring more accurate knowledge of the rock succession.[26] Though this technique became widely adopted, particularly in North America, recent technical literature (see e.g. internet sites) gives no acknowledgement to the original designers.

Figure 7: *Alidade map of portion of Kirbys Hill survey, showing extent of basal Marrangaroo Conglomerate (dots), Lithgow Seam (cross-hatched), and Irondale Seam (vertical lines), the hill now (2012) being a potential open – cut site.*



Source: E.O. Rayner & D. Branagan, 1952.

The drilling, however, was of two types, core drilling and percussion drilling, or a combination. Percussion was faster, but only produced rock fragments. While such drilling gave an indication of coal thickness, the details of seam variation, such as the presence of persistent clay bands, ash content variation etc., could only be roughly assessed. Core drilling, under the best conditions, gave a continuous record of the rock succession, and allowed accurate sampling and testing of the seams, and better correlation. In some cases percussion drilling was carried out through overburden, and core drilling began when not far above the seam. Drilling records enabled the preparation of extensive maps showing variations in seam thickness, seam quality, seam dip and faulting, all-important for ensuring successful mining.[27]

(d) Conservation

During the initial period of open cut mining little thought was given to conservation matters, and in the early 1950s the Blackmans Flat - Western Main area, adjacent to the Mudgee Road, resembled a war zone. It took some time before rehabilitation of the mined areas was undertaken properly, but in general the old open cut sites were finally reasonably rehabilitated. Former mines at Blackmans Flat and elsewhere are now filled, re-contoured and re-vegetated, although Marshall indicated at that time, that the removed topsoil was not stored, because it was expected rehabilitation would take place by natural revegetation processes.[28] Requirements for rehabilitation are now enshrined in law.

(e) Today

The establishment of vibrant offices of the NSW Mines Department, the Joint Coal Board and a number of private companies saw a re-invigoration of Lithgow and surrounding villages in the 1950s. The present is a period of even greater development. Equipment which would have been unthinkable in the 1950s now operates, and open cut mining on a scale unimaginable 60 years ago is the norm. For example, at Tyldesley, north of the former Cullen Bullen railway station, seams well above the Lithgow Seam, including the Irondale Seam and Middle River Seam (in earlier days referred to as the 'Dirty Seam'), are being mined essentially in a single operation. The nearby Kirbys Hill (Fig.6) mapped by us, apparently now offers distinct open cut possibilities.[29]

(f) A geologist's life

In the days of the early mapping, there were no motels and we occasionally stayed in pubs. However they were generally so awful that camping was a better alternative. At that time we had few or no worries about the camp being disturbed (Fig. 8), even though our campsites were relatively close to roads. We could cook our own, generally more nutritious, meals, and get on with the necessary writing up of results without too much distraction. Part of the camping process included ensuring adequate food supplies. While bread and fresh meat could often be obtained locally, these were the days just before the immensely useful portable kerosene refrigerator (Hallstrom's famous 'Silent Knight') became readily available. Consequently we had recourse to various tinned supplies. As many of the Survey's field parties were camp-based it made sense to buy non-perishables in bulk from a wholesale source, and divide up as desired. One delicacy we originally looked forward to was 'Herrings in tomato sauce'. Although initially relished, after the thousandth or so tin we were somewhat less enthusiastic, and the worst experience involved a lunch time when the roll-back key failed, leaving us (tin-opener missing) to attack the tins with a geological hammer.

Getting back to camp, or to our vehicle, sometimes involved a long walk, but in the days before health and safety watch-dogs we were occasionally lucky enough to 'hitch' a ride with railway gangers on their push-pull or petrol-driven vehicles. The thrill of riding the rails and feeling the wind blowing through our hair was a rare treat indeed, spiced by the need to keep a lookout for any errant, unscheduled train coming from the opposite direction on the single track!

Figure 8: *Campsite near Ben Bullen Railway station (1951 – 52)*

Source: Photo D. Branagan

Figure 9: *Washout of seam near Ulan exposed (1952) on uncompleted Dunedoo-Sandy Hollow railway (built in the 1930s). Ulan later became a major open-cut area.*

Source: Photo D. Branagan.

One pub we did stay at, which was both memorable and enjoyable, was at Ulan, the furthest north of our Western Coalfield work**.** At Ulan, there was then a small underground coal mine operating, with the proposal to be enlarged to provide fuel for the local council's plan to generate electricity for the region. Rayner with F. Loughnan first visited it on geological work concerned with the expanded mining program in 1949,[30] and Rayner and I followed in 1951. Ulan was on the route of the abandoned Maryvale-Sandy Hollow railway scheme, a project begun in the 1930s depression years with all the formwork completed, even with some bridges and tunnels (Fig. 9), but which was suddenly suspended without any sleepers or rails laid. Ulan was then a veritable backwater. However the pub was welcoming (they didn't have a lot of visitors), as were the locals. There was no electricity, lighting was by kerosene lamp and vigorous coal-fuelled fireplaces. After-work hours were never dull at Ulan. There was an aged piano, a competent pianist and lots of community singing, accompanied, it must be admitted, by a certain amount of alcoholic beverage. They were good times, indeed; far-removed from the present huge open cuts of the area and a railway line to Newcastle carrying very long trains with coal for export.

Relaxation in our two-man camps consisted of annoying each other (Rayner and Branagan) by our individual attempts to conquer the clarinet (each had the same length of practice time allotted!). Good sleeps on cold winter nights were assured, in part, by a good nip of rum. While the geologist's life on these surveys was hard, most of us wouldn't have missed it for quids.

Acknowledgements

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[20] *Ibid*.

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