1893.

NEW ZEALAND.

REPORT ON LEASEHOLDS OF GREY VALLEY COAL COMPANY.

Presented to both Houses of the General Assembly by Command of His Excellency.

Messrs. H. A. Gordon, F.G.S., Inspecting Engineer; A. McKay, F.G.S., Mining Geologist; and N. D. Cochrane, Inspector of Mines, to the Hon. A. J. Cadman, Minister of Mines.

Mines Department,
Wellington, 7th September, 1893.

Sir,—

In accordance with your instructions to us to examine and report on the conditions of the Brunner, Coal-pit Heath, and Wallsend Mines, the properties of the Grey Valley Coal Company, we have the honour to report as follows:—

Brunner Mine.

A lease of this property, comprising an area of 1,280 acres, being Section 2A, Square 119, in the Grey Coal Reserve, was originally granted to Messrs. Croaker, Hughes, and McCarthy, for twenty-one years from the 1st of January, 1874. It was transferred by them in 1875 to the Brunner Coal Company, who subsequently transferred to Martin Kennedy in 1879.

This lease was surrendered in the end of December, 1886, and a new lease granted from the 1st January, 1887, for a term of sixty-three years. This new lease has been transferred to the Grey Valley Coal Company, the present proprietors.

Conditions of Lease.—The conditions on which this new lease was granted were as follows: For the first eight years the dead-rent was to be £480, and the output of coal 45,000 tons per annum; the next twenty years a dead-rent of £750, and an output of 75,000 tons of coal per annum; and for the remainder of the term a dead-rent of £1,000, and an output of 100,000 tons of coal per annum.

Royalty.—When the original lease of this mine was granted, for a term of twenty-one years only, the amount of royalty specified to be paid was 6d. per ton, and this lease, if not surrendered, would have expired on the 31st of December, 1894. Arrangements were made, in granting the new lease for a longer term, that no increase in the royalty was to take place until the date of the expiration of the original lease, but after that date the royalty was to be increased to 1s. per ton, the dead-rent to merge in the royalty—that is to say, when the royalty exceeded the dead-rent; the latter was not to be paid.

Output.—The total quantity of marketable coal taken out of this mine since it was first opened, up to the end of July of the present year, is 986,675 tons. The area in which the whole of the coal has been worked is about 145 acres, and in addition to this there is about 48½ acres formed into pillars on the bord-and-pillar system. These pillar areas contain about 50 per cent. of the solid coal, making a total area over which the workings have been extended of 193½ acres.

Taking the total output of coal from this mine, and the number of acres from which the whole of the coal has been worked—namely, 145 acres—and the area of the pillar-workings, equal to 48½ acres, of which 50 per cent. of the solid coal has been taken out, this would equal an area of 169¼ acres from which the whole of the coal has been won. To take the thickness of the coal over the whole area worked, an average of at least 9ft. would be obtained, and the actual quantity of coal in a seam of this thickness is about 10,800 tons per acre, making a total of 1,827,900 tons. This shows that only about 54 per cent. of the seam has been disposed of as marketable coal.

Coal-pit Heath Mine.

A lease of this mine was originally granted to the Coal-pit Heath Company from the 1st January, 1875. It comprises an area of 777 acres, being Section 231, Square 119, Grey Coal Reserve.

This lease was transferred to the Westport Coal Company in September, 1887, and again transferred to the Grey Valley Coal Company in August, 1888. A surrender of this lease was made, and a new lease granted to the latter company from the 1st January, 1889, for a term of sixty-three years.

Conditions of Lease.—The conditions on which the existing lease was granted were: For the first eight years of the term the dead-rent was to be £250, and the output of coal 25,000 tons per annum; for the next twenty-eight years, a dead-rent of £500, with an output of 30,000 tons per annum; for the next twenty-one years the dead-rent was to be £750, and the output of coal 50,000 tons per annum.

Royalty.—A royalty of 6d. per ton was to be paid for the first twenty-one years of the lease, and for the remainder of the period 1s. per ton; the dead-rent to merge in the royalty, the same as stipulated for the Brunner Mine.

Output.—The quantity of coal taken out of this mine since it was first opened up to the end of July in this year was 573,141 tons. The total area in which workings have been carried on is about 73¼ acres; and in this area the whole of the coal has been taken out in about 39½ acres, and 27¾ acres have been formed into pillars, of which 60 per cent. of the coal has been won. This is equal to 56¼ acres as the total area from which the coal has been entirely worked, or a produce of 10,207 tons per acre. The average thickness of coal in this mine was about 15ft., and the actual quantity contained in this thickness should be about 18,000 tons per acre, which would make a total for the area worked of 1,010,700 tons. This shows that only 56½ per cent. of the whole of the coal in that area was disposed of as marketable coal.

Wallsend Mine.

A lease of this property was granted for twenty-one years from the 1st August, 1873, to the Greymouth Coal Company. This company, having expended its capital in sinking shafts and erecting machinery, was unable to continue operations in opening out and developing the mine, so they sold their property to a syndicate, who afterwards transferred it to the Westport Coal Company; and in August, 1888, it was again transferred to the Grey Valley Coal Company. This lease was originally granted for an area of 1,000 acres situated on the south side of the Grey River, and opposite the Brunner and Coal-pit Heath Mines. There was a provision in the lease that should the company fulfil all the conditions imposed therein, they should acquire the right to purchase 150 acres of the land at £5 per acre, at any time within five years from the expiration of the lease. This freehold was, however, acquired before the time stated in the lease, and the leasehold area was thus reduced to about 853 acres.

Conditions of Lease.—The conditions in the lease in regard to output, dead-rent, and royalty, were as follows: For the first year of the term the output of coal was to be 2,000 tons; for the second year, 5,000 tons; and for the remainder of the term, 15,000 tons. The dead-rent for the whole of the term was £20 per annum, and a royalty of 6d. per ton was also provided so long as the coal was conveyed to Greymouth other than by rail; but as soon as the railway was opened a charge of 2s. per ton was to be paid for coal freight to Greymouth, and this charge included royalty.

After the purchase of this property by the Grey Valley Coal Company, the mine was closed, in July, 1890, and operations entirely confined to the Brunner and Coal-pit Heath leases. The total quantity of coal put out to date is 205,539 tons; a portion of this quantity is from the company's freehold, part from under the Grey River and Railway Reserve, and the remainder from below the private freeholds on Taylorville Flat. No coal was taken from the leasehold, with the exception of what was worked from the Tyneside mines hereafter referred to.

Tyneside Mine.

This mine is in the leasehold originally granted to the Greymouth Coal Company, and now the property of the Grey Valley Coal Company. Before the latter company took over the various coal properties in the Grey Valley, the Westport Coal Company had granted a sub-lease of 70 acres to Mr. Joseph Kilgour, in June, 1885, and from that time till he sold his interest to the Union Steamship Company, the output of coal was 18,398 tons. Since that purchase was completed the mine has been closed. There is still a small area of coal available which should be worked out.

Aggregate Produce of Coal per Acre.

The total output of coal from all the Grey Valley Coal Company's mines up to the end of July last amounts to 1,783,753 tons, and the area over which the workings have extended is about 296¼ acres, of which area 184½ acres have been practically exhausted, while 105¾ acres have been formed into pillars, which contain about 45 per cent. of the solid coal. In addition to this there are about 6 acres of solid coal in the barrier between the Coal-pit Heath and the Brunner Mines.

Taking the total aggregate output, and also the area from which the whole of the coal has been won—namely, 184½ acres, together with 55 per cent. of the area in pillars, say 58¼ acres, or 242¾ acres in all, this shows a production of 7,348 tons of marketable coal per acre.

Mine Workings.

The Coal-pit Heath Colliery was originally worked from a shaft, but since the amalgamation of the coal leases the coal has been drawn up a dip drive, which enters from a point adjoining the Brunner Mine mouth. From the shaft, which is some 14½ chains down the incline, to the bottom of the latter, a further distance of 18 chains, a strip of solid coal has been left on its eastern side parallel with the bank of the Grey River. This block of coal is two chains 75 links broad at the upper end, widening out to 4 chains at 9 chains from the shaft, and continuing at that width to the foot of the incline. To the north, the mine workings were limited by the boundary, to the west, by the continuation of the Brunner No. 1 fault, on the south, by the southerly down-throw known as the "Kimberly fault," and on the east, by the boundary of the lease along the side of the Grey River. This area comprises 73½ acres, and has all been formed into pillars excepting the strip of coal left as a barrier between this and the Brunner lease.

At the date of the report by the Grey Valley Coal Commission of 1890, the extraction of the pillars had been begun, and, indeed, was well under way; and it was then obvious that the area of coal was circumscribed by faults on two sides and by the boundaries of the lease on the remaining two, and unless further explorations were made the coal within the fault-locked area would undoubtedly soon be exhausted. The pillar work had been started at the rise of the workings, and the reasons for this appear to have been: (1) the difficulty of dealing with the water at the lowest level, which even then was liable to be flooded, and (2) the belief that if the

roof were once broken in this district, as would necessarily happen on the pillar work being started, the increased flow of water could scarcely be coped with; and this view has since proved to be correct. The pillars could, of course, have been left in; but the extraction of the pillars constitutes one-half of the work for which the mine is opened out, and is frequently the more profitable part of the working; so that a very heavy claim for damages would have resulted had the company been prevented from working the pillars out. As it was, there was no power to stop such work, neither would it have been desirable to do so.

Another consideration in working this fault-bound area of Coal-pit Heath was, that the faults might to some extent isolate this area with its heavy water from any subsequent workings in the further parts of the lease. At all events it would have been impracticable to work the latter area from the fault-locked portion of the lease. This further area, so far as is known, can be worked from the Brunner dip without the very expensive fault-cutting required from Coal-pit Heath; the only obstacle being the great depth from which the coal and water would require to be raised, and this is the same no matter from which lease it might be done. Further, had the pillars in this mine been left in, it would have served no purpose, as the increasing amount of displacement when the Brunner No. 1 fault is followed to the dip, would have rendered the work of fault-cutting so costly that it could not have been undertaken, and thus the fault-locked area would have had to be abandoned, with the loss of the whole of the pillars, instead of a small fraction of them, and no object attained.

Coal Lost.—In regard to the quantity of coal lost by the flooding of this mine, we have shown that the area over which the pillars extend is about 27¾ acres, but of this area there has to be deducted about 9¾ acres of pillars, which could not have been taken out under the face of the cliff without having a tendency to fracture the rock to such an extent that very large masses would probably have fallen from the face of the cliff from time to time. At the same time, giving due consideration to the position and pillars as left in the mine, we do not consider there is any likelihood of a slip taking place whereby the cliff might slide into the Grey River and block it up. Deducting the 9¾ acres of pillar-workings from their total area, it leaves 16 acres of pillars in which there is about 40 per cent. left of the solid coal. Assuming, therefore, that there are 10,207 tons per acre of marketable coal, the actual loss of coal in the pillar area which might have been extracted under the most favourable conditions would have been about 65,325 tons.

In dealing with this area it must be borne in mind that, in stating that the maximum amount of coal left in the pillars is 65,325 tons, it would be almost impossible to extract the whole of that, having regard to the safety of the workmen employed, because the pillars have been taken out in the rise workings, instead of commencing at the dip, and in all probability not more than 30,000 or 35,000 tons of coal could have been taken out with safety. There is also another element which must not be lost sight of, and that is, before the different mines were amalgamated and worked under one proprietary, the length of time that elapsed during which the former workings were carried on, allowed settlement to take place, and subsequent working has increased this, resulting in opening cracks and joints in the rock-covering of the coal, and allowing surface water to get into the workings; the influx of water became so great that the pumps were unable to keep it down to the bottom of the dip, more especially in wet weather, and this seems to have been the principal reason for commencing to work out the pillars at the rise.

At the time of our inspection the whole of the workings in the Coal-pit Heath Mine and the lower workings in the Brunner Mine to the eastward of the Brunner No. 1 fault were full up to the water-level channel which leads into the Grey River. The quantity of water flowing out of these workings would be about six hundred or seven hundred gallons per minute, and after heavy rain it would probably be nearer twelve hundred gallons.

Barrier.—There is a barrier of solid coal between the Brunner and Coal-pit Heath Mines, which the Committee appointed in 1890 recommended should be left in, and of which about six acres might have been taken out if the water had not risen. This would give about 60,000 tons of coal; but as the pumps have been withdrawn, and the rails lifted, it would not pay the proprietors to place the pumps again in position to recover this coal.

Brunner Colliery.—The old Brunner workings, forming the area north of the Coal-pit Heath lease, and east of the No. 1 fault-line, consist of partly worked-out pillars; and nothing has been done therein for a considerable time except working some fire-clay.

The No. 1 fault has been cut by the extension of the main level at a point where the amount of displacement is *nil*, as the faulting gradually disappears when the line is followed to the north. The main level has been further extended to the north-west, until, at a distance of 65 chains from the mine mouth, or 33 chains from the No. 1 fault, a thinning of the coal is reported to have been met with about six years ago. The area to the rise, or north-east of the level, has been formed into pillars up to a line roughly parallel with it and some 24 chains distant, where the coal is said to have been of unsaleable quality; and thence the pillars have been almost all extracted back to the level. The area to the dip has been opened out by an incline, which is 29 chains long, and from which the present workings are being carried on. At the face of this incline, which is the farthest point to the dip yet reached beyond the No. 1 Brunner fault, a thinning of the coal has been met with, the total thickness being 3ft., of which 1ft. was stony coal, quite unfit for use, leaving a thickness of only 2ft. of clean coal. Driving was continued in this some 80ft., and, as no improvement took place, it was concluded that this was the line of thinning met with in the main level, and nothing further was done towards opening up the back portion of the lease. It seems to be this thinning of the coal in the dip incline which disheartened the company, and caused them to abandon prospecting operations which previously had been contemplated by them. We are, however, of opinion that there is a fair probability of the coal thickening out again, as there is a roll met with coming down through the workings from the rise, and the incline crossing this at a very slight angle may account for the greater width of the thinning that has taken place.

This incline, from the face to a point some 15 chains up, has been since under water, which is now being drained to admit of the area of coal being worked towards the back portion of the lease. Along the lower side of the main level, from the top of the incline to the thin coal, a distance of 28 chains, a rib of coal 2 chains wide has been left at the desire of the Inspector of Mines, and, having in view the future development of the mine, we consider that this rib of coal should be left, as a means of providing access to the back of the lease. This coal at present serves the purpose of keeping the water from gaining access to the dip workings, but the chief object in leaving it was to provide a roadway, should it be decided to further prospect the line of thinning—a roadway which would also be the best for the future working of any coal that may be found beyond that line in the western portion of the Brunner lease. A lower level has also been driven from a point 10 chains down the incline; and the coal from this up to the rib already mentioned has been formed into pillars, the most northerly of which are now being taken out. At this level face the coal is 9ft. in thickness, the upper half of which is of unsaleable quality; the rails have been lifted, and the pillar-work, as already mentioned, started, but the fact of the coal having maintained a good workable thickness right up to the line where it commenced to thin in the end of the main level, which is 10 chains to the rise, gives good grounds for expecting a fair area of coal to the dip, and possibly the dying out altogether of the thinning. This will be proved as the lower levels extend westward from the incline, a position further away from the stone drift, and more favourable for the haulage of the coal. Almost all the way along this lower level, clear and unmistakable signs of stress and movement are visible both in the coal and hard grit roof; this is in the structure of the measures, and is in no way due to any of the workings, but no actual displacement is to be seen anywhere near the face.

A prospecting drive was extended from the face of the main level into thin coal a distance of 13 chains some six years ago. Mr. Bishop informs us that the coal in this drive was irregular, being in some places one foot and at other only a few inches in thickness, and finally, after passing the shear of a fault, of which the amount of throw was not apparent, cut out altogether. It was impossible to examine this drive, owing to falls from the roof, which have precluded access to it for years back. This thinning of the coal, at the western side of the working, would appear to run in a north-easterly direction, and is likely to be irregular in course, but how far it may continue is uncertain, and there is no evidence apparent to base any calculations on.

New Works.

A shaft was sunk on the north-east corner of the Brunner lease, when the mine was worked under the Nelson Provincial Government, and this went through coal about 5ft. in thickness. It is, however, a question whether the coal found in this shaft is not the upper seam, which was cut through in the shaft sunk by the present company about two years ago, and that the main seam may yet be found below this. The present proprietary, about two years ago, sunk another shaft in this part of their lease, about 20 chains nearer their present workings, and coal was found in it about 8ft. in thickness, of good marketable quality. With the exception of these two shafts, there is nothing further known respecting this part of the leasehold beyond the fact that the coal in the old workings adjoining this block was stated by the manager to be soft and unsaleable.

Portion of the area proposed to be worked lies directly northward of the workings on the western side of the Brunner No. 1 fault, and, on the northern faces of these workings, the coal, although it maintained a thickness of about 8ft., is stated by Mr. Bishop to have been of inferior quality, being neither suitable for market nor coke-making. How far this soft unmarketable coal may extend northwards is unknown, but it is not likely to extend for a great distance, or, at least, it has not proved to be of any large extent in other portions of the mine where it has been met with. This question, however, affects the probable extent of the coal area proposed to be opened up.

The probable area of coal to be worked by the proposed tramway has been referred to as being 20 acres in extent, but this area is problematical, and, until further prospecting is done, all that can be said is that there is a certain known area containing marketable coal, the extent of which is at the present time unknown; and while it might be less than 20 acres in area, it might equally as well be said that it may prove to be very much more. Further, if the line of thinning should not continue to the northwards, the working of this block would be the means of prospecting the western area of the Brunner lease, and perhaps of disclosing a large field of coal in that direction.

Having examined the mines as far as practicable, and obtained information from Mr. Bishop of the workings which are now closed, we consider there is a probability of opening up a considerable area of coal from the proposed tramway, if the coal extends further to the northward from the old prospecting shaft, already referred to, sunk by the Nelson Provincial Government. From the explorations made by Messrs. McKay and Cochrane in tracing outcrops in the Coal Creek lease, and on the Bald Hill, above the Brunner lease, it is not likely that the coal seam will prove to be the same thickness at the western boundary of the lease as is found in the old workings. But, although the strata immediately covering the coal can be seen in some places near the most northerly point of the lease, there are no thick outcrops of coal to actually prove that there is a workable seam, beyond the fact that the coal again crops out in the Coal Creek lease, about a mile further to the north-west.

Although we have stated that there is a certain area of coal that can be worked from the proposed tramway, this area is not sufficiently proved to justify a large expenditure being made in opening it up; and, before any money is expended in the construction of a tramway, it would be desirable to further prospect the seam.

In regard to the present workings, unless prospecting-works are carried on simultaneously with the working of the coal, it will have a disastrous effect on the Grey Valley District, and place the Government in a worse position than it is at present in regard to getting revenue from these mines.

The present company are in a better position to develop these coal properties than any new proprietary would be (in having their machinery and officials on the ground), but, unless they carry on prospecting operations simultaneously with taking out the coal from the present known area, they will remove all the easily-wrought coal from the side of the lease facing the Grey River, and leave the mine in such a condition that it would be difficult to get any new company to take it up. At the present time there is some inducement in the opening-up of the new area of coal referred to; but should this be worked out, and the extension of the line of thinning met, without steps being taken to prospect and develop further areas in the back portion of the lease, there is every probability of the lease being abandoned and the prospect of its again being taken up considerably lessened, since any new company would then have to open up the mine afresh in the northern portion of the leasehold before they could expect to find that their venture would prove to be remunerative. Further, the time likely to elapse before this could be done would cause a considerable loss in the revenue.

Royalties.—The principal reason the Company and the inhabitants about Brunnerton give for prospecting operations not being carried on is, that after the end of next year the amount of royalty is increased from 6d. to 1s. per ton, and that the Grey Valley Coal Company will be the only one on the Coast which will then be paying that amount. Therefore, they will be debarred from competing successfully with the coal companies in the Westport District, where the royalty is only 6d. Moreover, the coal now being mined is inferior in quality to that found on the eastern side of the Brunner No. 1 fault. That being so, and the Westport coal commanding a readier market for some purposes, the Grey Valley Coal Company is, no doubt, placed in a worse position than other coal proprietors on the West Coast.

Working Coal-pit Heath Mine.—It may be urged that the increased royalty from Coal-pit Heath Mine does not come into force before the year 1909; but the position of this mine is such that it would entail a very large expenditure in prospecting the back portion of the lease before any coal area could be proved, and after that it would require at least one shaft to be sunk to a depth varying from 1,000 to 1,200ft. before the coal could be worked efficiently. The present workings in this mine must necessarily be abandoned. They are cut off, as already explained, from the rest of the leasehold by the Brunner No. 1 fault on the western side, and this has a down-throw at the lowest level face of about 387ft., while the "Kimberley" fault, with a down-throw of 180ft., runs along the southern boundary. These, together with the fact that there has always been a large influx of water to contend with in this fault-locked area, are the reasons why a shaft would be required, and unless the inclination of the dip of the seam greatly varies from what it is in a distance of 23 chains in the Brunner Mine, the depth of the shaft required could not be less than that stated.

Working from the Wallsend Shaft.—In regard to the question of working the low ground from the Wallsend shaft, which is 670ft. deep, a portion of the seam on the south side of the Kimberley fault has been worked from it, but in carrying on the operations in a westerly direction the "Taylorville" fault was met with, which runs north and south, with an estimated down-throw of 250ft. to west. This fault was met at a point 132ft. lower in level than the bottom of the shaft, in working from an inclined plane to the dip, so the coal on the western side of it under the Taylorville Flat would be about 1,050ft. deep. To this would require to be added the dip of the strata, as the workings extended to the low ground in the Taylorville freehold, or the lower portion of the Coal-pit Heath lease. These coal areas could therefore be worked from the Wallsend shaft; but before this could be done it is estimated by the manager, Mr. Bishop, that an expenditure of about £7,600 would have to be made in the erection of pumping machinery, and in the construction of a stone drift to cut the fault. But, in our opinion, it would probably require an expenditure of at least £11,000 before the mines could be efficiently opened out from this shaft. Before any expenditure is made in this direction the coal should be proved at different places on the leaseholds. The whole surface of the back portions of these leaseholds being covered with heavy timber and dense undergrowth, and no outcrops of coal appearing either on the surface or in any of the creek-beds, necessitates this being done by boring, and the actual depth and thickness of the coal would be then determined. The cost of these prospecting operations, including the purchase of a diamond drill, would probably amount to about £5,000.

Wallsend Lease outside the Freehold.—In regard to the coal in the Wallsend lease outside the freehold, there is no doubt of a large fault existing to the south-east of the workings. This, we call the "Dobson Fault." It is apparently a great displacement, since the grit above the coal to be seen in the river at the Brunner Mine can be found on the top of Mount Buckley. This fault trends in a south-westerly direction, with its up-throw to south-east. In confirmation of this view, similar grits to what occur 60ft. to 90ft. above the coal at Coal-pit Heath, are found on the side of the Grey River, near Dobson's Bluff, which would indicate that the coal could be found at a comparatively shallow depth at that point. These grits are found about 650yds. down the river from the Wallsend shaft. Taking the depth of the shaft, 670ft., and the dip of the coal in the direction of this fault, there is a probability of an up-throw displacement of about 800ft., as the grits out-cropping on the edge of the Grey River would seem to indicate that coal at this point is not more than 200ft. in depth on the south-eastern side of this up-throw; and on this basis, should no other fault exist, the coal near Dobson Railway Station should be found at a depth not exceeding 700ft.

Geology of the Coalfield.

The area of the coalfield, of which the company's property forms a part, is included in a length of twelve miles along the western slopes of the Paparoa and Mount Davy Range on the north side, and the slate ridge of Mount Buckley on the southern side of the Brunner Gorge. The breadth of the coalfield in the part south of Coal Creek, from the outcrops on the range to the sea at Greymouth, is about eight miles, but of this not more than one-third could be worked at a moderate depth from the surface. In the northern part of the field, the coal-measures reach to

the coast-line, between the Seven-mile and Ten-mile Creeks. The sequence of strata, of which the coal-measures and the underlying beds form the lower part, and which is closed by the Cobden limestone, is of Upper Cretaceous or Cretaceo-tertiary age.

The larger and more characteristic divisions of the whole sequence are given below :—

VII. Lower conglomerates.
VI. Lower grits, sandstones, and shales.
V. Coal-measures.
IV. Fine-grained sandstones.
III. Dobson's Bluff beds = Island sandstone.
II. Mudstones and marly clays.
I. Cobden limestone.

VII. *Lower Conglomerates.*—The Lower conglomerates are not seen in the section through the Brunner Gorge, but they show on the southern side of the Grey Valley near Stillwater Creek, the exposure there being on the north-east side of the anticlinal axis, commencing on the northern bank of the river, and continued south and south-west through Mount Buckley, and along the slate ridge in the direction of the western sources of Stillwater Creek and the New River watershed

Passing to the northern side of the anticline in the Brunner Gorge, these conglomerates are seen to form and constitute some part of the spur, which, from the northern part of Mine Cliff, reaches down to the low grounds of the Grey Valley, a little above the St. Kilda portion of the Brunner workings. In the low grounds on the south side of the river the conglomerates are but a few feet thick ; but on being followed to the north-west, on to Bald Hill Range, and towards Mount Sewell, they rapidly increase in thickness, and on the north-east face of Mount Sewell there is a fine exposure displaying not less than 300ft. of these conglomerates in vertical section. At no other place have these beds been observed during the progress of our investigations. Shaly bands appear amongst these rocks on the east face of Bald Hill Peak, but nowhere definite indications of the presence of even thin seams of coal are to be met with in them. From Bald Hill these conglomerates for some distance run along the base of the northern continuation of Mine Cliff, along which, to the peak of Bald Hill, the dip is to the south-south-west, at angles varying from 13° to 23° ; the north-east dip met with in the St. Kilda workings being local.

VI. *Lower Grits, Sandstones, and Shales.* — These beds consist of hard, gritty sandstones, having an irregular stratification. With these are associated bands of indurated micaceous shale, appearing at different horizons, but more abundantly in the upper part, and immediately under the main seam of coal. The beds are from 80ft. to 100ft. thick. Sometimes the upper beds form the floor of the overlying coal, but as frequently there are interposed beds of fire-clay, which have to be regarded as belonging to the coal-measures proper.

These lower grits, &c., show well along the banks of the Grey River in the Brunner Gorge, between the outcrops of the coal on each side of the anticline, a section of which can be seen on either bank of the river. On Mount Sewell they appear to be somewhat of a different character, being less irregular in stratification, and having two or three strong bands of shaly rock with which there may be thin seams of coal. The cliff face on the north-east side of Mount Sewell being inaccessible, this point could not be determined ; and there is the further possibility that the rocks of this locality may belong to the coal-measures—the next formation overlying these lower grits—in which case the small seams seen to underlie the 3ft. 6in. seam of coal in the cliff face, are apparently the same as that found on the south slope of the mountain. At no other place have these beds been studied, except it may be near Stillwater Creek, where they have a very feeble development.

V. *Coal-Measures.*—These beds consist of grits and sandstones, having the main or Brunner coal at their base, underlain or not, as the case may be, by fire-clay and micaceous shales. The beds, not including the main seam of coal, have a thickness of from 60ft. to 90ft. About 20ft. above the Brunner seam there is a 2ft. or 3ft. band of a very close-grained and exceedingly hard sandstone, resembling chert or water-quartz, which serves as an indication of the near presence of the Brunner seam, not only near the Brunner Mine, but for some considerable distance along the face of Mine Cliff, and in other parts of the field also. Above this, on the banks of the Grey River, there are two small seams of coal associated with, and overlying which are bands of shale and gritty sandstone. These beds—*i.e.*, the coal-measures proper—are closed by one or two bands of gritty micaceous sandstone, which, on exposure to the atmosphere, acquires a rusty-brown colour. Samples of the less decomposed rock are remarkable on account of the presence in them of a leek-green or paler-green ferriferous mineral, which accounts for the colour of the rock under exposure to the air. This particular band is seen on both banks of the Grey River; first, on the right bank, between the natural exposure of the Brunner seam and the Coal-pit Heath shaft ; and second, a little to the north of Dobson's Bluff, forming a reef of rock washed by the river during floods, but fully exposed when its volume is moderate. The same rock appears to have been passed through in the air-shaft on the Wallsend freehold. The coal-measures show on both sides of the river in the lower and upper parts of the Brunner Gorge, and on Mount Buckley, east of Wallsend and Taylorsville ; along Mine Cliff to Bald Hill, and thence along the Bald Hill Range as far as examinations were made, and for some distance from the top of the range along the beds of the various creeks draining to the south-west. Towards the north-west, on Bald Hill Range, it is possible there are two distinct seams of coal. That which is supposed to be the higher in the sequence has a thickness of 3ft. 6in. while the supposed lower seam seen further down the slope of the range has a thickness of nearly 5ft.

IV. *Fine-grained Sandstone.*—These rocks are well seen in Mine Cliff, on the right bank of the Grey, also on the left bank through the Gorge, and at the northern foot of Dobson's Bluff. They appear at the surface over the greater part of the Brunner lease, and outside the northern boundary of this lease they rise along the spurs on to the higher part of Bald Hill Range, and also form thf

higher part of Mount Sewell. Within the boundaries of the Coal-pit Heath lease, this rock is seen only to the north of the Kimberley fault, along the bank of the river, and in Mine Cliff, and over a small area towards the western end of the lease. Over the western part of the Brunner lease this sandstone is deeply cut into by various creeks, and, by a variable amount, the thickness of the cover over the coal is less than what would have to be encountered on the spurs between the different gullies.

There is a possibility of this sandstone being thicker over the western area of Coal-pit Heath and Brunner leases, but this may be more an appearance than a reality, the fall of the country and the dip of the beds being in the same direction at nearly the same angle; and it is only because the creek-beds cut deep in their upper parts that the underlying coal-measures appear as far down the slope of the range as they do. On the spurs between the various creeks the fine-grained sandstone reaches to the top of the range. In following down Back Creek to the upper boundary of Coal-pit Heath lease the fine-grained sandstone is said to be continuous; and a little below the boundary the inclination of the strata is reversed, and the dip is towards the eastward. The thickness of these beds ranges from 140ft. at Dobson's Bluff to fully 200ft. towards the western boundary of the Brunner lease.

III. *Dobson's Bluff Beds.*—Of these the lower beds are fucoidal, earthy micaceous sandstones, with irregular concretions and balls of ironstone. The middle part is no less fucoidal, but of a lighter grey colour, and contains less mica and fewer concretions of ironstone. The upper part is a moderately soft grey sandstone, divided into two members, the lower of which is massive in one or two thick beds, and the upper part forms thin-bedded flaggy sandstones with micaceous or carbon partings. The same beds appear between the top of Mine Cliff and the line of Brunner No. 1 fault, as this has been indicated on the surface by a line cut through the bush. There are, on the right bank of the river, north of the Kimberley fault, beds of similar appearance to those on the top of Dobson's Bluff; but the true position of these has now been ascertained to be under the Dobson's Bluff beds, forming part of the fine-grained sandstone formation. Half-way along the southern boundary of Coal-pit Heath lease, in Pascoe's Creek, which is between Sulky Gully and Back Creek, there are brown sandstones, evidently belonging to the higher beds on Dobson's Bluff; while west of Back Creek the underlying fucoidal beds appear in a line of cliffs on the right bank of the creek, and it may be that the same beds occur on the crests of the ridges between the creeks further to the north, towards the higher part of the range.

II. *Mudstones and Marly Clays.*—These may be regarded as conformable to the Dobson's Bluff beds. They extend over the low grounds between the outcrop of the Dobson's Bluff beds and the east slope of the limestone range stretching along the coast-line from Point Elizabeth to the New River watershed. In consequence of the Kimberley fault having a down-throw of 180ft., the mudstones extend over the whole of the Taylorville Flat, and across the river till met and cut off by the Dobson's Bluff fault, trending north-east and south-west.

West and south-west of Mine Cliff these beds are found on the east side of the Brunner No. 1 fault, to nearly abreast of the main level of the Brunner Mine. Where the southern boundary of the Brunner lease crosses Sulky Gully, the mudstones for a short distance reach on to the lease, but over the northern and western parts, these rocks are not known to be present. They are present over the greater part of Coal-pit Heath lease. These rocks are readily distinguished from those next underlying, and where they are absent it may be considered that the coal lies at a moderate or reachable depth from the surface. On the southern side of the river these beds overlie the Dobson's Bluff beds, and beneath the valley gravels are the first beds to be met with within the Township of Dobson. They are of great thickness, and, to the westward of more than one-third of a mile from the outcrop of their lower beds, the depth to the coal should be very considerable.

I. *Cobden Limestone.*—These beds lie outside of the special district examined in connection with this report, and have no important bearing on the various subjects discussed herein.

The lowest beds of the sequence, the "Lower conglomerates," over the region described, consisting of well-rolled sandstone gravels, indicate a source distant from where they are now found; and having their chief development showing the greatest thickness on the higher part of the Bald Hill Range, probably the whole of the Paparoa Range have as a chain of mountains arisen or been upheaved since the deposition of the coal-bearing portion of the sequence. We have thus to regard the special area under consideration as forming but part of a much larger and greatly extended area, over which different members of the Cretaceo-tertiary series were deposited, and, without doubt, the lower part of the series embracing the coal-measures and underlying conglomerates. This is made abundantly clear by a study of the sequence in part, or in its entirety, at many localities on the west coast of the South Island. By the time the lower grits and sandstones had been deposited, and the beds laid down over which the coal-forming material accumulated, there seem to have been wide areas of comparatively level land at no great height above sea-level, on which grew and accumulated the material of the future coal-seams. Fluviatile beds, to a thickness of from 60ft. to 100ft., covered up the carbonaceous accumulations, and then at all points it is generally evident there was depression of the land, and thick deposits of marine strata were formed above those of a more terrestrial character. The gradual sinking of the land continued, without any reversal of the process, till the Cobden limestone and the highest beds of the sequence were deposited.

Faults.

The only faults that have come under our consideration are situated near the Grey River. These are exposed in the mine-workings, or indicated at the surface on both banks of the river. Faults, however, may abound in other parts of the leases held by the Grey Valley Coal Company, and are almost certain to exist where they cannot be traced on the surface, and where as yet mine-workings have not reached. Over the western parts of the Brunner and Coal-pit Heath leases the

uniform character and considerable thickness of special rocks prevent faults being readily traced, and the dense forest growth on what is otherwise a rough country, difficult to explore geologically, yet further adds to the uncertainty in this respect.

Brunner No. 1 Fault.—This is met with in the main drive, 22 chains from the entrance to the mine. At the top of the dip drive there is little or no displacement of the strata, and the down-throw, where it exists, being to the westward, the coal beyond the fracture was reached by driving along the line of fault till the displacement became *nil*. From this point the fault extends in a south-south-west direction, nearly parallel to the Grey River, the amount of throw is found to increase. From the top of the incline, a distance of 577ft. along the line, the displacement was found to be 93ft. In the lower workings of the Coal-pit Heath Mine the throw of the fault continues to be augmented.

Kimberley Fault.—This trends west-south-west, 4 to 6 chains from the southerly boundary of the Coal-pit Heath lease, and is met with in the workings of that mine. The fault has a down-throw on its southern side of 180ft. It extends to the east-north-east across the Grey River, and is continued through the northern part of the Wallsend freehold in the direction of the junction of Stillwater Creek with the Grey. The down-throw of the Kimberley fault, together with the south-western dip of the strata, involves the presence of the coal at a very considerable depth over the southern part of the Wallsend lease to near Dobson's Bluff and under Taylorville Flat.

Dobson's Fault.—This, so far as can be determined, trends north-east and south-west from the western side of the slate belt, reaching the Grey River a little south of Stillwater Junction, along the lower slopes of Mount Buckley to the Grey River, near the northern base of Dobson's Bluff; thence the line, continued south-west, crosses the river to the foot of the low spur cut by the road-line along the right bank of the stream to Coal Creek.

The upthrow of this fault is on its southern side, and, from the evidence of the strata seen on the bank of the river, the displacement at this point is so considerable that the coal might be reached at a depth, probably, not exceeding 200ft. The fault continues to the north-east till it either cuts into the slates showing on the northern slope of Mount Buckley, or, slightly changing its direction, it is seen to separate the old slates from the beds—probably the upper part of the soft sandstone—at the further end of the tunnel on the Midland Railway line.

Taylorville Fault.—This runs N.N.E. from the deep workings of the Wallsend Mine in their prolongation under and across the river, or in the direction of the lower end of Mine Cliff. The down-throw is to the westward, and estimated at 250ft. It is thus roughly parallel to the Brunner No. 1 fault, and, like it, is probably a hang-fault, having its maximum throw towards the south, and gradually lessening in the amount of its throw as it extends northwards. This is shown by the fact that there is no trace of such a fault known above the Brunner Bridge. Mr. Bishop indicates a fault nearly in this line between the foot of Mine Cliff and the river, between the Coal-pit Heath shaft and the upper end of Taylorville Flat. This is said to have a down-throw on the west side of 80ft.

Other Faults on the East Side of the Brunner Gorge.—In the east workings of the Tyneside Mine the measures are reported to have acquired a westerly dip, giving indications of an up-throw fault. This might be due to the fault last described, or to a fault running in the same direction and on the western side of it, which would supplement the amount of up-throw due to the Dobson fault. But the amount of displacement due to both these faults would not account for the great displacement which has resulted in the carrying up of the grit beds over the coal at the river-level, or their occurrence in the Wallsend Shaft 600ft. below the river-level, to the top of Mount Buckley, 1,140ft. above sea-level. To account for the presence of the grit on Mount Buckley, a gigantic dislocation and displacement of the strata on its western side must be considered as having taken place. Minor faults there are, but these are of no serious moment as affecting the working of the coal. The various thinnings of the coal at different places in the mines are not regarded as faults, though in some cases they may indicate the near presence of faulting, facilitating the removal of carbonaceous matters from the seam.

Future Developments.

1. In regard to the future development of the field, we would recommend that the dip heading in the Brunner Mine to the westward of the No. 1 fault should be pushed ahead, as, although the coal is only 2ft. in thickness at the present face, it is of good quality, and it is very probable this thinning out will disappear and the coal resume a workable thickness. This heading would also be of service as a return air-way, and second outlet, in the event of this lower part of the Coal-pit Heath lease being worked, and the expense of a second shaft, otherwise absolutely necessary, would be thus avoided.

2. A level should also be continued from near the bottom of the present dip towards the north-west, where the line of thinning will probably not be found. And if a dislocation or No. 2 fault be met with, a cross-measure drift should be continued sufficiently far to determine the position of the seam.

3. As the rib of coal which has been left along the lower side of the Brunner main level not only prevents the water from the rise workings getting into the dip, but also preserves the means of making a road, whereby the coal in the back portion of the lease can be worked, should it become of workable thickness beyond the line of thinning, on no account should this rib of coal be taken out until the field is proved in that direction.

4. That a couple of bore-holes should be put down on the back portion of the Brunner lease, some 20 chains ahead of the face of the stone drift: one of these to be in the line of the main level, and the other to the dip. Also, a bore-hole should be put down in the lower portion of the Coal-pit Heath lease, to the westward of the Brunner fault, to prove the coal in that direction. And in regard to the Wallsend lease, a bore-hole should be put down on the Wallsend side of

Dobson's Bluff, to prove the coal on the southern side of the Dobson fault. Another bore-hole should be put down (if the Wallsend Mine is re-opened) from a stone drift carried, say, from 100ft. to 180ft. on the level from the place where the Taylorville fault is met with across the fault-line, and the coal proved beyond it. If the result was satisfactory, the coal in the Taylorville freehold and Coal-pit Heath leasehold could be most advantageously worked from the present Wallsend shaft. With reference to the coal on the south side of the Dobson fault, it would be a question whether it could not be worked more economically from a shaft about Dobson Township, as the up-throw from the Wallsend Mine is so great, and the dip of the coal is in a seaward direction; but it becomes a question for further consideration when the field is proved by the bore-holes.

5. In opening up the new area of coal to the rise of the Brunner workings, we would strongly recommend leaving a solid rib of coal on one side of the main level, about 2 chains in width, in order to preserve a roadway to the back portion of the lease, in the event of the level not meeting with or piercing the line of thinning. Should it be found that the back portion of the lease can be worked from the new area, it is absolutely necessary that such a rib of coal should be left, in order to provide a future means of working the western area.

6. That the extra sixpence per ton royalty which comes into force on the Brunner leasehold on the 1st January, 1895, and in the Coal-pit Heath leasehold on the 1st January, 1910, be not charged provided the company fulfil all the other covenants and conditions of their leases, and expend a sum during the first two years equal to the amount of the increased royalty of sixpence per ton during that period in carrying on prospecting operations in different portions of their leaseholds, and in constructing works for the future development of their mines, simultaneously with carrying on their ordinary workings in winning coal.

We have, &c.,

HENRY A. GORDON, F.G.S., Inspecting Engineer.
ALEX. E. McKAY, F.G.S., Mining Geologist.
N. D. COCHRANE, Inspector of Mines.

To the Hon. the Minister of Mines, Wellington.

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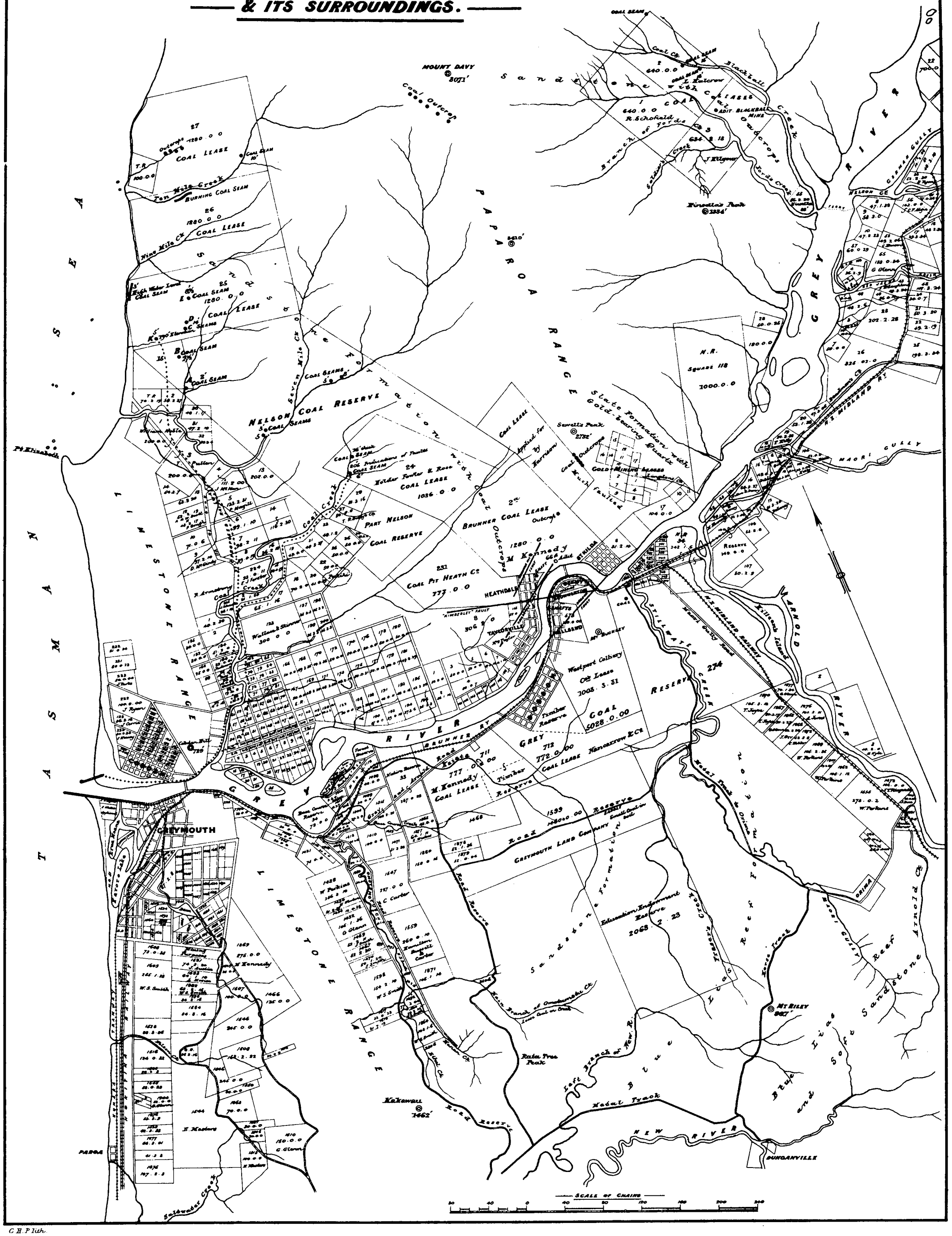
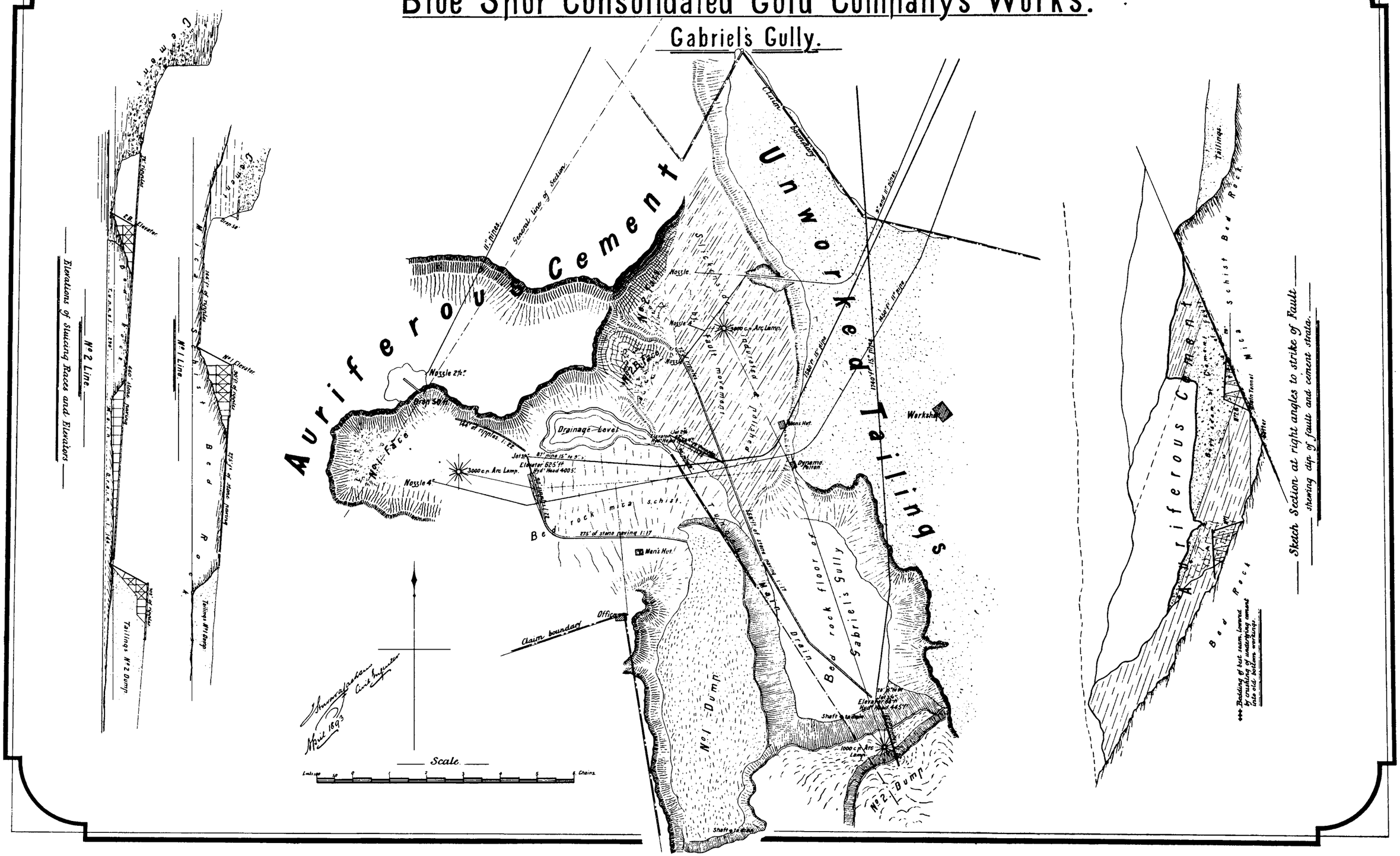
MAP OF THE GREY COAL-FIELD
& ITS SURROUNDINGS.



C.H.P lith.

Blue Spur Consolidated Gold Company's Works.

Gabriel's Gully.



GEOLOGICAL MAP OF THE GREY VALLEY COAL-FIELD.

GREY VALLEY COAL Co's LEASES.

To illustrate Report by Messrs Gordon, McKay, & Cochrane.

— 1893. —

— REFERENCE. —

- Alluvial.
- 1 Mudstones & Marls.
- 2 Dobson Bluff Beds.
- 3 Fine-grained Sandstone.
- 4 COAL MEASURES.
- 5 Sandstones under Coal.
- 6 Conglomerates.
- CARBONIFEROUS { Old Slates & Sandstones.

CRETACEOUS

Boundary of Leases.

Heights in Feet above Sea Level thus 512'

BRUNNER COAL LEASE.

COAL PIT HEATH Co

Outcrop 1250'

Outcrop

Pascoe's Ck

Sulky Gully Creek

"KIMBERLEY" FAULT

TAYLORVILLE FAULT

DOBSON FAULT

Section No 3

Section No 2

Section No 1

Mount Buckley

Railway Station

Quarry

Island

GREY RIVER

Creek

DOBSON

SCALE OF CHAINS.

C.H. Prerard. del.

GEOLOGICAL SECTIONS OF THE GREY VALLEY COAL-FIELD

GREY VALLEY COAL COMPANY'S LEASES.

To illustrate Report by Messrs Gordon, McKay, & Cochrane.

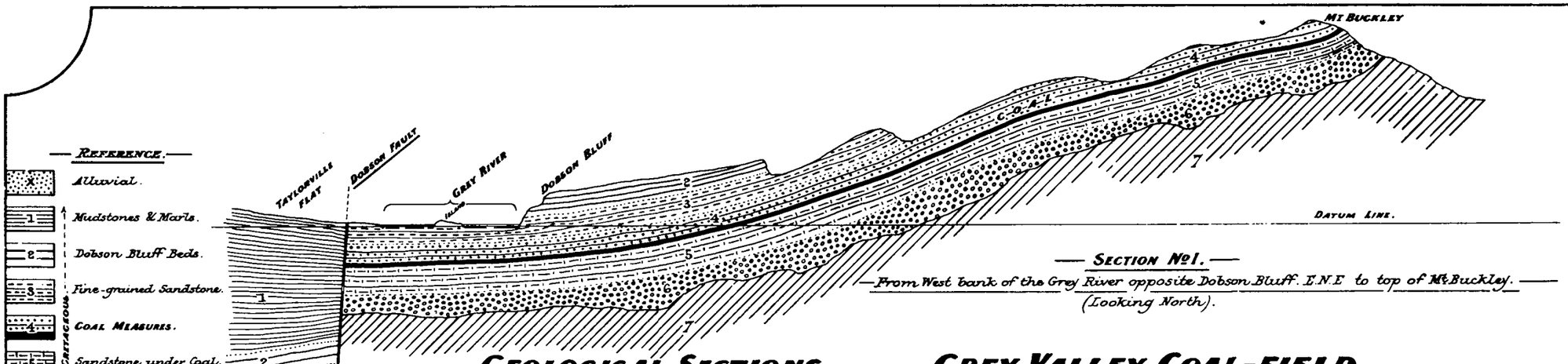
1893.

— REFERENCE. —

- Alluvial.
- 1 Mudstones & Marls.
- 2 Dobson Bluff Beds.
- 3 Fine-grained Sandstone.
- 4 Coal Measures.
- 5 Sandstone under Coal.
- 6 Conglomerates.
- 7 Carboniferous { Old Slates & Sandstones.

Cretaceous

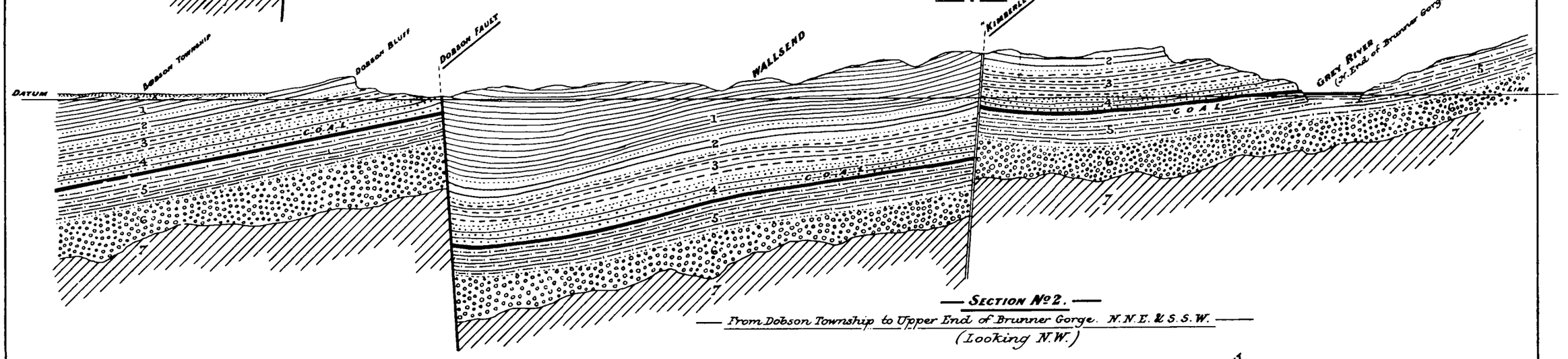
Datum Line = Sea level.



— SECTION No 1. —

From West bank of the Grey River opposite Dobson Bluff. E.N.E to top of Mt Buckley.

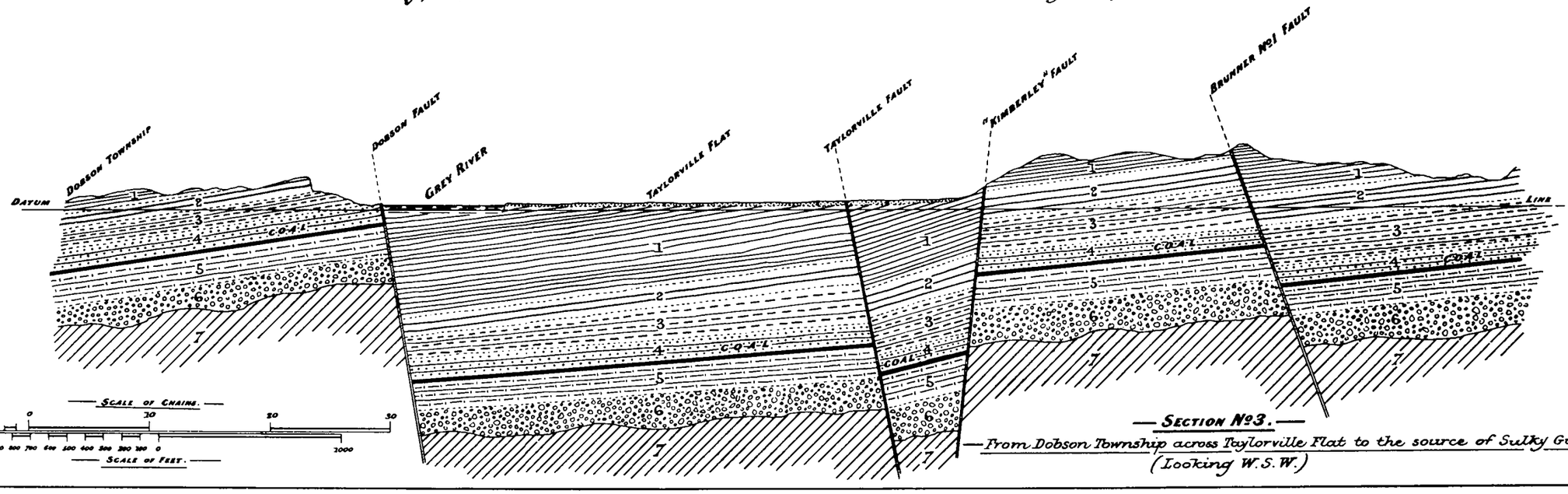
(Looking North).



— SECTION No 2. —

From Dobson Township to Upper End of Brunner Gorge. N.N.E. & S.S.W.

(Looking N.W.)



— SECTION No 3. —

From Dobson Township across Taylorville Flat to the source of Sulky Gully.

(Looking W.S.W.)

C.H.P. delt.