The whole of the plant is electrically driven, individual motor drive being adopted for almost all units. Power is obtained from the generating station of the electrolytic works alongside.

Machinery is coming forward, and also being constructed in the company's shops for service in the manufacture of bare-stranded copper cables and cotton-covered wires. The company also propose to manufacture copper and brass tubes.

CEMENT MANUFACTURE.

THE COMMONWEALTH PORTLAND CEMENT CO., LTD.

This important industrial enterprise was started in 1900 by a company formed exclusively of British capital and shareholders, with an output capacity of 20,000 tons per annum. The works were at Portland, New South Wales, at that time merely a small bush settlement, which has now grown into a well-ordered township of 5,000 inhabitants. Portland is situated 110 miles north-west of Sydney, on the Wallerawang-Dunedoo branch of the Great Western line, some 15 miles from Lithgow. From a small beginning these works have now evolved into one of the largest commercial undertakings in the Commonwealth, having a yearly output capacity of over 150,000 tons of cement, or, say, a production of one ton during every minute of an eight-hour working day.

The installation of these works has cost over £150,000, and during their existence have produced one and a quarter million tons of cement. Amongst some of the large works exclusively supplied were the Cataract Dam, taking 20,000 tons of cement; and the Burrinjuck Dam, to which 70,000 tons were supplied.

The works are unique in many respects, having practically inexhaustible supplies of limestone, shale and coal—the necessary raw materials for the manufacture of cement—situated on the one property. Very rapid developments have been made during recent years, and many labour-saving devices have been installed. Some items of the plant are:—Five-standard gauge locos, two large steam shovels operating in the quarries, and the largest rock-breaker in the Southern Hemisphere. Plans are in preparation for additions and improvements, estimated to cost some £300,000. Originally the Rushcutters Bay cable power-house plant was purchased and installed for motive power, but for many years continual additions of the most modern plant have been made. The power plant (including electric generators) now has an output of over 7,000 horse-

power. All outlying units are now electrically driven, and it is contemplated installing a new power-house right at the coal mine, with turbo-generators taking the power at high voltage to the various points where used.

Dams have been constructed at the works, holding two hundred million gallons of water, and a subsidiary supply of 300,000 gallons per day is pumped from the quarries. The coal mine is one of the best in the Western district, being well equipped, with a possible output of over 200,000 tons per annum.

The company has a highly-trained staff, with extensive chemical laboraties and testing rooms. To insure continuity of supplies—especially as regards Government tested stock—silos storing over 20,000 tons have been erected, and further additions of equal capacity are now in hand.

KANDOS CEMENT.

The cement works of the New South Wales Cement, Lime and Coal Co., Ltd., are situated at Kandos, on the Mudgee line, 160 miles from Sydney.

The company has extensive deposits of the necessary raw materials of high grade, a large coal field, and many advantages necessary to a cement works.

The works were commenced a few months prior to the outbreak of war, and during the early stages were much hampered by the non-delivery of plant, which ultimately necessitated purchasing a complete second unit, which was contracted for, delivered, and erected before the first unit was released.

The layout is quite modern, every care being exercised to provide for further additions up to a 12 kiln plant. A modern power-house with Babcock and Wilcox boilers and steam-turbines supplies the whole works with power and light. The system of lighting is also extended to the township. The power is transmitted to the water storage 1¼ miles distant, and also to the limestone quarries 3¼ miles distant, where it is used for drilling, crushing and transporting.

The limestone is brought to the works by aerial ropeway, capable of delivering 80 tons per hour. Large deposits of shale occur adjacent to the works at a higher level.

Coal occurs about 300 feet above the level of the works. The seam now being worked is approximately eight feet thick —practically horizontal. It is brought from the mine by a gravity system of tramway; the large coal is separated from the small, the former being delivered into railway trucks and sold; the latter, viz., screenings, is taken to the works and power-house by an electrically-driven haulage line.

The power installed is comprised of two Babcock and Wilcox boilers, and two B.T.H. Co.'s turbines, 750 K.W. each, and a complete switchboard with panels for operating every department of the factory. The company is now erecting a large boiler of 6,200 feet heating surface, and has ordered another 1,500 K.W. turbine-set to take care of the additional plant which will be installed at an early date, and will practically double the output of the present works.

The system is known as the dry process, where the raw materials pass through two crushers, dried, and ground to an extremely fine powder. This raw meal is converted into clinker by rotary kilns, two being in operation at the present time. Each kiln is approximately 141 feet in length and 8 feet in diameter, capable of turning out upwards of 220 tons per day.

The clinker is kept in storage piles until it is thoroughly matured and ready for grinding. Any uncombined lime is thereby hydrated, and yields a quality of cement that can only be attained by this method.

The mills employed for grinding both raw materials and cement are combination mills of large type, better described as a ball-mill and tube-mill in one.

After leaving the cement mill the product is conveyed to storage silos. From here it is automatically withdrawn and conveyed to Bates' bagging machines. Each machine is capable of bagging 30 tons per hour. From these machines the finished cement is either directly loaded into railway waggons without further handling, or delivered into Government stores for test purposes.

Careful control is exercised in the manufacture by continuous sampling. Tests are made every hour, day and night, of the raw materials and finished cement.

The test sheets for the past years have shown a wonderfully uniform and high-grade cement, averaging over 50 per cent. above the requirements of the Public Works Department's specification.

The company has experienced considerable trouble during the past few months, owing to the prolonged drought conditions. The water supply in October last year gave out, and although a recurrence is scarcely likely, it has been decided to bring in a water service from the Cudgegong River, a distance of 14 miles, for the purpose of supplying both the works and the township. This work is now in hand, and, when completed, will remove the slightest danger as to short supplies in the future.

This company has been progressive, and it is mainly due to their efforts that the works in West Australia and Newcastle are now existent.

NEWCASTLE SLAG CEMENT CO., LTD.

Slag cement has been well known for many years. In England, the Continent of Europe, and America, the product is analogous to Portland cement, and may be safely used for general works where Portland cement is employed.

The tests—tensile, compression, and expansion—are very similar to normal Portland cement. The setting time is usually slower in duration and is more feeble at the early stages. It requires more water, and is well suited to damp and underwater conditions.

With a view of utilising the slag from Broken Hill Proprietary's Steel Works at Newcastle, this work was founded. It has been in operation for several months. Already the quality has found favour in the local market, as the whole of the output is readily disposed of.

The works are situated at Waratah, Newcastle, and connected by rail with the slag works and the general railway system. The power (electric) is obtained from the Newcastle Corporation.

The slag as received at the works is graded, and mixed with Portland cement clinker. It is then passed through a burning drum, 60 feet long by 6 feet in diameter, where all water and moisture is expelled. After coaling, the slag passes through two grinding mills—first, the "Kominor," for reducing and screening through a 20-mesh per square inch sieve. Thence it is elevated, and is finely ground in a powerful tube-mill, which delivers it to bins in the stockhouse.

The fineness of the finished product has a residue of barely 10 per cent. on the 32,000 mesh sieve.

The mills and all appliances are driven by separate motors. Tests are made daily of the product, and careful control is exercised to regulate both the strength and setting time. The works are capable of an output of 25,000 tons per annum.

The company will consider at an early date the advisability of duplicating this plant.

WEST AUSTRALIAN PORTLAND CEMENT COMPANY, LIMITED.

This company was founded early in 1919, and has already made considerable progress in installing a cement factory at Perth, and a lime recovery plant at Lake Clifton.

The lime deposit occurs in the form of precipitated lime, covering the whole bed of a lake 14 miles long and ¾ of a mile wide. The lime averages in depth about 12 feet. From this source the company has command of millions of tons of excellent material suitable for the manufacture of Portland cement, and also an economical form of agricultural lime.

The cement works are situated on the Swan River, within one mile of Perth. They will include two full units, washing and correcting basins, rotary kilns, coal-dryer and grinding plant, also reduction mills. The process adopted, owing to the nature of the materials, will be wet.

The company owns about 32 acres of freehold land, and an enormous bed of excellent clay, varying in depth from 12 to 44 feet, adjacent to the works. A complete system of sidings for inwards and outwards delivery has been completed.

The works should have been in operation at the end of last year, but unforeseen difficulties and strikes completely stopped progress for many months. The plant installed will be capable of producing upwards of 50,000 tons of cement per annum.

The lime works are already in operation. A dredge has been built, and a large system of delivery piping completed.

The method adopted is to pump the lime by centrifugal pumps, and discharge it on the drying ground, which is 7½ acres in extent. Here large dumps of lime will be stored until sufficiently dry for transport. The loading from storage to trucks will be done entirely mechanically.

BRICK MANUFACTURE.

The extent of building operations in the State can be fairly gauged by the annual brickmaking statistics. In the year 1891 there were 2,018 persons employed in brickworks, the output being 184,862,000 bricks. Then followed a decline in building operations, with a consequent decline in the brickmaking industry, although the population returns show a steady increase.

BRICKS MANUFACTURED IN N.S.W.

The maximum output of bricks was in the year before the war (1913) :—

TABLE NO. 7.

Brick Manufacture in N.S.Wales

Year	Population	Number of Brickworks	Number of Employees	Output of Bricks	H.P. of plant. Full capacity
1891	1,162,190	190	2,018	184,862,000	1,447
1895	1,262,270	163	1,211	99,587,000	989
1900	1,364,590	157	1,535	128,430,000	1,639
1905	1,469,007	172	2,006	162,643,000	2,074
1910	1,638,220	220	2,514	251,546,000	5,389
1913	1,832,456	217	3,665	389,435,000	10,788
1914/15	1,870,415	188	3,230	331,107,000	11,192
1917/18	1,928,174	162	2,597	218,005,000	9,843

The output of bricks per 1,000 population for the years indicated is given in the following table:—

TABLE NO. 8.

Output of Bricks in New South Wales per 1,000 population.

Year	Output	Year	Output
1891	159,090	1910	153,570
1895	78,910	1914/15	212,460
1900	94,000	1917/18	113,070
1905	110,700		

This table is a rough indication that there has been a decline in building operations during recent years, and partly explains the general shortage of houses throughout the State.

The excess of immigration, 1917 over 1918, was 7,185, which is the first increase since the war, and, following the decline in building operations in previous years, has accentuated the trouble caused throughout the State by the shortage of house accommodation, and the consequent high rents.

In 1911 the State Government decided upon the erection of a brickworks at Homebush for the purpose of supplying Government Departments. Up to the 31st December, 1919, the number of bricks sold was 229,327, of which 59,819,829 bricks were sold to the general public. The manager states that the yard has a weekly output of nearly 1,000,000 bricks, and is considerably larger than any other yard in the Southern Hemisphere.

An output of 1,000,000 bricks per week means that material for 100 five-roomed cottages could be supplied in three weeks.

The manager reports that since the establishment of the State yards, savings amounting to £109,645 have been made in the cost of bricks to purchasers, over the costs ruling outside. Of this amount, the saving to Government Departments amounted to £83,788.

AVIATION.

Progress in the science and art of aviation was accelerated during the war, and there is every possibility that flying machines, which proved of inestimable value in war-time operations, will prove of still greater service in what we trust will be the coming years of peace and national advancement.

Early in 1916, Professor Warren, Mr. Cutler and myself were appointed by the State Government a committee to erect an Aviation School and train men for aerial service for the war.

The Town-Common at Richmond was selected as the best site readily available, and within three months the hangar at Richmond was completed, capable of housing an aeroplane 80 feet over the wings, whilst in the annexes a machine shop was installed for the manufacture of aeroplanes, except the engines, which were to be made at the Walsh Island Works at Newcastle.

Two teachers were engaged in England—Flight-Lieutenants Stutt and Lang, two "Curtis" biplanes were obtained from Canada, and in less than six months from the date of our appointment men were being trained and taken into the A.F.C.

The school was opened on July 21st, 1916, on which date, from the Empire point of view, the prospects of the war were very gloomy. Whilst we were endeavouring in a small way in New South Wales to do what we could, vast works were operating in England on the construction of giant machines, and large numbers of young men were being trained as navigators and air pilots. We, as Australians, have reason to be proud of the fact that two young Australians, who left this country with no previous knowledge of the art of aviation, have been able to travel a distance of 11,340 miles in one of England's largest flying machines, a "Vickers-Vimy," covering the distance from England to Australia in just under 28 days, with an actual flying time of a little over 5½ days. December 10th, 1919, is an epoch-making date, which will be recorded in history—the day when Sir Ross Smith and Sir Keith Smith, with the two Australian mechanics, landed in

Port Darwin, after a journey of danger and difficulties overcome by the grit and determination of this little band of Australian aviators, deservedly honoured by our King.

At this, the last meeting of the Sydney University Engineering Society, as President, and on behalf of the Society, I wish to acknowledge our indebtedness to those 1,800 graduates, undergraduates, or members of the staff of this University, who recognised their duty to their country during the past five years of national danger, and voluntarily left these shores to engage in a war unparalleled in the world's history.

The Roll of Honour of the P. N. Russell School of Engineering contains 237 names :—

Adamson, R. W.
Alexander, H. de V. (Serb. G.M.)
Alison, C. A.
Anderson, R. C. (O.B.E.)
Anderson, W. T.
Armstrong, J. N. F.
Asher, G. B.
Audet, L.
Baldwin, J.
Barber, W. W.
Barnet, R. J. M.
Bate, R. V.
Beeston, S. L.
Bennett, V. C.
Best, G.
Bill, W. G.
Black, R. A. W.
Blaxland, G. H.
Blumer, C. H.
Booth, E. H.
Bourne, C. A. (M.C.)
Boyd, E. E. G.
Brain, V. J. F.
Brett, H. V.
Bridge, C. W.
Bugler, V. V.
Bull, L. M.
Bundock, H. C. (D.S.O.)
Burnell, J. G. (M.C., C. de G.)
Burnett, H. C.
Busby, F. W. M.
Butler, A. L.
Caddy, J. P.
Callen, V. C. (M.M.)
Callender, G. G.
Campbell, E. F.
Caro, P.
Carr, L. J.
Carter, E. M.
Carter, H. G. (D.S.O.)
Clayton, C. H. J.
Clerke, A. W.
Close, J. C.
Cohen, A. F. (M.C.)
Cohen, H. F.
Colyer, M. J. G.
Corfe, D. B. (M.C.)
Corlette, J. M. C. (C.M.G., D.S.O.)
Cox, M. C.
Cran, C. R. (M.C.)
Crane, C. G.
Cripps, R. F.
Cropper, C. (M.C.)
Cunninghame, W. A. F. (M.C.)
Cureton, F. H.
Davidson, G. F. (O.B.E.)
Davies, H. W.
Davis, H. P.
Day, F. H.
Day, R. S. A.
Debenham, A. J.
Denison, L. A.
Dennis, C.
Dight, A. H.

Dowling, B. S. (M.C.)
Doyle, A. B.
Duffy, L. J.
Edgley, H. H.
Edgley, L. N.
Edwards, A. R.
Eedy, A. N.
Elliott, M.
England, V. T.
Fallon, H. G.
Fell, J. S.
Fitzgerald, G. L.
Forbes, A. M.
Foxall, J. S.
Foyer, A.
Fry, H. G.
Fry, H. W. (M.C.)
Fry, R. H.
Fuller, C. D. (M.M.)
Galloway, R. F.
Gelme, R. W.
Gibbes, F. W.
Gibbs, K. C. M.
Graham, W.
Green, E. O. K.
Gregson, W. H.
Haigh, V. A.
Hain, L. T.
Hall, G. E.
Hamilton, J. (D.S.O.)
Harden, G. B. (M.C.)
Harding, V. J. G.
Harrison, C. O.
Harrison, J.
Harrison, J. F.
Hay, W.
Hebblewhite, F. S.
Henderson, J. W.
Henry, T. H.
Herbert, D. P.
Herbert, J. E.
Hiatt, N. E.
Hill, A. J.
Hill, R. F.
Hinder, R. B. (M.C.)
Hirst, G. W. C.
Hollingdale, G. F.
Holloway, R. A.
Hooper, A. W.
Hooper, G. H. (M.C.)
Hope, B. C.
Horne, T. C.
Houston, R.
Howard, R. W. (M.C.)
Howatson, G. (D.S.O.)
Hutchinson, E. O.
Ireland, O. A.
Irons, R. G.
Irvine, L. R. H.
Job, B. C.
Kingel, E. A.
Lahey, R. W.
Latta, C. H.
Laws, F. W.
Lehmaier, L. H.
Lennox, F. W.
Litchfield, F. R.
Lysaght, D. R.
Macintosh, I. R.
Mackay, D. A.
Mackenzie, G. L.
Mackey, E. C.
Mackinnon, J. Y.
Maclean, A. G. (M.C.)
MacTaggart, J. N. C.
Mallarky, S. R.
Mann, G. H. (M.C.)
Marden, S. A.
Martyn, A. M. (C.M.G., D.S.O., C. de G.)
Massie, R. J. A. (D.S.O., C. de G.)
Mawson, Sir Douglas
Maxwell, M.
McBryde, J.
McGrath, M. J.
McIntyre, W. K. (M.C.)
McKern, G. J.
McMahon, J. T.
McPherson, H.
McRae, M. P.
Meldrum, E. A.
Millner, J. S.
Morris, A. C. (M.C.)