

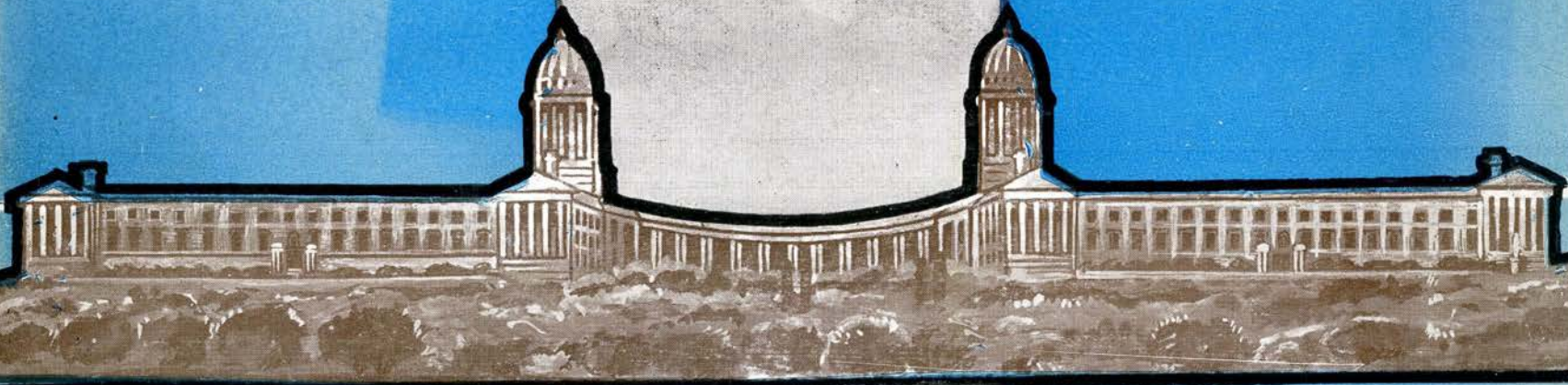
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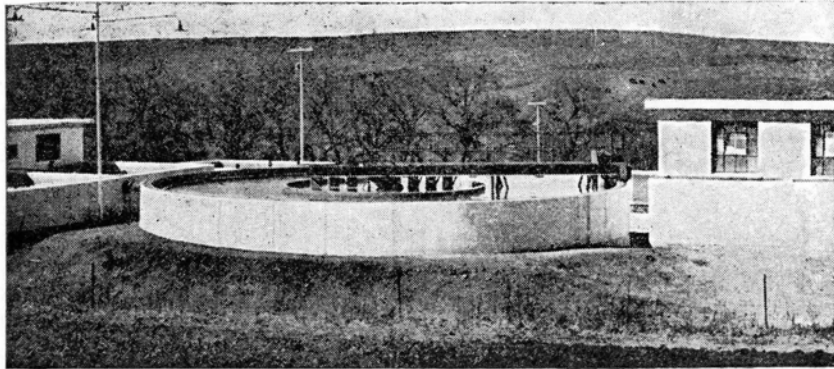


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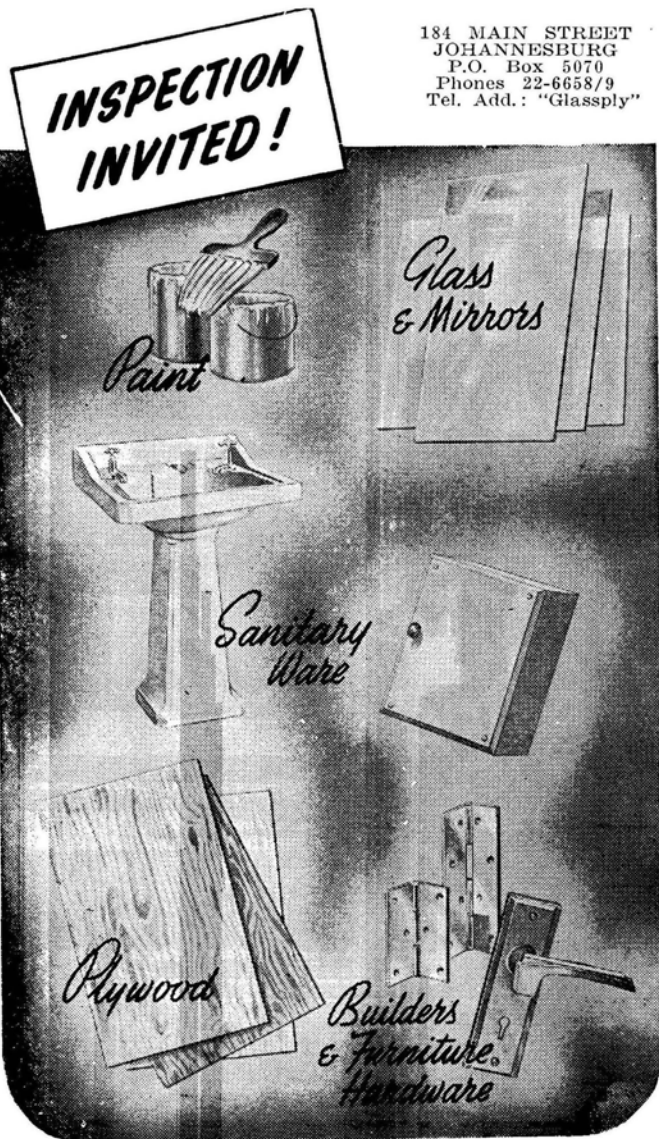
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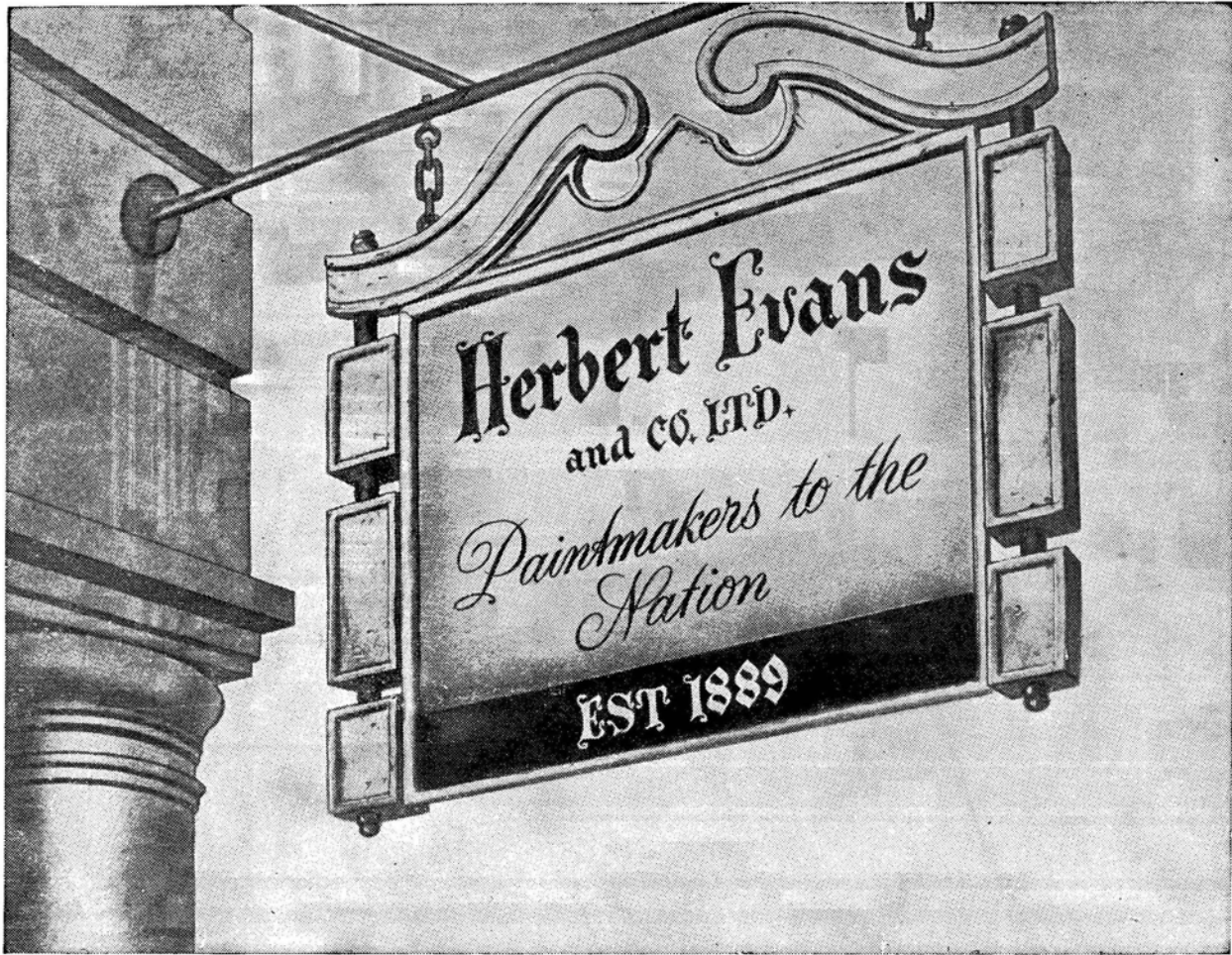
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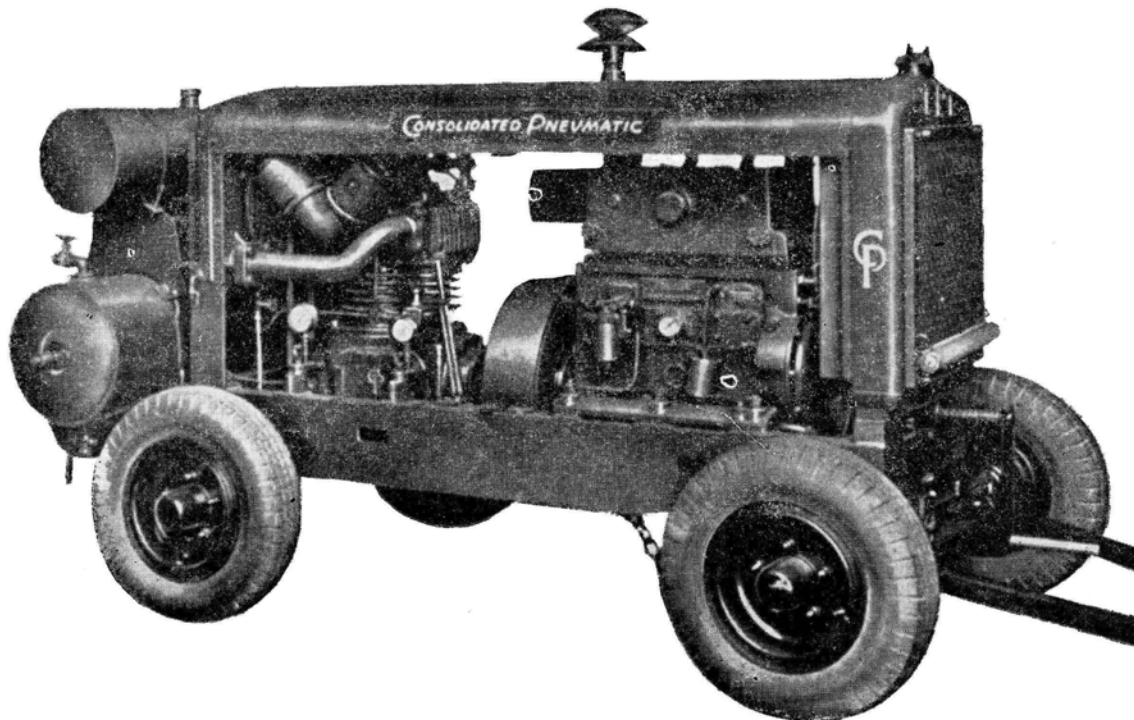
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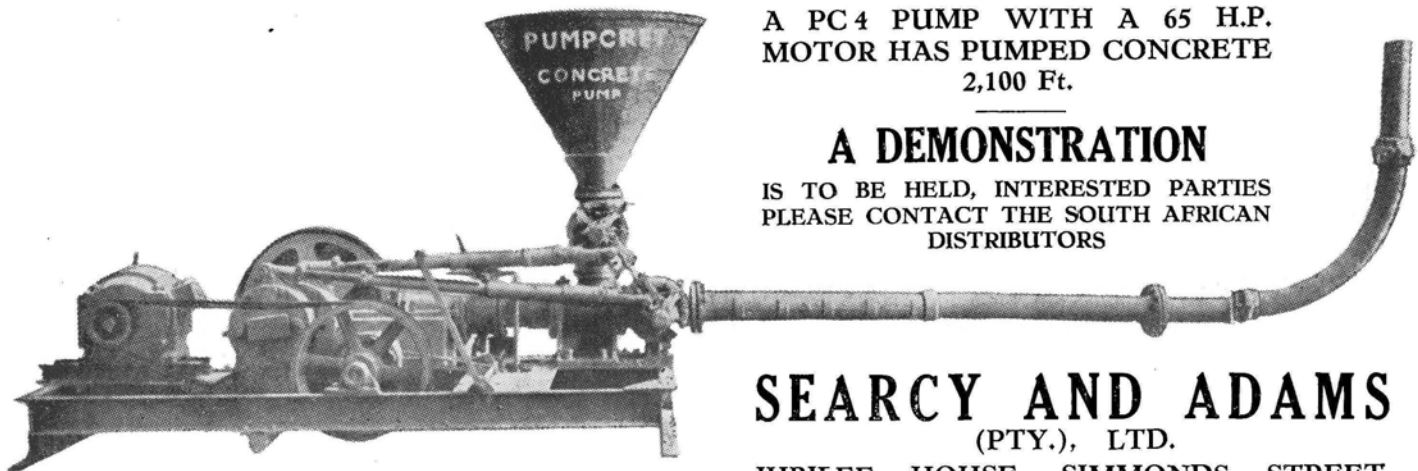


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OBITUARY, R. W. NORBURN

CONCRETE BY PIPELINE

TENDERS INVITED



Photograph : S.A.R.

THE WANDERERS GROUND.

THE NEW RAILWAY STATION JOHANNESBURG

WHEN senior Railway officers were sent abroad a few years ago they were instructed to have a good look at new stations. They visited Grand Central, New York, the new station at Montreal in the heart of the shopping centre, and representative main-line and suburban stations in the United States, South America and Europe. The results of their observations, plus the fruits of experience of the South African Railways in the Union, are being incorporated in the new station projects on which the South African Railways have decided.

The Johannesburg station plan has now been approved and the new station will incorporate many novel ideas, with special attention to travel comfort and public convenience, on the one hand, and smooth working conditions on the other. The architects employed for this scheme are Messrs. Kennedy, Furner and Irvine-Smith.

When completed in about five or six years, Johannesburg station will cover an area of nearly 14 acres. The present platforms and tracks will all be lowered to a depth of 11 feet below their present level, in accordance with the wish of the Johannesburg City Council, which wants all bridges at street level. This lowering of the tracks will enable the main buildings, with their booking offices and other passenger facilities, to be sited at street level. At the same time, it will eliminate the steep ramps which at present mark the approaches to the road bridges. This direct access to bridges will serve to remove the impression that railway lines form a barrier between different parts of the city.

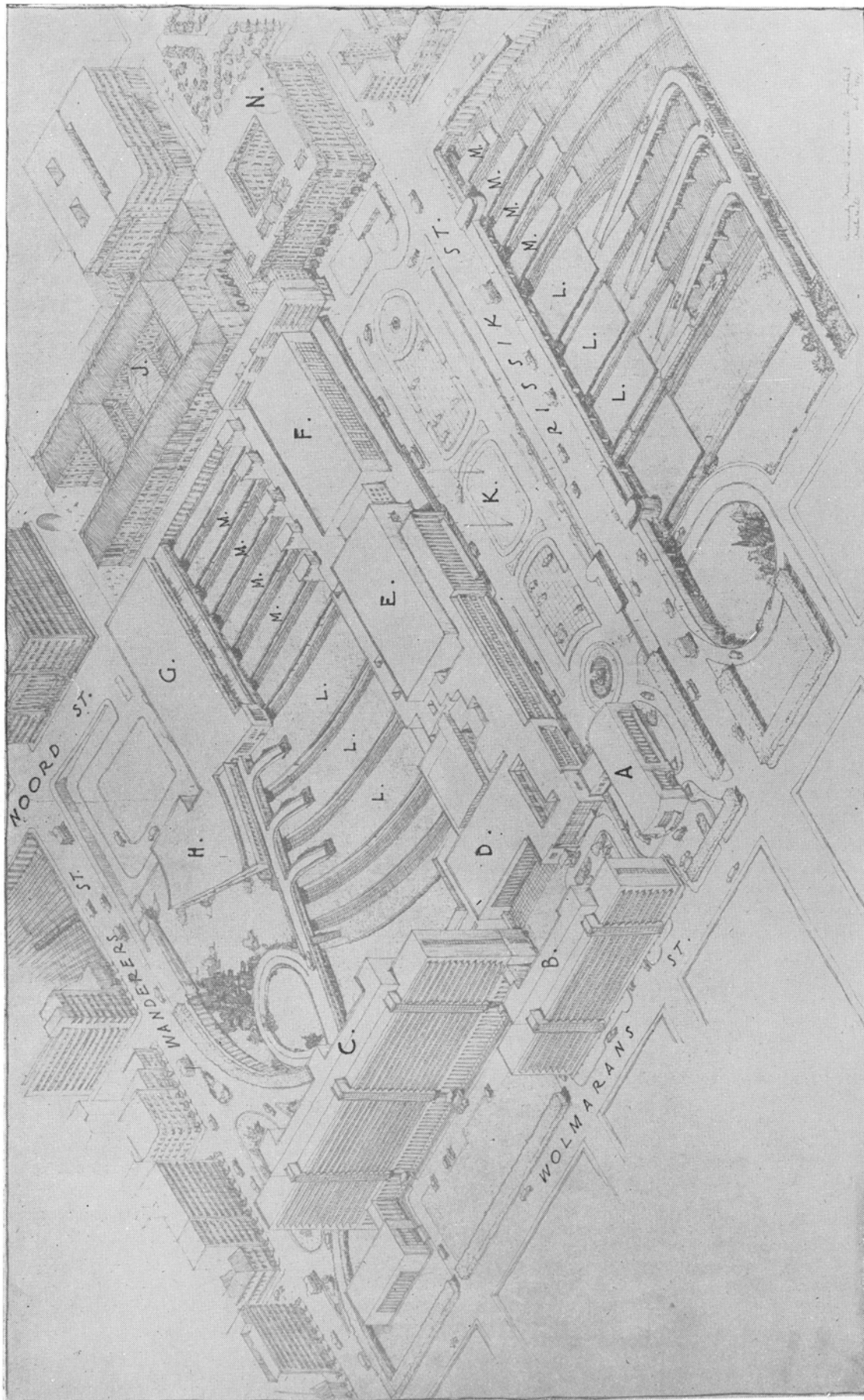
Although entrance to the new station will still be possible from Joubert Street, the main frontage will face westwards on to the new Rissik Street Bridge. This bridge will be some 100 feet wide and will accommodate a main artery to the north. It will be separated from the station buildings by a forecourt, (marked K on perspective drawing), 200 feet wide, which will be laid out in gardens and will provide car parking facilities.

In so far as the platforms are concerned, there will be ten for suburban passengers on the lowered site of the existing platforms (marked M), plus to the north six for main line traffic (marked L). In addition, there will be one through platform and two dock platforms reserved solely for van luggage and parcels traffic. To ensure as great a measure of segregation as possible between suburban and main-line passengers and to expedite movement to and from platforms, two adjoining concourses (Blocks F and E), are to be erected immediately above the suburban and main-line platforms respectively. Owing to their close proximity to the various platforms and the fact that each concourse will contain all the necessary passenger amenities, such as booking offices, refreshment and retiring rooms and bookstalls, the concourses will serve as the main rendezvous for passengers and will, therefore, materially relieve congestion on platforms. These concourses will face on to the wide forecourt adjoining the new Rissik Street Bridge.

Non-European passengers will be accommodated at the eastern end of the station, where they too will have separate concourses for main line and suburban traffic (in blocks H and G respectively), each providing all necessary passenger amenities. Entrance to these concourses will be from Hoek Street.

All main line platforms will be connected by ramps with a special service road, so that motor cars will be able to drive down on to the platforms. The traffic on these roads will all be one-way, from east to west, the cars entering the platforms from the Wanderers Street end and returning to street level at the Harrison Street end of the station.

In planning the new station, provision has been made for requirements for many years ahead, both in respect of traffic and staff accommodation. Towards this end, a third concourse (Block A) will be erected in the north-east corner of the layout. This will house the Airways Booking Offices and other facilities for Airways passengers. Adjoining this building will be a spacious restaurant (Block D) under which will be located a garage in which passengers travelling by



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- F. Suburban Concourse.
- G. Non-European Suburban Concourse.
- H. Non-European Main Line Concourse.
- J. Existing Station Building.
- K. Forecourt to New Station Buildings.
- L. Main Line Platforms.
- M. Suburban Platforms.
- N. Existing Railway Headquarters Building.

train or air may leave their cars to await their return.

The new plans absorb the entire area of the old Wanderers Grounds, since on the north perimeter of the area, facing Wolmarans Street, are to be erected two large administrative blocks (marked B and C) for the railway staff. At the present moment different branches of the staff are housed in a number of separate buildings scattered round the station. The new administrative blocks, together with the existing Headquarters buildings, will permit of all sections being concentrated in one area.

PROGRESS OF RECONSTRUCTION

The reconstruction of the station is being carried out in two stages. Initially, the area to the north of the present station, which was previously occupied by the Wanderers Club, will be excavated to the level of the proposed new station, and the new tracks, platforms and facilities provided. All the present station activities will be transferred to this section on the completion of this work, and thereupon the existing platforms will be closed and work put in hand to lower this area and construct the new structures and platforms. In this way, the dislocation of traffic, inseparable from so major an undertaking, will be reduced to a minimum.



THE TEMPORARY FOOTBRIDGE.

Photograph : S.A.R.



ACROSS THE EXCAVATIONS TO THE OLD STATION.

Photograph: S.A.R.

Approximately 180,000 cubic yards of earthworks had already been completed by April this year, in connection with the first stage. This represents nearly one-quarter of the quantity of earth that has to be removed. A large portion of the main Wanderers arena has now been excavated as has most of the Pirates Ground to the west, while the dance hall, club, offices and the concrete grandstand adjoining the hall have all been demolished and removed.

One temporary track has been laid at the same level as the existing station to assist in relieving the present congestion, but the remainder of the area is being excavated to the proposed new level, and a temporary footbridge has been erected over the temporary construction tracks to provide access to the north from the Joubert Street subway.

This footbridge is being extended to double its original length to permit of further excavation work to the north.

Since the construction of the new station will necessitate the temporary closing and replacement of certain of the city's existing outlets to the north, work is being pushed ahead on the construction of temporary bridges, which will take the place of those demolished until such time as the final layout is completed.

One span of the new temporary bridge at Harrison Street, together with the approaches has been completed and opened to traffic and work is now well advanced on the duplicate span. When completed, this bridge will serve the needs of all traffic at present using the Harrison Street subway, which will disappear in the new layout. This subway will, however, not be closed until the Johannesburg Municipality has available sufficient buses to take the place of the trams now feeding the northern suburbs via routes that pass through the subway.

A start has also been made on the construction of another temporary bridge connecting with Claim Street, for which the foundations of the south abutment are more than half completed, while excavations on the northern side of the line have been commenced. As soon as this bridge has been completed, Wanderers Street bridge will be closed to enable work on the eastern end of the station to be put in hand.

In planning the construction of the new station and the change-over from the old to the new conditions, special care has been taken to ensure that road traffic over the railway will suffer no inconvenience and that train passengers will have to cope with only a minor degree of traffic dislocation.

THE PUBLIC RELATIONS OFFICER, S.A.R. & H.

PRETORIA LINKS UP WITH RAND WATER BOARD

By The Public Relations Officer, City Council of Pretoria.

WITHIN the next month or two Pretoria's municipal water distribution system will be linked to that of the Rand Water Board and an additional 10,000,000 gallons per day will eventually become available. This, together, with the existing sources of supply should be sufficient to meet all requirements for the next decade.

The Rand Water Board water has been a long time in coming, for negotiations for this supply began in 1929, and even prior to that there had been references to the possibility of Pretoria obtaining its water from the Vaal River. But it was not until 1941, when the Minister of Irrigation, Senator A. M. Conroy, had to deal with an appeal from Pretoria, asking him for his assistance in securing a supply of water from the Rand Water Board or to allow Pretoria to make use

of the Hartbeestpoort Dam, some 25 miles west of the capital, as a source of supply, that positive action was taken.

The Minister heeded this appeal and called a round-table conference at which the basic terms of an agreement between the Municipality and the Water Board were decided on. Features of this agreement were a reduction of £130,000 in the amount Pretoria would have to pay to obtain 10,000,000 million gallons daily from the Board, this quantity of water being 250,000 gallons daily more than that originally suggested.

These negotiations took place in August, 1941, and since then and after Parliament had agreed to the necessary changes in the statutes of the Board, there has been steady progress.



THE LAST LENGTH OF PIPE.

Photograph: City Council of Pretoria.



INSTALLING A VALVE.

Photograph: City Council of Pretoria.

Now this work is nearing completion and it is expected that the additional supply will reach Pretoria some time before September 1st, the date on which it had first been thought the two systems would be linked.

The Municipality also took the necessary steps in the meantime to be ready to deal with this water. The pipe line from Signal Hill, near Germiston, where the Rand system is "tapped" to obtain Pretoria's quota, to the capital, a distance of 35 miles, was laid by the Rand Water Board. Up to the municipal boundary the cost of this pipe line — 29 inches outside diameter steel pipes are used — was estimated at £560,000, of which the Rand Water Board undertook to pay half, any excess over the estimate having to be met by the City Council. In addition, the Council paid £80,000 for the three miles of pipe line within the municipal boundary.

Though there are two break pressure tanks between Signal Hill and Pretoria, there still will be a considerable head of water when it reaches the capital, owing to the big difference in altitude between Pretoria and the Rand. To break this head, a reservoir of 1,000,000 gallons capacity has been built into which the pipe line first feeds the water.

At this control reservoir special streamline Larner Johnson needle valves fitted with jet dispersers have

been incorporated into the line. Jet velocities in the region of 120 miles per hour will be experienced during early draw offs. A small tank of 30 feet by 15 feet by 10 feet deep has been constructed beneath these jets to cushion out the force while filling the reservoir. The static head of 500 feet means that the last section of 18-inch pipe has to be anchored to withstand a force of 28 tons.

This reservoir, which was built by a Pretoria contractor, Mr. E. U. Gioia, cost £18,200. Work began in May, 1946, and it was completed recently. Altogether 4,000 cubic yards of soil had to be excavated.

From this reservoir, the water will flow into another reservoir, the total capacity of which is 11,000,000 gallons, but for practical purposes a capacity of 10,000,000 gallons. To make its construction possible, 25,000 cubic yards had to be excavated. It is 405 feet long, 206 feet wide, and 20 feet water deep. Its concrete slab roof is supported by 338 steel-reinforced concrete pillars, and it has an area of 80,000 square feet. It was built by a Pretoria contractor, Messrs. Mark Bros, for £77,800, making the total cost of the two reservoirs £96,000. These reservoirs were designed and supervised by the City Engineer and his staff. Building operations began in January, 1946, and it will be completed by the time the water from the

Rand reaches Pretoria. Five hundred tons of steel and 12,000 cubic yards of concrete were used.

In addition to the £80,000 for the pipe line within the municipal area, about £10,000 has been spent on additional pipes and valves to connect the reservoirs and systems.

These two reservoirs, not yet officially "christened" but unofficially known as the "Heights Reservoirs," are situated a short distance off the Pretoria-Johannesburg road where the road to Voortrekkerhoogte (Roberts Heights) branches off. To feed the water from these reservoirs into the existing service reservoirs, in order to make it available for household and industrial purposes, additional pipelines, altogether eight miles long, are being, and will have to be, laid. The pipes used for the main and the branch lines vary from 27 inches to 12 inches in diameter.

Valves were a problem because 27-inch and 21-inch valves could only be obtained on 24-months' delivery. To obviate this delay due to late delivery and as 12-inch valves were on reasonable delivery, by application of the Venturi principle and the incorporation of tapers, smaller valves were used in the line. The saving effected in this way was over £1,000, and when the system works "flat-out" — i.e. when about

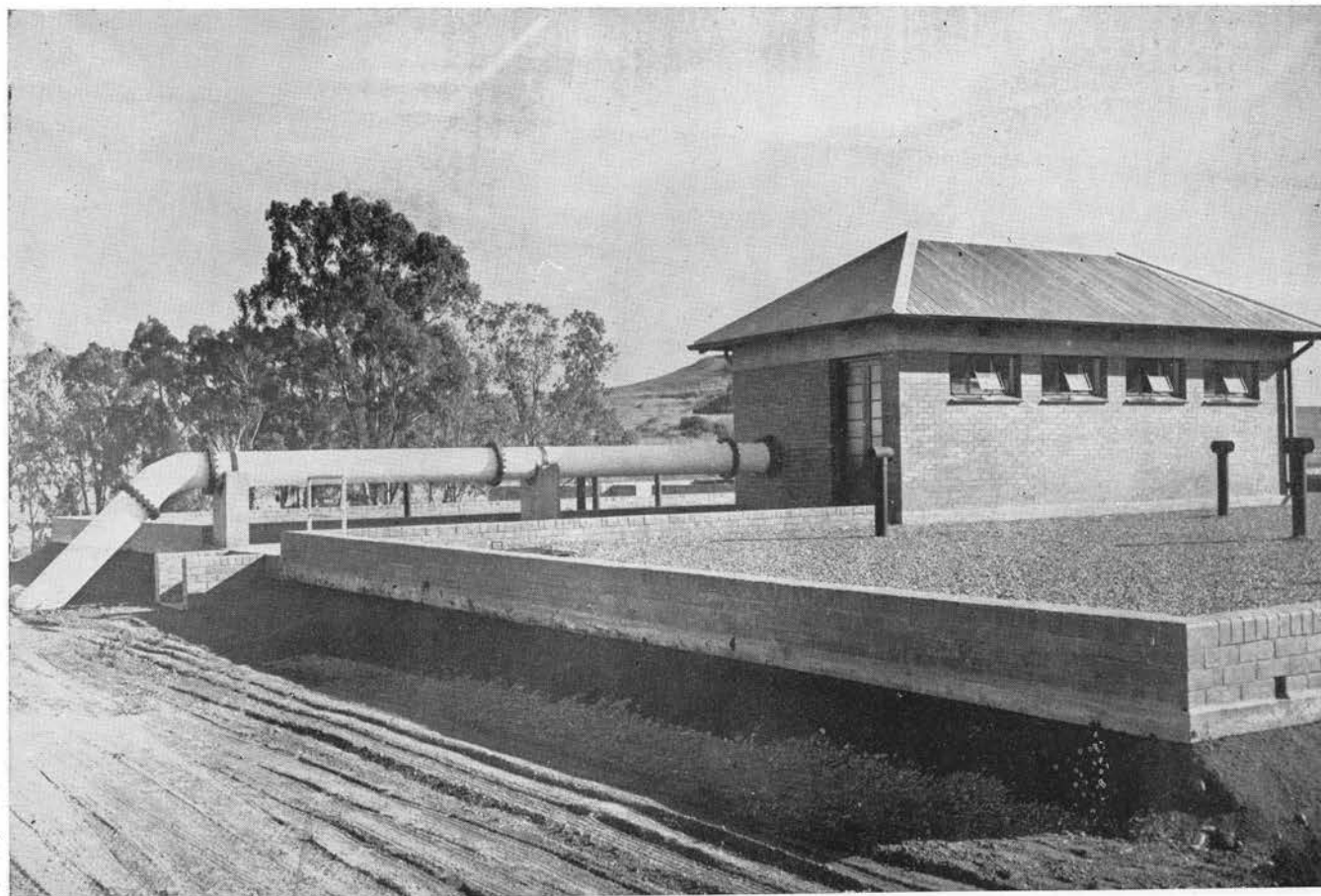
8,500,000 gallons pass daily through these main pipes — the loss in the water head will be only two feet per valve in the worst case.

This main line will serve existing service reservoirs, namely, the Muckleneuk and Hospital Hill reservoirs, as well as the new 2,000,000-gallon reservoir being built at Meintjieskop, just east of the Union Buildings. The total expenditure on this part of the scheme will be £100,000, including over £60,000 for pipes and £13,000 for valves.

In the near future the City Council will have to incur an additional expenditure of £73,000 to extend the pipe line right across the Moot Valley — the northern suburbs — to a new reservoir to be built in the Magaliesberg where this range passes through Villieria. The pipe line required for this reservoir is estimated to cost £21,000 and the reservoir £52,000.

This reservoir is required to meet the growing demands of the rapidly expanding northern suburbs.

The linking of the Rand Water Board's great distribution system to that of the City Council of Pretoria will mean very much for the future expansion of the capital as water will now be available for all requirements.



JET CONTROL HOUSE ON TOP OF RESERVOIR.

Photograph: City Council of Pretoria.

CONCRETE RAILWAY BRIDGES ON THE NATAL COAST

THE new railway and road bridge over the Umkomaas River on the Natal South Coast, which is expected to be completed by the middle of next year, is the second concrete railway bridge to be constructed by the South African Railways in the Natal coastal area.

THE UMHLATUZI RIVER BRIDGE

When, in 1940, particularly heavy floods carried away several of the spans of the bridge over the Umhlatuzi River, the difficulty of obtaining fabricated steel spans compelled the South African Railways to examine alternative methods of construction. Reinforced concrete bridges of various types were considered, and it was eventually decided to erect a bridge consisting of seven tied-arch spans with a reinforced concrete ballasted deck.

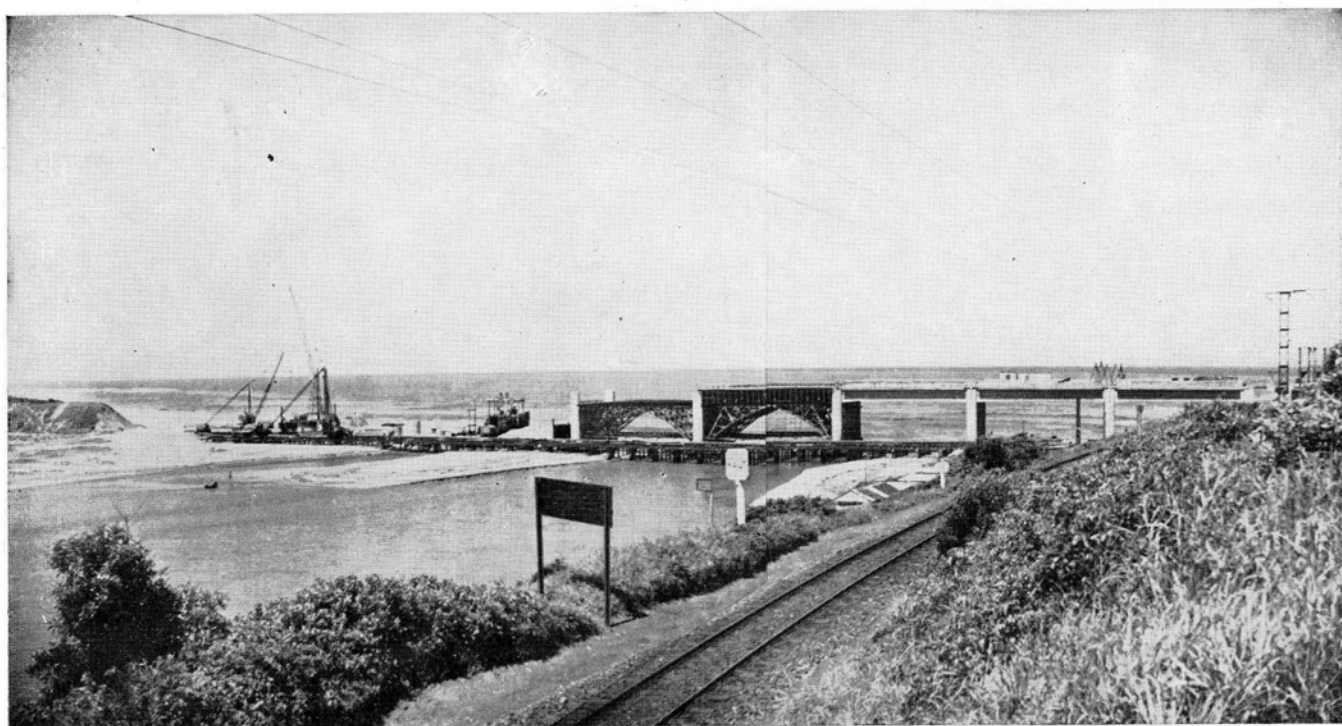
Although fairly common in road bridges, where loads are comparatively light, this type constituted a new departure in railway bridge construction, where very heavy loads have to be borne and the periodic hammer blows of a locomotive cause large impact effects. The tied-arch type of bridge is extremely rare in railway practice, and extensive research had to be carried out to ascertain the degree of agreement between the calculated and actual period of vibration of the bridge span.

Initially, a scale model was constructed, three-sixteenths of the full size, in which the span was 22 ft. 6 in. long and the arch rise was 5 ft. 7½ in. From experiments carried out on this model, it was found that the assumptions used in the design could be relied upon, and thereafter construction work commenced.

As the Natal rivers are subject to violent floods with considerable scour of the river beds, open caissons of reinforced concrete were first sunk. For the abutments, these caissons were 43 ft. long and 20 ft. wide overall, with a wall thickness of 2 ft. 6 in., while the piers were 37 ft. 6 in. long and 15 ft. wide.

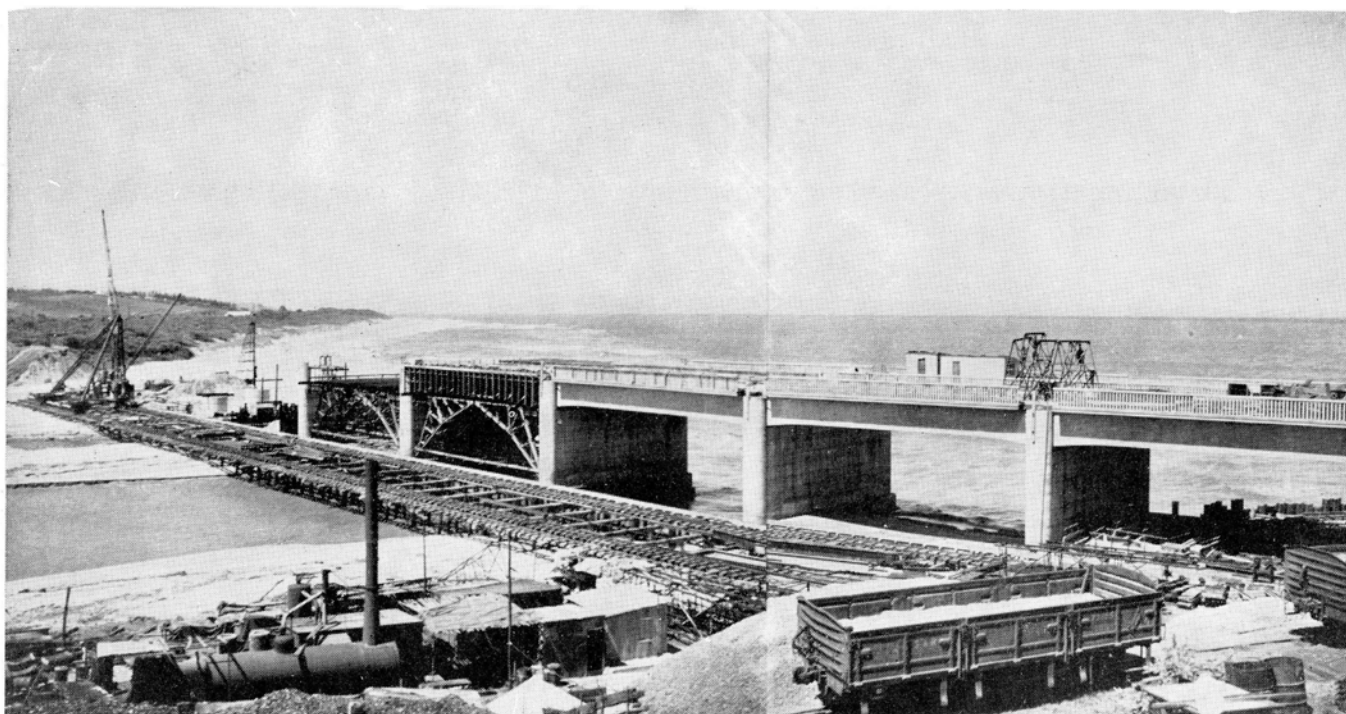
Sinking was commenced towards the end of 1942, and took two years to complete, in the face of adverse conditions. Most of the caissons were sunk to rock, the depth varying from 73 to 109 feet, the construction involving some 10,000 cubic yards of concrete and 440 tons of reinforcement. In certain cases where it was not possible to sink to rock, hard material was found and the caissons were sealed in this.

The superstructure, which took a further two years to complete, owing to the difficulty in obtaining necessary materials and plant, consists of seven tied-arch spans, each 120 feet centre to centre, with a rise of 30 ft. The construction of the superstructure entailed



THE UMKOMAAS RIVER MOUTH.

Photograph: The Editor.



THE UMKOMAAS BRIDGE.

Photograph : The Editor.

the use of 2,500 cubic yards of concrete, and 260 tons of reinforcement.

Upon the completion of the bridge, one of the spans was fully ballasted and static deflection tests were carried out with a Garrat type locomotive.

These tests demonstrated that the period of vibration of the span accorded with both the calculated and experimental predeterminations.

THE UMKOMAAS BRIDGE

The new bridge over the Umkomaas River which, when completed, will permit of considerable improvements to the suburban railway service between Durban and Port Shepstone, will be a nine-span structure of reinforced concrete.

Construction of the bridge, which was started in June, 1943, and is now about 70 per cent. complete, is being carried out departmentally, owing to war conditions, and has proved a continual battle against shortages of materials, plant, and skilled labour. Construction has been further handicapped by the fact that the bridge is sited at the mouth of the river, where the combined action of sea and river has provided many difficult construction problems. Spring tides and river floods have on numerous occasions undone in a few hours many days and weeks of patient and strenuous work.

During the past year the serious shortage of cement has hindered the progress most grievously, but it is expected to complete the bridge by the middle of next year, if the cement supply improves.

The piers of the bridge are at 81 ft. centres with the clear spans between the pier faces each 75 feet in length. The superstructure consists of simply supported tee beams, and the deck is wide enough to

accommodate two railway tracks as well as a national road and two footways. The span length is considerably greater than that usually adopted for reinforced concrete girder bridges of this type carrying railway loading.

Except at the south end of the bridge where rock is comparatively near the surface, the foundations consist of reinforced concrete cylinders of 14 ft. external diameter, sunk to an average depth of 45 ft. below H.W.O.S.T. The deepest cylinder is down about 60 ft. below H.W.O.S.T. The cylinders are taken down to solid rock where possible, but in certain cases where this has not been possible, they have been sunk well into decomposed dolerite of good bearing capacity. In all cases the foundations are taken well below the scour depths of the river, a very necessary precaution in bridging South Coast rivers. Very great difficulty has been encountered in sinking many of the cylinders, and it has proved necessary to resort to working under compressed air, employing an "Air Lock." Working under such conditions is extremely trying and arduous.

The overall length of the bridge is 732 ft. 1 in. and the width is 60 ft. 6 in., the railway portion being 28 ft. 3 in., the national road 22 ft. and two footways, one 5 ft. 9 in. and one 4 ft. 6 in. The height of the bridge deck above H.W.O.S.T. is 36 ft. 6 in. It is estimated that the total cost of the bridge excluding the railway deviation and road work will be in the vicinity of £170,000, and that the material used in its construction will total some 16,400 cubic yards of concrete and 930 tons of reinforcing steel.

The longest bridge in the Union is the one over the Orange River at Upington. This is 3,514 feet long.

Obituary

R. W. NORBURN

WEDNESDAY, June 4, was marked by the death of Mr. Wilfred Richard Norburn, one of the outstanding figures amongst Public Works Department official architects. His passing after a long and tedious illness will be regretted by his friends and associates who always hoped for a recovery.

Mr. Norburn was born in London in 1890, and came to South Africa as a child with his parents in 1894. He was educated at the Diocesan College for Boys, Pretoria, under Canon Sidwell, afterwards Bishop of George, and was fortunate enough to inherit considerable musical ability from his mother; he sang for many years in the Pretoria Cathedral and Arcadia Church Choirs, commencing his choral singing as a boy as far back as 1902; he was also an active member of the Pretoria Male Voice Choir.

The Profession of Architecture claimed Mr. Norburn in the early days of Pretoria's development and he served his articles in Pretoria with Mr. Ellis, architect of Tudor Buildings.

In February, 1909, Mr. Norburn first joined the civil service as a junior draughtsman and he was employed in this capacity until 27th February, 1915, when he was forced to leave due to a reduction in staff. After this he served a short period with Cowin & Powers and then he went to England working for Jessop Hardwick, F.R.I.B.A., of Sutton, England, for a time. In July, 1919, Mr. Norburn, after returning from England, rejoined the civil service as a draughtsman in the Department of Public Works, and he remained in this Department until 3rd July, 1943, when he was retired on account of ill health.

Towards the end of the first World War, Mr. Norburn served for a short period in the South African Infantry, and during the recent world war from 1940, he was seconded by the Department of Public Works to assume duty as Deputy-Director of Works, with the rank of Lt.-Colonel.



The Late R. W. Norburn.

Mr. Norburn during his architectural career developed an outstanding knowledge of hospital planning and requirements and he was engaged on Pretoria, Bloemfontein and Cape Town National Hospitals and the Cape Town Medical School amongst other important works. He was also an authority on school buildings and for many years was a member of the Departmental Committee on School Buildings for the Department of Union Education.

Public Works of South Africa associates itself with the late Mr. Norburn's many friends in extending its deepest sympathy to his widow and daughter.

EDITOR.

CONCRETE BY PIPELINE

A DEVELOPMENT IN BUILDING METHODS



IN these difficult post-war days the efficient and economic handling of materials is a vital factor in the building industry. At the present time the necessity for saving time and manpower goes hand in hand with the need for speeding up production and reducing the very high cost of building.

For efficient and economic operation of mechanical aids however, it is essential that the equipment is appropriate to the particular duty required. In building generally, due to the difficulties of moving heavy plant from place to place on a usually congested site, a great deal of mechanisation is not possible and the contractor usually has to rely on a few simple items, such as concrete mixers, chutes, hoists, etc. The hoists at certain periods of the construction become congested. This is likely to occur particularly during the periods when concrete is being placed.

To-day concrete deliveries by pipeline is an accomplished fact and to date hundreds of thousands of cubic yards of concrete have been pumped into place.

The past few years have seen many revolutionary changes in the construction industry, but none, despite their greatness can compare with this last development.

If the concrete is being delivered from the mixing point to the point of placing by pipelines, the hoist on the works, usually diverted to supply haulage for concreting, is left completely free for raising bricks and other materials. This means that other work, usually badly delayed during the concreting periods, is kept fully supplied with materials.

The labour saving incurred by placing concrete by pipeline is considerable and this is a great advantage to the builder or construction engineer, who no longer requires to scratch around for a large labour force for

the concreting periods. He no longer has to rob every other operation of its unskilled labour and almost bring these activities to a stop.

These last points are by no means the only possibilities; many other savings can be made during construction if the concrete is pumped to the placing position; it is possible for instance to pour the columns at the same time as the slab in a concrete framed structure for a building by leaving openings at the top of the columns so that these can be filled as the slab boxing is being poured.

Initial outlay on the plant is comparatively heavy but over a period of years considerable saving in construction costs can be made and the Contractor possessing the pumping equipment can not only undercut his competitors but give a greater margin of profit.

During the war period a great deal of concrete for heavy construction was pumped, and a typical undertaking was the Thorndon Breastwork, constructed by the Wellington Harbour Board, New Zealand, for berthage purposes and described in the Commonwealth Engineer, published in Melbourne.

The breastwork is of reinforced concrete, 3,680 ft. long and 45 ft. wide. The landward edge of the breastwork is carried by a mass of concrete wall retaining the reclamation, and reinforced concrete piles support the main body of the breastwork. The construction is of beam and deck type with the main transverse beams 15 ft. 0 in. centre to centre and the subsidiary longitudinal beams 6 ft. 8 in. centre to centre. The superstructure called for 3.6 c.yd. of concrete per lineal foot of breastwork. The total length of 3,600 ft. was divided into sections, which were constructed as required, and on the final 1,000 ft. a concreting pump was employed to deliver the concrete for placing.

The pump in use was of the Pumpcret type P.C. 4, two valve, and the maker's description of the machine is as follows:—

Capacity — 8–10 c.yd. per hour.

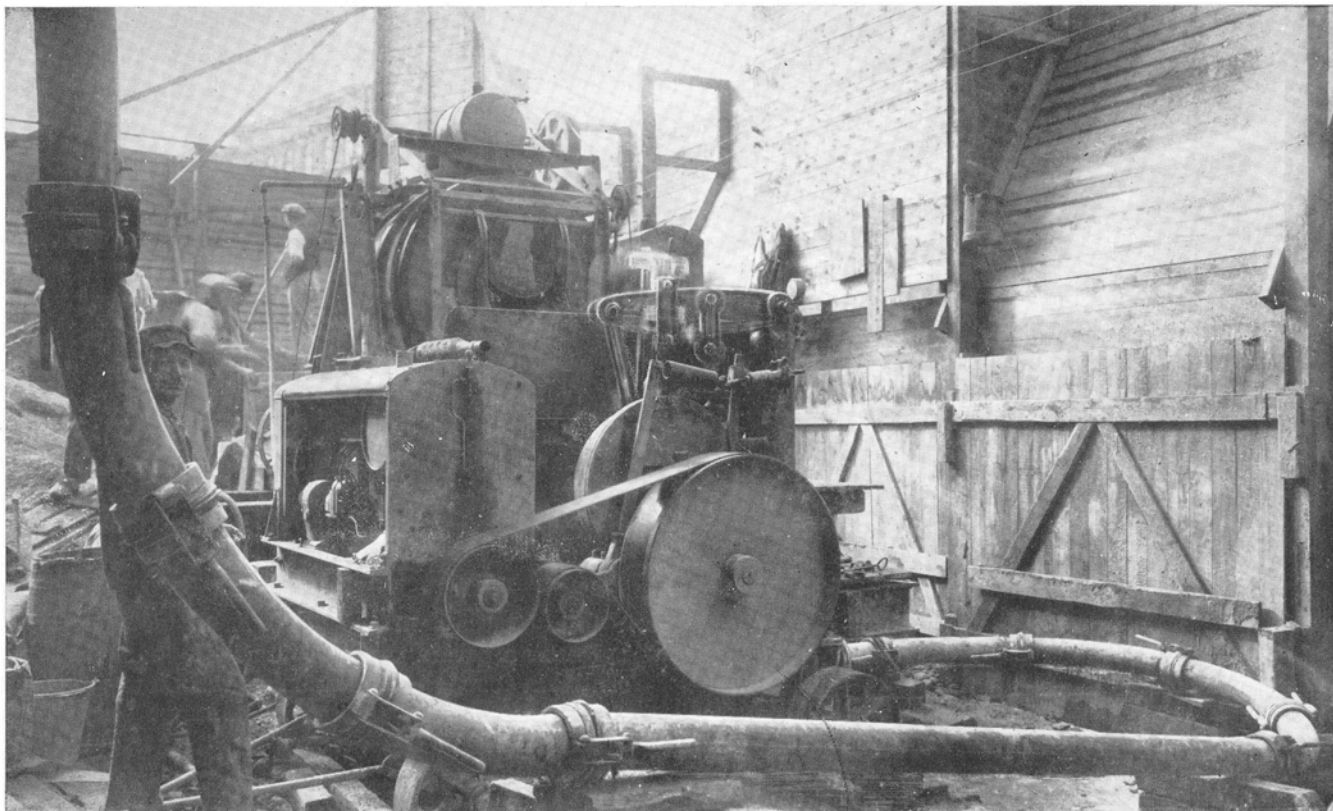
Range — 1,250 ft. horizontal or 124 ft. vertical.

Power required — 22–25 h.p. (electric, diesel or petrol).

Pipe line — 4½ in internal diameter.

Maximum aggregate — 1½ in.

The concrete enters a hopper on the bottom of which is a rotary valve actuated by an arm attached



CONCRETE PUMP AND MIXER WITH START OF PIPELINE.

to a cam. When the valve is opened the piston is at the end of its backward stroke, thus allowing the concrete to fill the chamber. The piston then begins its forward stroke, the inlet valve closes and the outlet valve opens. To this outlet valve is attached the delivery pipe into which the piston forces the concrete. Both valves have adjustable arms so constructed that should a stone jam in the valve opening, a spring is compressed in the arm thus allowing the valve to remain stationary without throwing undue shock on the actuating cam.

The pump works horizontally and is in line with the discharge pipe, the end of the piston being protected by a rubber composition cap. In Wellington the sand used for concrete was fairly abrasive, and it was found that these caps needed renewing after pumping about 750 c.yds. of concrete.

The motive power used in Wellington was a 27 h.p. diesel engine, and used Dieseline at the rate of two hours running time per gallon; the cost of lubricating

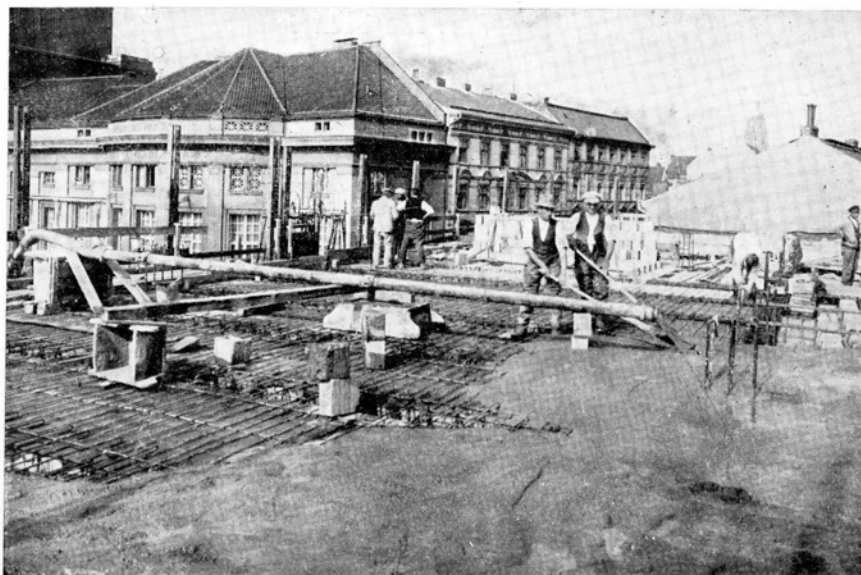
oil was practically negligible. The engine drove the pump by five V belts and a clutch arrangement allowed the pump to be started and stopped independently of the engine.

There are several points of practical importance to be observed when planning the layout of a plant. It was found that the vertical distance from the discharge chute of a mixer to the hopper should be kept as small as possible to obviate segregation of the mixed concrete as it falls from the chute into the hopper, and on no account must the tailings from each mix be allowed to fall into the hopper, but be retained and absorbed in the next batch.

In the layout for the breastwork the mixer was placed above the pump, the wheels and undercarriage having been removed, the roof of the pump housing forming the operating platform for the mixer.

It was found that a positive form of signalling was necessary from the delivery end of the pipe line to the pump operator in order to minimise delay when it

●
CONCRETE
DELIVERED
BY PIPELINE
FOR PLACING.



was necessary to stop the pump to allow of alterations to the pipe line.

The pipes are supplied in three lengths, 10 ft., 7 ft. and 3 ft. 6 in. and there are three standard bends of 30 deg., and 45 deg. and 90 deg. It has been found that two 45 deg. bends with a length of pipe line between them cause less friction in the pipe line than when using a 90 deg. bend. At all bends the pipe line must be securely braced to take up thrust. When lengthening, shortening or shifting a pipe line, much time can be saved if each man is previously drilled in the things he has to do; the men used for altering the line are those who spread the concrete. When possible the pipe line should be laid overnight and filled with water, so as to loosen the incipient rust in the pipes. Before commencing to deposit concrete a two bag gauge of grout is put through the pump and line followed by a sufficient number of mixings having a 6 in. slump to fill the line, when this liquid mix reaches the end of the pipe the mixing of concrete of the desired slump can be commenced.

Care must be taken in designing the concrete mixture to ensure a high degree of workability with a low water-cement ratio. The addition of water will not make the mixture more "pumpable" and may cause a block through segregation. The mix used on the breastwork was designed to meet these conditions and was in the proportion of 1 : 2 : 4, the sand was graded between 3/16 in. and 3/4. When using standard portland cement this gives a density of 152

lb. per c.ft., and an average strength of 2,000 lb. at three days, 3,000 lb. at seven days and 5,000 lb. at 28 days. The cement content is 560 lb. per c.yd. of deposited concrete. It was found that a 2½ in. slump with a 0.6 water/cement ratio gave the best pumping results.

The concreting operations were so arranged that an average day's work was 60 c.yd. The pump was started at 8 o'clock in the morning and reliefs were provided so that work continued through the meal hour at mid-day. From tests carried out the rate of delivery of the pump including stoppages for altering the pipe line was 8.75 c.yd. per hour.

One man operated the pump, one regulated the flow from the mixer into the hopper and kept the throat of the hopper clear, two placed and spread the concrete, and one vibrated; a total of five. The sand, gravel, and cement were drawn straight from storage bins.

Maintenance of the pump was not a serious item, consisting in the main of replacements of washers and piston caps, etc.

For cleaning the pipe line a special connection was supplied to which an air compressor could be attached. The method employed was to place a cylindrical wad of paper in the special pipe, which was pushed along the pipe line by the air pressure, forcing the concrete out at the end of the pipe. Care must be taken to see that too much air pressure is not applied, also when

the wad is nearing the end of the line the air must be eased otherwise the wad shoots out with great force; in any case it is wise to keep the men away from the pipe end and erect a board to stop the concrete from spreading as it leaves the pipe.

From a practical point of view it has been found that if a compressor is not always available at the moment the pipe line is to be cleared, very little time is lost if the pipes are broken at the joints and emptied into a barrow. It is advisable to employ the pipe line as soon as possible after completing concreting, especially if compressed air is used because the movement of the concrete in the pipe line provides its own lubrication by virtue of bringing the cement and fines to some extent to the periphery of the pipe and if this has begun to harden friction is too high. For this same reason it is advisable in hot weather especially, to give the pump a few turns every half minute or so, should there be an undue time spent altering pipes. After completing work for the day all pipes and the pump should be effectively washed out.

For some considerable time vibrating has been used in preference to hand ramming. For large sections, such as heavy piles and beams, and with concrete of $2\frac{1}{2}$ in. slump or less, it is found that one man with a "spud" vibrator can do the work of four men hand ramming, and with better results. The moving of the concrete from the end of the pipe line to the actual point of deposition, which distance should be reduced to a minimum, should be done by shovels and not by means of the vibrator, which latter is liable to cause segregation. In practice the man handling the vibrator tends to over vibrate rather than under vibrate. With careful vibration it is possible to throw off any surplus water used in the mixing; this water is clear and does not carry off cement or fine grout.

The "Pumpcret" pumps are simple and robust machines, which any foreman can handle. The distance and height that can be attained depends upon the power of the prime mover, which can be electrical, diesel or petrol.

With a 22-25 h.p. motor a P.C. 4 model "Pumpcret" pump can pump 125 feet vertically or 750 feet horizontally. The same pump with a 65 h.p. motor will reach approximately 2,100 feet horizontally. The capacity of the P.C. 4 model is 8 to 10 cubic yards per hour.

For ordinary purposes the suppliers provide for a horizontal distance of 1,300 to 1,400 feet with machines powered by 45 h.p. and 25 h.p. units. When diesel engines are used, altitude and temperatures must be borne in mind and the h.p. of the power unit increased correspondingly.

The sole agents for "Pumpcret" concrete pumps for the Union of South Africa and the Rhodesias are "Aerflo" (Pty.) Ltd., 301 Union Castle Buildings, Loveday Street, Johannesburg, who carry a complete range of spares and run maintenance services, and the sole distributors are Searcy & Adams (Pty.), Ltd., Jubilee House, 15 Simmonds Street, Johannesburg.

Tenders Invited

THE following are particulars of the more important tenders which have been invited, up to the time of going to press, for Public Works by Government Departments, Provincial Administrations and Municipalities. In each case the date by which the tender must be submitted is given.

BUILDING TENDERS:

Prospect: Waterproofing of a reinforced concrete roof. Deposit £2-2-0. S.A.R. & H., Park Chambers, Johannesburg. Due 28/7/47.

Klipplaat: Labour and materials for the erection and completion of proposed new rest room building with 20 bedrooms for S.A.R. & H. Deposit £2-2-0, at General Manager's Headquarters, Johannesburg. Due 7/8/47.

Senekal: For P.W.D., Pretoria. Additions to Paul Roux School. P.W.D./847. Due 29/7/47.

Amatikulu Leper Institution: For P.W.D., Pretoria. Further accommodation. P.W.D./815. Due 31/7/47.

Somerset West: For P.W.D., Pretoria. Carrier terminal station and extensions to post office. P.W.D./852. Due 31/7/47.

Port Elizabeth: For P.W.D., Pretoria. New Trunk and Automatic Telephone Exchange. P.W.D./853. Due 7/8/47.

Lutzville, Van Rynsdorp Division: Secondary School. Erection of a teachers' residence. Cape Provincial Tender Board. Architects, Leek & Ritchie Fallon, 88 St. George's Street, Cape Town. Due 5/8/47.

Zastron: Additions to Primary School. P.W.D., Pretoria. No. 854. Due 5/8/47.

Zastron: Additions to Secondary School. P.W.D. Pretoria. No. 855. Due 5/8/47.

Potchefstroom: New Laundry, Witrand Institution. P.W.D., Pretoria. No. 856. Due 7/8/47.

BRIDGES:

S.A.R. & H., Park Chambers, Johannesburg: Construction (Labour only) of a concrete arch bridge and deviation over the Umzimai (No. 1) River from 42 miles 04 chains to 42 miles 69 chains between Park Rynie and Kelso Stations. System Manager (Room 35, Durban). Due 28/8/47.

EARTH WORKS, ETC.:

Cape Town Municipality: Execution of earth works, being portion of the Zand Vlei Development Scheme, Muizenburg. The work consists of deepening part of an existing vlei and reclamation of adjoining areas with the soil excavated.

The quantity of excavation involved in the main scheme is approximately 700,000 cubic yards. Deposit £3-3-0. Tender form D.E. 1/47. Development Engineer, City Engineer's Department, Cape Town. Due 8/8/47.

Cape Town Municipality: Construction of a 150 ft. wide concrete-lined canal and incidental works affected by the re-location of the Salt River, Cape Town. The main works will involve:

- Earth works. Approx. 75,000 cub. yds.
- Concrete slabs, walls, etc. Approx. 9,000 cub. yds.
- Reinforcing steel and mesh. Approx. 100 short tons.

Form of tender D.E./2/47. Development Engineer, City Engineer's Dept., Cape Town. Due 5/8/47.

SEWERAGE INSTALLATIONS, ETC.:

Cape Town (City Engineer): New disposal works at Athlone. Four sewage distributors complete with sprinkler arms, pipes, bends, etc. Form of tender C.A./1/47. Due 31/7/47.

Cape Town (City Engineer): Supply and erection of mechanical equipment comprising sludge pumps, sludge removal device and flocculating equipment required to be installed within two concrete humus tanks which will be provided by the Council. Due 31/7/47.

HEATING AND VENTILATION, ETC.:

Public Works Department, Pretoria: Calorifiers for Public Works Department, Johannesburg. P.W.D./S.98. Due 7/8/47.

Public Works Department, Pretoria: Supply, delivery and erection of air-conditioning plant, New Automatic Telephone Exchange, Rosettenville, Johannesburg. P.W.D. No. 858. Due 31/7/47.

ELECTRICAL INSTALLATIONS, EQUIPMENT, MATERIALS AND LIFTS:

Shabani, Southern Rhodesia: Electricity Supply Commission. Supply, delivery and erection of circulating water piping and spray cooling plant at the Commission's Shabani generating station. Contract 53/1947. Deposit £5-0-0, extra copies of documents 5/- each. Due 29/7/47.

Electricity Supply Commission: Electricity House, Cape Town (The Manager). Insulators, specification 220/1947. Due 8/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Electrical signalling materials. No. 6379. Due 14/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Telegraph line materials. No. 6680. Due 30/7/47.

Natal Provincial Tender Board: P.O. Box 358, Pietermaritzburg. Lifts in Surgical Block, Addington Hospital. Provincial Work's Office, Pietermaritzburg. Due 30/7/47.

Bulawayo Municipality: Town Clerk. Switch gear, transformers, insulators, variable speed couplings, lightning arrestors, tubular steel poles, metres, underground cables and auxiliary equipment and overhead line equipment. Contract E.35/1947. Offers ex export and ex Rhodesian or Union stocks are required, the last named in preference. Deposit on documents £1-1-0. Additional copies of documents 10/6 each. Due 15/9/47.

Matatiele Municipality: Town Clerk. Electrical equipment:

- (a) Supply and installations of two sets of Diesel engines and alternators, 125 k.v.a., 3-phase, 4 wire, 400/230 volts, .8 power factor, not exceeding 600 r.p.m.
- (b) Supply and installation of one set of Diesel engine and alternator, 50 k.v.a., 3-phase, 4 wire, 400/230 volts, .8 power factor, not exceeding 750 r.p.m.
- (c) Materials for alterations to distribution.
- (d) A.C. meters.
- (e) Necessary switchboard instruments for the above installation.
- (f) Various household equipment and motors, i.e., refrigerator motors, 3-phase motor fans, wireless sets, etc. Deposit £3-3-0. Due 25/8/47.

Uitenhage Municipality: Electrical Engineer. Electric cables and joints. Contract E/22. Due 31/7/47.

Johannesburg Municipality: Stores Dept. Distribution transformers. Contract 127. Due 15/8/47.

Public Works Dept., Pretoria: Supply, delivery and erection of one electrical passenger lift, Old Govt. Buildings (Raadzaal), Pretoria. P.W.D./825. Due 28/8/47.

Port Elizabeth: City Electrical Engineer. One set of electrically-operated automatic traffic signals for fixed-time operation and necessary multi-core P.I.L.C. armoured cable. Specification 293. Duplicate copies of documents on deposit of 10/6, extra copies 10/6 each. Due 14/8/47.

Murraysburg Municipality: One 50 k.w. Diesel alternator, circulating water piping, sprays and switch panel including erection. Specification M.O. 1/1947. Deposit £3-3-0, extra copies of documents £1-0-0 each. Consulting Engineer, J. S. Clinton, P.O. Box 4648, Johannesburg. Due 31/7/47.

S.A.R. & H., Park Chambers, Johannesburg: Electrical signalling cable. No. 6891. Due 7/8/47.
Department of Posts & Telegraphs, Pretoria: Radio telephone equipment. P.O. 799. Due 7/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Train lighting cells. No. 6981. Due 11/9/47.

Pretoria Municipality: Trolley bus overhead equipment. Specification M.T. 4/47. Controller of Stores, Pretoria West. Due 29/7/47.

Department of Public Works, Pretoria: Single-operator transformer type electric welding sets. P.W.D./S.100. Due 11/9/47.

Cape Town Municipality: City Electrical Engineer. 6 k.v. and multicore cables. Specification 1423/1947. Due 30/7/47.

Johannesburg Municipality: Stores Dept. Overhead line control gear. Contract 155. Due 18/8/47.

Ladysmith Municipality: Borough Electrical Engineer. Certain high tension switch gear with protective equipment. Contract 31. Three copies of documents on deposit of £2-2-0, extra copies 10/6 each. Due 14/8/47.

Municipality of Johannesburg: Stores Dept. Electric cable. Contract 157. Due 15/8/47.

Electricity Supply Commission: Electricity House, Cape Town (Cape Town undertaking). Pole fittings. Specification 221 & 222/1947, to the Manager. Due 31/7/47.

S.A.R. & H., Park Chambers, Johannesburg: Carbon brushes. Contract 7007. Due 14/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Electrical material. No. 6872. Due 21/8/47.

Provincial Works Office, Pietermaritzburg: Lifts, New offices for Education Dept. Pietermaritzburg. Due 6/8/47.

Public Works Department, Pretoria: Apparatus for an electric clock system, Government Buildings, Pietersburg. P.W.D./848. Due 7/8/47.

Pietersburg Municipality: Electrical extensions. Supply, delivery and erection of:

- A. Steam raising plant, coal and ash-handling plant, valves, piping, water tanks, water softener and alterations to existing boilers.
- B. Two 2,000 k.w. steam turbine-driven generating sets, main and auxiliary switch gear, station transformers, main and auxiliary cables and power station wiring, circulating water piping, pumps and cooling pond equipment.

Deposit of £3-3-0 each section — extra copies at 10/6 each. Consulting Engineer, George Drewett, Manlin House, 17 Harrison Street, Johannesburg. Due 22/9/47.

Johannesburg Municipality: Stores Dept. Armature and field coils. Contract 159. Due 16/9/47.

Johannesburg Municipality: Stores Dept. Electrical Conduit. Contract 161. Due 15/8/47.

Kimberley Municipality: City Electrical Engineer. Certain E.H.T. and L.T. two, three and four core armoured cable. Due 1/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Telegraph line material. No. 6883. Due 2/10/47.

S.A.R. & H., Park Chambers, Johannesburg: Armature coils. No. 6961. Due 7/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Electric lamps. No. 6873. Due 21/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Switch boards for Table Bay Harbour. No. 7079. Due 25/9/47.

S.A.R. & H., Park Chambers, Johannesburg: Electric cable. No. 7080. Due 7/8/47.

S.A.R. & H., Park Chambers, Johannesburg: Radio spares, Langlaagte. Enquiry C. 7079. Due 6/8/47.

Keetmanshoop Municipality: Electricity undertaking. Supply, delivery and in certain sections the erection of the following plant and equipment:

- A. 6.6 K.V. and L.T. power station switch gear and sundries.
- B. 6.6 K.V. and L.T. cables, laying, jointing.
- C. 6.6 K.V. overhead line materials and construction.
- D. 6.6 K.V. and L.T. sub-station equipment.
- E. Transformers.
- F. Indoor and outdoor house services.
- G. Motors and starters.
- H. Replacement of D.C. equipment, radios, refrigerator motors, fans and sundries.

Specification K.H. 1/1947. Deposit £3-3-0, extra copies £1-0-0 each. Consulting Engineer, J. S. Clinton, P.O. Box 4648, Johannesburg. Extended now due 15/9/47.

Ladysmith Municipality: Transformers. Town Clerk. Extended now due 14/8/47.

Electricity Supply Commission, P.O. Box 377, Salisbury: Supply, delivery, erection and finishing complete at the Commission's Umtali, No. 2 Generating Station, Southern Rhodesia, of the following circulating water piping and spray cooling plant:

Section 1. 42, 36 and 30" main delivery and suction flanged piping together with all branch piping, specials, valves, bolts, nuts, jointing, etc.

Section 2. Spray cooling plant complete with headers and distributor pipes, crosses nozzles, valves, jointing material and all accessories.

Contract 55/1947 (Secretary). One copy of documents on deposit of £5-0-0, extra copies at 5/- each.

Public Works Department, Pretoria: Supply delivery and erection of two electric passenger lifts, Central Govt. Offices, Pretoria. P.W.D./859. Due 2/10/47.

Public Works Department, Pretoria: Two Diesel alternator sets, Fort Cox Agricultural School, Middeldrift, Cape Province. P.W.D. No. 861. Due 2/10/47.

ROAD PLANT, ETC.:

Umkomaas Municipality: One crawler-type 20/30 h.p. Diesel tractor with 8"-blade and 8-tooth ripper complete with all necessary attachments. Town Clerk. Due 31/7/47.

Barkly East Divisional Council (to Secretary) :

1. One motor grader of approximately 20,000 lbs.
 2. One pneumatic-tyred wheel tractor of approx. 6,000 lbs. weight, preferably powered with Diesel engine.
 3. Two bottom dump waggons suitable for haulage of road material, each 4 cubic yards capacity.
 4. One angle dozer for attachment to 1938 model "D. 6 Caterpillar" Tractor.
 5. One scoop.
- Due 9/8/47.

Van Rhynsdorp Divisional Council (to Secretary) :

1. One motor grader, approximate weight 18,000 lbs.
 2. Two four-wheeled water trailers, 600 gallon capacity.
 3. Four bottom-dump waggons, $2/2\frac{1}{2}$ cubic yard capacity.
- Due 11/8/47.

National Roads Plant: Cape Provincial Roads Engineer's Dept. Portable houses manufactured with steel or metallic framework with metallic, cement-asbestos, hardboard or timber panels, plus kitchen furniture units, sinks and draining boards. No. F. 38/1947. Due 8/8/47.

Newcastle Municipality, Town Clerk: One pneumatic-tyred wheel tractor, petrol or paraffin driven engine, suitable for haulage work. approximately 24 h.p. drawbar-pull, complete with electric starting and lighting equipment and safety drawbar hitch (quick delivery essential). Due 31/7/47.

Cape Provincial Roads: Major plant for the Transkei. Provincial Roads Engineer's Dept., Cape Town :

- Item 1. Up to four (4) Petrol-driven motor truck chassis with payload capacity of 10,000 lbs., complete with hoist and power take-off mechanism. Power hoist mechanism is to be of the roller-wedge or compound leverage type, giving a 55° tip angle suitable for the above payload and for longest type body which can be fitted to this truck.
- Item 2. Three (3) petrol-driven motor truck chassis, with the following :—
Net payload capacity 6,000 lbs. Complete with hoist and power take-off. Specifications as under Item 1.
- Item 3. One (1) 3-ton motor truck with platform body suitable for the cartage of 3,000 lbs. of explosives. It should be noted that maximum permissible load of explosives is 60 per cent. of the rated payload of the vehicle in normal service. Cab, engine and equipment specifications as for Item 1 except that tow hooks are not required. Tank capacity 20 gallons.

The truck must be so constructed with all the necessary equipment to comply with the Explosives Regulations, and must be delivered fully licensed to carry 50 cases of explosives.

All information as to fire extinguishers, construction of the body, etc., is obtainable from the Chief Inspector of Explosives, Box 4570, Johannesburg.

- Item 4. One (1) Light pick-up van; payload capacity $\frac{3}{4}$ -ton, to the following specifications :

Petrol engine governed to 45 m.p.h., fitted with heavy duty oilbath and sump breather with filter cap. Steel lock-up factory-built Sedan cab. All electric starting and lighting equipment with at least a 100 amp hour battery. Hydraulic shock absorbers front and rear. Open steel body with rolled edges. Lock-up petrol tank cap.

- Item 5. Two (2) Portable two-stage air compressors, capacity 105 cubic feet of free air per minute at 100 lbs. sq. ins. pressure at an altitude of 5,000 ft. above sea level, Petrol or Diesel engine, with a heavy-duty oilbath air-cleaner, mounted on the same chassis as the compressor, the whole unit to be on spring-mounted pneumatic wheels. Sketches must be submitted showing clearly the method of mounting the engine and compressor into the chassis. No. F.27/1947.

Due 29/8/47.

WATER SUPPLIES, PUMPS, PIPING AND WATER WORKS :

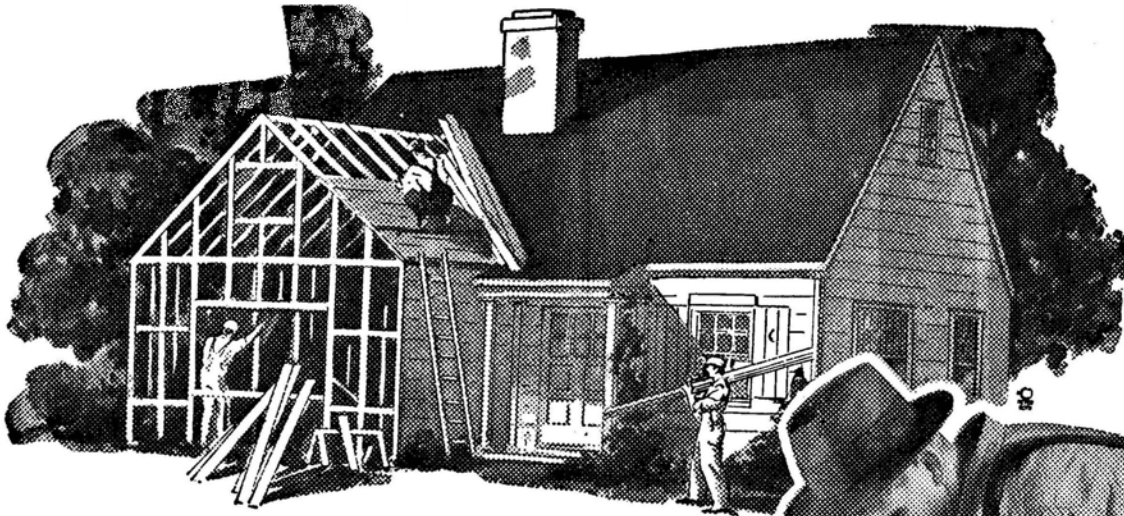
Fish Hoek Municipality: Water supply scheme. Spun iron or asbestos cement pipes, specials, valves, fittings and jointing material. Contract 8/1947. Deposit £2-2-0. Consulting Engineer, Ninhan Shand, 806 Groot Kerk Building, Cape Town. Due 31/7/47.

Pietermaritzburg Municipality: City Engineer. Henley pipe line. Main aqueduct.

1. Sluice and air valves. Contract 8/1947.
 2. Steel pipes and specials. Contract 9/1947.
- Both due 1/9/47.

Ladysmith Municipality: Water supply extensions. Supply, transport and erection of one free roller sluice gate and level recorder and supply of sundry penstocks and valves. Contract A/1947. Deposit £5-5-0, extra copies of documents £2-2-0 each. Consulting Engineer, Stewart, Sviridov and Oliver, Balgownie House, 66 Commissioner St., Johannesburg. Due 31/7/47.

Ladysmith Municipality: Water supply extensions. Construction of concrete dam across the Klip River above the existing Municipal intake weir. Contract B/1947. Deposit £5-5-0, extra



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copies of documents £2-2-0 each. Consulting Engineer, Stewart, Sviridov and Oliver, Balgownie House, 66 Commissioner Street, Johannesburg. Due 31/7/47.

Kempton Park Municipality: Water scheme. Pipes (steel and/or asbestos cement), valves, specials and accessories for water mains of 8, 6, 4, 3, 1½, 1 and ¾ inch bore. Contract D/1947. Extended now due 31/7/47.

Rand Water Board, P.O. Box 1127, Johannesburg: Construction of reinforced concrete sedimentation tanks, flumes, etc., at main pumping station, Vereeniging. Contract 701. Deposit £5-0-0, additional copies £2-2-0 each. Due 29/7/47.

Durban: City & Water Engineer (Water Division) Sand Washing Plant. W. 117/US. Due 8/8/47.

Bergvliet: Extensions to water scheme. 24,855 ft. straight pipes, class "C," sizes 6, 4, 3 and 2 inch; 61 valves of various sizes; 46 hydrant tappings of various sizes; 20 bends of various sizes; 6 reducers of various sizes; 30 ties of various sizes; 2 crosses, 6 x 4 inch and 4 x 3 inch; 46 hydrant valves, boxes, etc. Secretary, Divisional Council of the Cape, 6 Dorp Street, Cape Town. Due 2/8/47.

LOCOMOTIVES:

S.A.R. & H., Park Chambers, Johannesburg: Petrol-engine driven locomotives. No. 7006. Due 7/8/47.

MISCELLANEOUS:

Omnibuses: City Electrical Engineer & Transport Dept., Pietermaritzburg. 12 single and double-decker. Contract 228. Three copies of documents free of charge, additional copies at 5/- each. Due 21/8/47.

Crematorium Furnace: City Electrical Engineer, Pietermaritzburg. Contract 234. Three copies of specification on application, extra copies 5/- each. Due 21/8/47.

Omnibuses: Stores Department, Durban. 25 double-decker motor. S.2694. Due 5/9/47.

Omnibuses: Stores Department, Durban. 50 double-decker motor. S.2695. Due 5/9/47.

Chemicals: To Director of Veterinary Services, Union Tender and Supplies Board, P.O. Box 371, Pretoria. S.O. 1409. Due 14/8/47.

Automatic Couplers & Knuckles: S.A.R. & H., Park Chambers, Johannesburg. No. 6901. Due 7/8/47.

Milling Machine: S.A.R. & H., Park Chambers, Johannesburg. No. 6912. Due 7/8/47.

Drilling Machine: S.A.R. & H., Park Chambers, Johannesburg. No. 6913. Due 7/8/47.

Log Frame Saw: S.A.R. & H., Park Chambers, Johannesburg. No. 6911. Due 7/8/47.

Mortising Machine: S.A.R. & H., Park Chambers, Johannesburg. No. 6812. Due 7/8/47.

Spanners and Wrenches: S.A.R. & H., Park Chambers, Johannesburg. No. 6948. Due 28/8/47.

Sodium Aluminate: S.A.R. & H., Park Chambers, Johannesburg. No. 6989. Due 4/9/47.

Automatic Couplers: S.A.R. & H., Park Chambers, Johannesburg. No. 6837. Due 21/8/47.

Leadless White Paint Paste: S.A.R. & H., Park Chambers, Johannesburg. No. 6992. Due 4/9/47.

Steel Axles and Tyres: S.A.R. & H., Park Chambers, Johannesburg. 6747. Extended, now due 14/8/47.

Blue-print Machine: Department of Posts & Telegraphs, Pretoria, P.O. 804. Due 31/7/47.

Fire Protection Equipment, automatic: Stores Department, Johannesburg. Contract No. 156. Due 12/9/47.

Cotter and Taper Pins: S.A.R. & H., Park Chambers, Johannesburg. No. 6914. Due 18/9/47.

Steel Rivets: S.A.R. & H., Park Chambers, Johannesburg. No. 6900. Due 25/9/47.

Buffer Nuts: S.A.R. & H., Park Chambers, Johannesburg. No. 6988. Due 11/9/47.

Tipping & Platform Type Trucks: S.A.R. & H., Park Chambers, Johannesburg. No. 6898. Due 18/9/47.

Wood-working Cutters: S.A.R. & H., Park Chambers, Johannesburg. No. 6986. Due 18/9/47.

Workshop Equipment: For Grey's Hospital, Pietermaritzburg. Provincial Accountant, P.O. Box 11, Pietermaritzburg. Due 13/8/47.

Conveyor Belt: Johannesburg Municipality, Stores Department. Contract 160. Due 29/7/47.

Rolled Ribbed Wire Woven Glass: S.A.R. & H., Park Chambers, Johannesburg. No. 7040. Due 18/9/47.

Wheels and Axles: S.A.R. & H., Park Chambers, Johannesburg. No. 6903. Due 25/9/47.

Pinion Shafts and Gear Wheels: For electric units. S.A.R. & H., Park Chambers, Johannesburg. No. 6918. Due 28/8/47.

Marine Paints: S.A.R. & H., Park Chambers, Johannesburg. No. 7059. Due 18/9/47.

Wash Basins for Coach Lavatories and Compartments: S.A.R. & H., Park Chambers, Johannesburg. No. 7019. Due 7/8/47.

Steel Castings: S.A.R. & H., Park Chambers, Johannesburg. No. 6890. Due 7/8/47.

Lathe: S.A.R. & H., Park Chambers, Johannesburg. No. 6972. Due 21/8/47.

Lathes: S.A.R. & H., Park Chambers, Johannesburg. No. 6976. Due 21/8/47.

Luggage Chute: P.W.D., Pretoria. No. 860. Supply, delivery and erection of a steel luggage chute in the King's Warehouse, Durban. Due 31/7/47.

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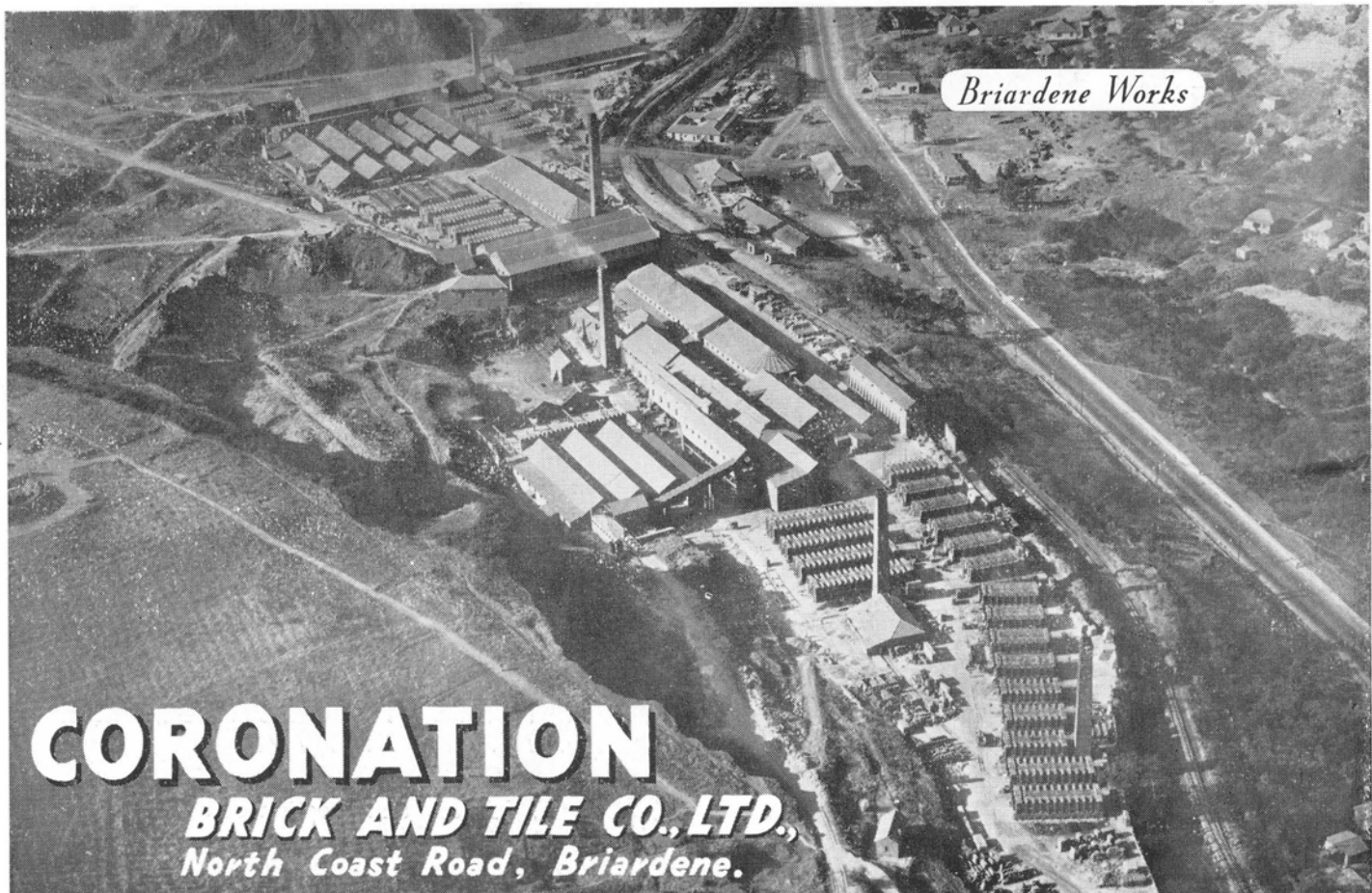
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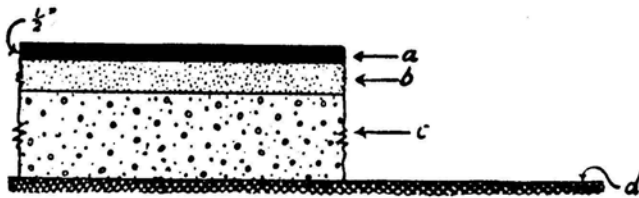
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