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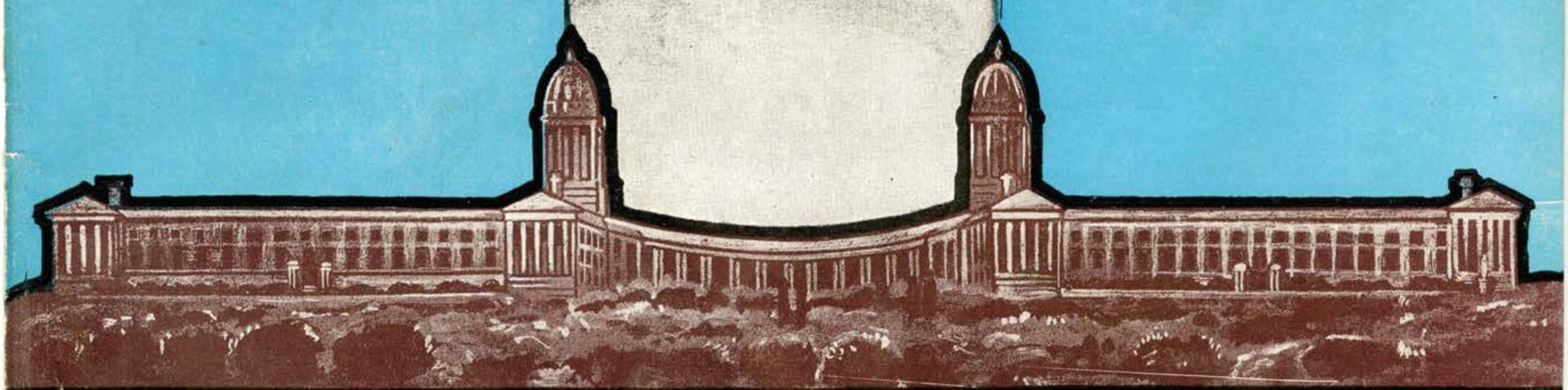
PUBLIC WORKS OF SOUTH AFRICA



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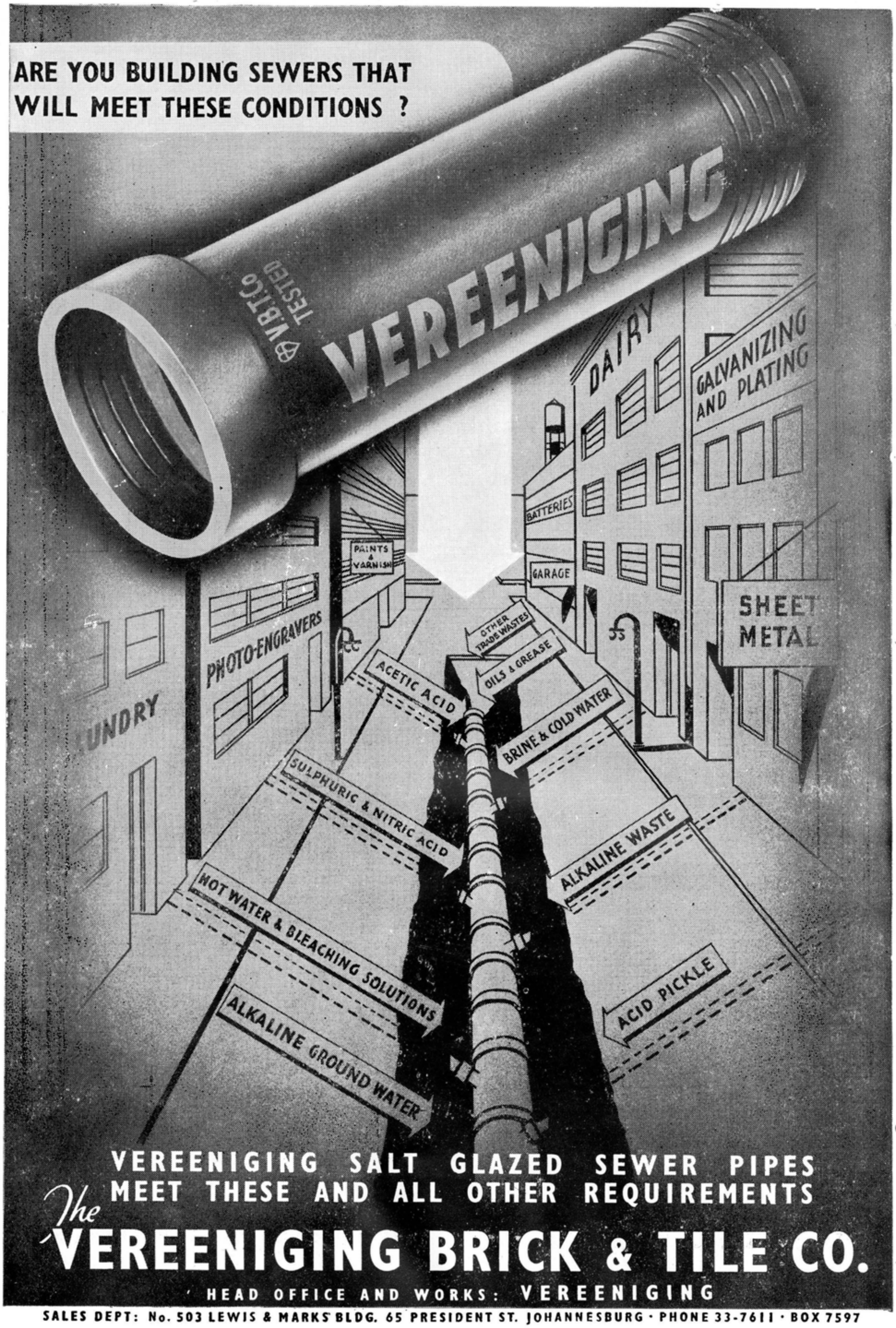
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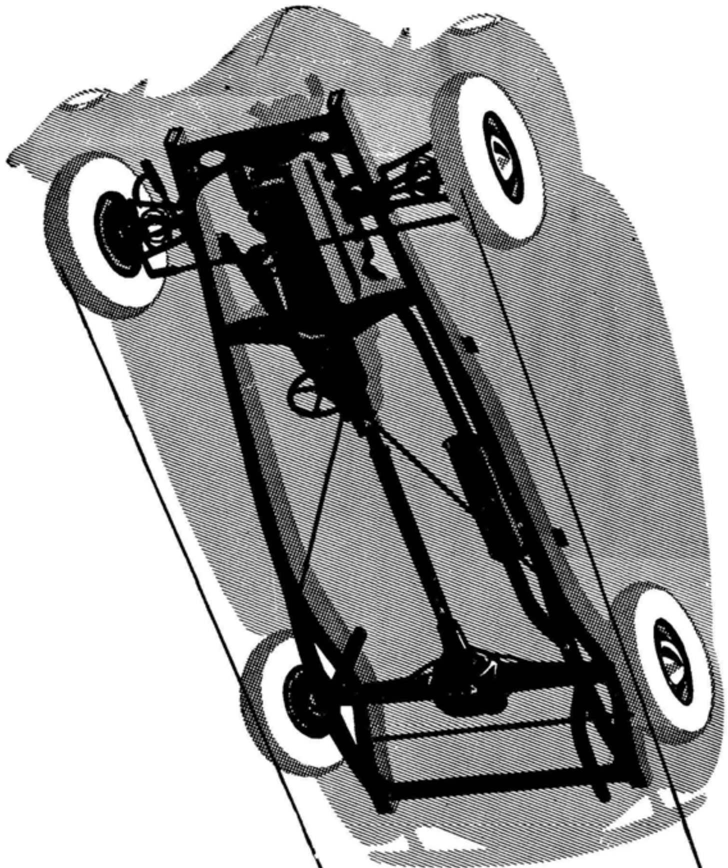

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CONTENTS

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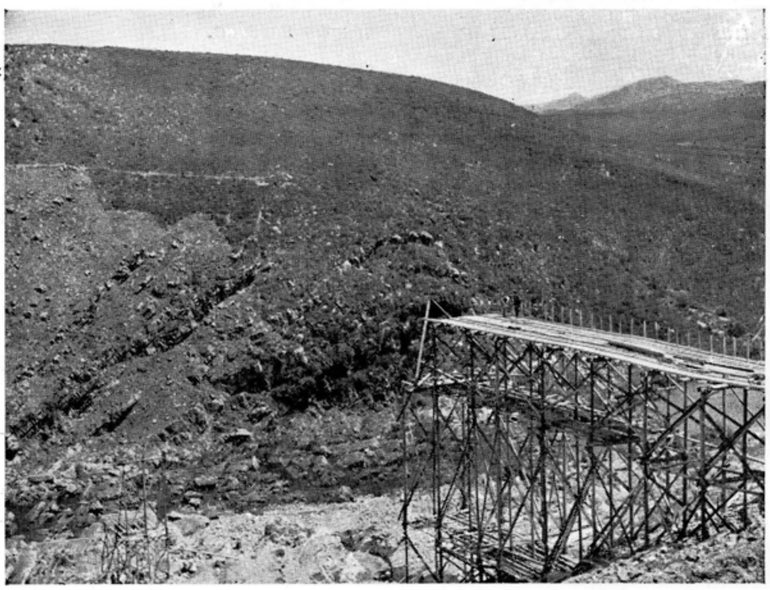
The

Kromme River Water Supply Scheme

for

Port Elizabeth

Now Under Construction



Construction on Dam begins.

ON completion of the first stage of construction, the Kromme River Water Supply Scheme will provide Port Elizabeth with an additional 5,500,000 gallons of water a day. Ultimately, it will supply upwards of 20,000,000 gallons a day.

The Scheme involves the construction of a 7,813,000,000 gallon conservation dam, purification and filtration plant, a 20,000,000 gallon service reservoir at Port Elizabeth and the laying of about 80 miles of 30-inch and 27-inch steel pipes across difficult mountainous country.

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THE KROMME RIVER WATER SCHEME

THE Kromme River Water Supply Scheme, which will satisfy the future demands of Port Elizabeth for a considerable time, ranks as the second largest Municipal Undertaking for the supply of water in South Africa. We are privileged to present our readers with details of this Scheme, which is now under construction and of which, it is anticipated, the first stage will be completed by the end of 1942. For our information we are indebted to the Authorities concerned.— EDITOR.

Giant New £1,500,000 Undertaking To Supply Port Elizabeth With Additional 20,000,000 Gallons A Day : : : : :

THE phenomenal increase in the population of Port Elizabeth, due mostly to rapid industrial development during the past decade or so, has entailed the augmentation of the water supply system to such an extent that it has become essential for the City Council to make provision for large additional supplies in the near future. Without such provision it has become a matter of doubt whether the present sources of supply, namely, the Upper and Lower Van Staadens Dams, the Bulk River Dam and the Sand River Dam would be capable of satisfying future demands.

To ensure an adequate supply of water the Port Elizabeth City Council has embarked upon the construction of a giant new supply scheme to cost approximately £1,500,000. It is known as the Kromme River Water Supply Scheme. When the first stage of this scheme is complete a new steel pipe-line, stretching across 80 miles of country, will supply Port Elizabeth with an additional 5,500,000 gallons of water a day. In its final stage the scheme will consist of three pipe-lines in all, capable of supplying upwards of 20,000,000 gallons a day. These supplies will be in addition to the present system, which is capable of delivering between 5,000,000 and 6,000,000 gallons of water a day.

The peak consumption of water in Port Elizabeth last summer was slightly in excess of 5,500,000 gallons a day, and the average daily consumption for the year 1939 was approximately 3,800,000 gallons. The average daily consumption figures for the past five years are as follows:—

1935	3,371,000	gallons
1936	3,386,000	,,
1937	3,426,000	,,
1938	3,430,000	,,
1939	3,758,000	,,

Construction, which is now well under way, started in January, 1940, and it is anticipated that the first stage of the scheme will be completed by December, 1942. The estimated pre-war cost was £1,250,000, but it has been stated recently by the chairman of the Kromme River Water Committee that the ultimate cost is likely to be near £1,500,000 owing to present conditions, war risk insurance costs, etc.

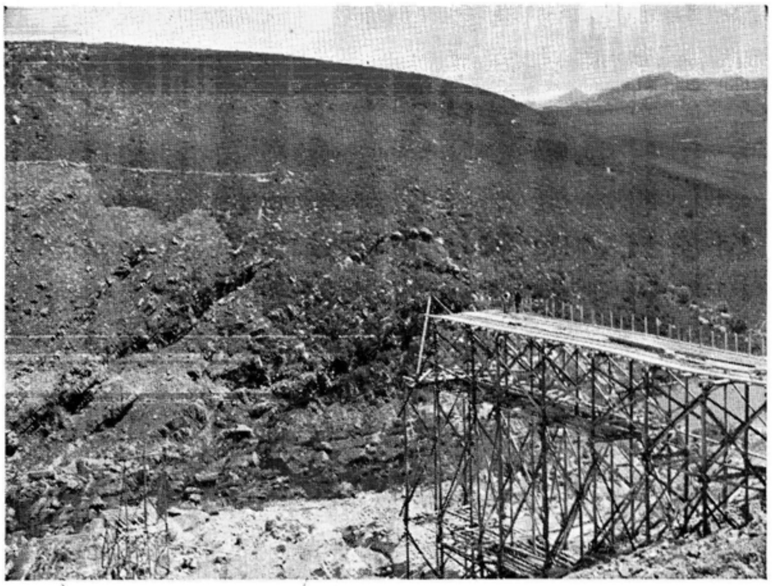
The following is a brief history of the Kromme River scheme.

For many years now the necessity to provide an additional water supply for Port Elizabeth has been recognised. As far back as 1932 the Port Elizabeth City and Water Engineer, Mr. George Begg, M.Inst.C.E., reported on an augmentation scheme. Three years later further advice was obtained from Mr. J. C. Hawkins, M.Inst.C.E., consulting engineer, Johannesburg, as to the adequacy of the catchment areas of existing sources to provide for the future.

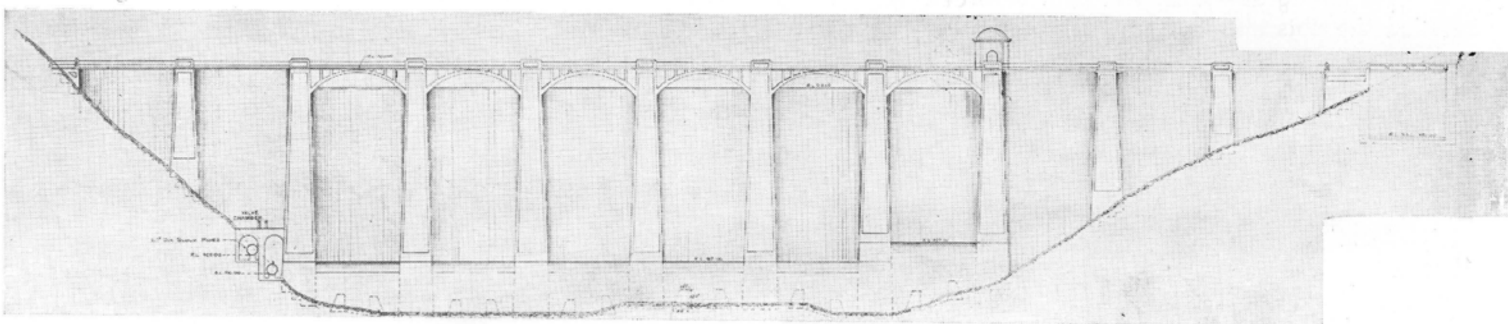
As a result of these reports, the Port Elizabeth City Council appointed Mr. J. C. Hawkins and Mr. G. A. Stewart, M.Inst.C.E., also a Johannesburg consulting engineer, as a Board of Engineers to report further on the best scheme to augment the water supply. After they had submitted their report recommending the Kromme River scheme, the Council instructed them to prepare the necessary designs and proceed with the construction. In addition, the Board prepared all data necessary to obtain legal rights to take water from the Kromme River and to purchase servitudes for the pipe-line across all farms between Kromme River and Port Elizabeth.

Because of the comparative inaccessibility of the dam and the pipe-line route in certain places, statistical information had to be prepared also for the Roads Transportation Board, to enable the Council to transport by road a large part of the pipes and fittings. All materials required for the construction of the dam have to be transported on the Avontuur railway line.

KROMME RIVER DAM



CONSTRUCTION STARTS ON DAM WALL: *Note in bed of river the semi-circular excavation for one of the arch foundations. The white beacon on the side of the hill in the right background indicates top water level of the dam.*



ELEVATION OF DAM WALL: *This wall is a multiple-arch type, constructed in reinforced concrete. The six arches in the river bed form an overflow section with 25-ft. deep stilling ponds between the buttress toes. Note twin 10-ft. training walls in each stilling pond. To the left, at the base of the wall, is the valve chamber for the scour pipes. Projecting above the wall on the right is the valve tower, and to the extreme right is the spillway channel in section.*

Outline of Scheme: THE Kromme River Water Supply Scheme will rank as the second largest Municipal undertaking for the supply of water in South Africa. It is a spectacular undertaking, involving the laying of about 80 miles of steel pipe-line across difficult country, as well as the construction of a large conservation dam in the Kromme River valley.

This dam is of considerable engineering interest, for the wall, now under construction, is of the multiple-arch type, used for the first time in the Southern Hemisphere. On completion of the first stage, the capacity of the dam will be 7,813,000,000 gallons, with a surface area of 625 acres. When the final stage is completed the capacity will be 12,470,000,000 gallons, with a surface area of 885 acres.

In outline the scheme is as follows:— Water is to be conserved in the Kromme River valley, which is a little more than 80 miles to the south-west of Port Elizabeth, midway between Humansdorp and Assegai Bosch and about 10 miles from the coast. The valley lies between the lower promontories at the feet of the Tsitzikamma and Zuur Anys mountain ranges, and is almost closed in at its seaward or lower end by a narrow bottle-neck gorge. The dam is to be formed by constructing a multiple-arch reinforced concrete wall across this gorge.

In appearance the Kromme River is not large, but it has a considerable flow. During nine months of last year the recorded flow was 7,980 million gallons of water. Over the same period this year the flow was 6,386 million gallons. In October last the rainfall over the catchment area was 1·67 inches, and during this period the recorded flow was 363 million gallons. The average flow may be regarded as being 24,000,000 gallons a day, which is sufficient to fill the completed dam in 9 or 10 months. It will be realised, therefore, that the catchment area for this river is quite considerable. Actually, it includes most of the inward slopes of the mountain ranges between which the river flows.

Water will be conveyed from the dam to Port Elizabeth entirely by a gravity pipe-line. At the dam site the river bed is 390 ft. above sea-level, and for the first stage of construction the top level of the water in the dam will be 510 ft. above sea-level. The level for the final stage will be 535 ft.

Water will be drawn off by gravity from the dam into a concrete pressure duct, through which it will flow until it is clear of the discharge from the spillway being constructed adjacent to the dam wall. From this point the water will then be led up the slope on the left bank of the river to a level of 480 ft. above sea-level. Here it will discharge into an open draw-off canal, 3 ft. 6 in. deep and 5 ft. wide.

The canal begins approximately 500 ft. downstream from the dam wall. It follows the river course for about 2,000 ft., at which point the water is led into a sedimentation and purification plant situated a further 1,500 ft. up a small valley. This canal, with its inlet at 480 ft. and the top water level in the storage reservoir at 510 ft., has command of about 4,000 million gallons of storage, or sufficient to supply Port Elizabeth with 5,000,000 gallons a day for two years without replenishment. The provision for the future raising of the dam wall will increase the storage by a further 4,670 million gallons.

Plans for the filtration plant have not yet been completed. However, the system adopted will be approximately as follows:—

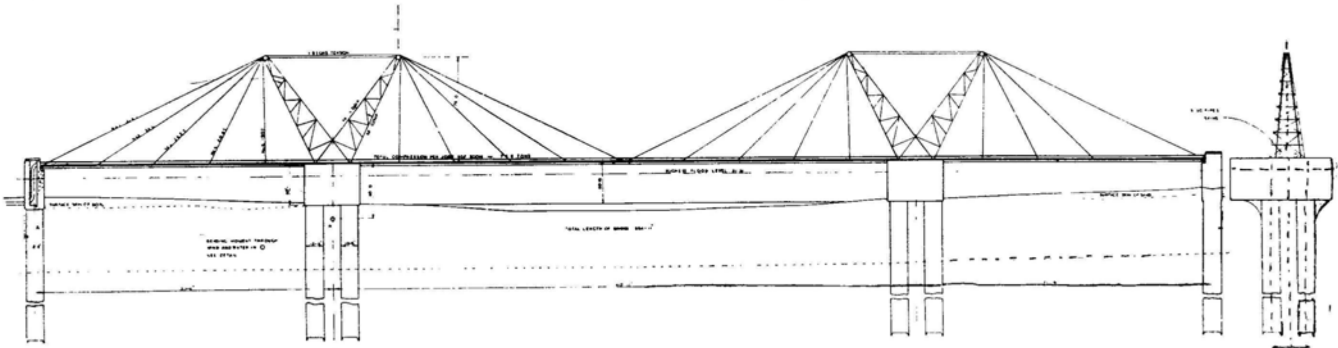
On leaving the draw-off canal, the water will be treated with chemicals and then passed into a tank for mechanical flocculation. From the flocculation tank it will then pass into sedimentation basins, after which it will receive secondary chemical treatment. The water will then pass through rapid gravity sand filters into a clear-water reservoir; at this stage it will be chlorinated also. The dimensions of these filters will be 17 ft. 6 in. by 24 ft., and each filter will have an approximate working capacity of 750,000 gallons in 24 hours.

The water will then be fed into the pipe-line, passing first of all directly into No. 1 rock tunnel, from which the steel pipe-line will emerge. This tunnel is driven through solid rock and lined with concrete. When finished it will be 5 ft. wide and 6 ft. high, with an arched roof.

At the Port Elizabeth end the water will discharge into a new 20,000,000-gallon reservoir, the construction of which is embraced in the Kromme River scheme. It will be situated in Mount Road, and will have a top water level of 260 ft. The existing reservoirs at St. George's Park and Fort Nottingham will be connected to the Kromme River dam also.

* * *

The Pipe Line: STEEL spigot and socket pipes, lined inside and coated outside with bitumen, are being used for the pipe-line. Pipes of 30-in. diameter are being laid over the first 45 miles from the dam. These are followed by 32 miles of 27-in. pipe.



ELEVATION OF GAMTOOS RIVER BRIDGE — STEEL BIJIB SUSPENSION TYPE.

For the first few miles from the dam the pipe-line passes through difficult mountainous country, and many excavations through solid rock have been necessary. The line rapidly approaches the coast, which it follows for the greater part of its length, passing Jeffreys Bay, Seaview and Schoenmakers Kop before branching inland to Port Elizabeth. For about 30 miles of its total length the pipe-line is laid in sand dune country. There is, however, little danger of shifting foundations, as thick bush and undergrowth anchor the sand and permit a certain amount of compactness.

Owing to the necessity for keeping below the hydraulic gradient — which in this case has a fall of 21 inches in every mile — it has been found impracticable to avoid tunnelling in several places where the rise of the hill would have elevated the pipe-line above the gradient.

These circumstances have resulted in the construction of two rock tunnels 2,700 ft. and 1,800 ft. long respectively, and three sand tunnels 2,000 ft., 850 ft. and 450 ft. long.

In addition to these tunnels, the pipe-line crosses the Kromme River twice. In its first crossing the pipe will be incorporated in a concrete wall which will form a weir across the river. On the site of the second crossing a good bed of rock exists about 10 ft. below the river bed. The pipe-line, encased in concrete, will be embedded in this rock.

The Kabeljaauws River also has to be crossed. This stream, however, is not very wide, and, as a good bed of rock exists below the river bed, the same method will be used as that in the second crossing of the Kromme River.

The major and most interesting construction on the pipe-line, however, is that necessitated by the crossing of the Gamtoos River. At the point of crossing the Gamtoos River has considerable width due to tidal water, and is subject to severe flooding. The peculiar conditions affecting this crossing have made it necessary to carry the pipe-line over the river on a special bijib steel suspension-type bridge of unusual design. Its design, and the problems of the Gamtoos River crossing are discussed more fully in a later section.

The pipe-line is to be carried across the Gamtoos River at a point to the seaward of the existing bridge on the road between Port Elizabeth and Humansdorp. A crossing of the Maitland River has also to be made. A similar type of bridge will be constructed here, comprising, however, only a section of the Gamtoos Bridge design.

* * *

Sand Tunnels: THE excavation of a tunnel through a sand dune usually demands great care and the adoption of a special method. At the time of writing, sand tunnel No. 1 on the pipe-line route has been under way for some time. This tunnel is 2,000 ft. long, and is being driven through a bush-covered sand dune composed mostly of wind-blown sand mixed with a certain amount of loose calcareous rock.

When this tunnel was visited by the writer in October the sand had just sufficient compactness to enable excavations to be made without the use of a shield. At the present time, however, the working face has become fine and dry, and has lost most of its cohesion. Great difficulty has been experienced in pushing forward the tunnel owing to the collapse of the working face. Progress has accordingly dropped from 20 ft. a day to about 5 ft. a day, sometimes less.

If these conditions get any worse the present method of tunnelling will have to be abandoned, and driving will have to be started at the other end by means of a shield. If the shield method has to be adopted, there will be no necessity to work under compressed air.

The method of tunnelling used up to the present has been as follows:—

As the working face of the tunnel is cut away, steel rings are bolted in to form a lining to the tunnel. These rings have a diameter of 6 ft., and are made up of five segments which are bolted together both horizontally and circumferentially. Small local excavations are made to permit each segment being bolted in its place and to its neighbour, the operation starting at the top of the tunnel and being carried down both sides at the same time. When the five segments are securely fixed, the entire working face is then excavated back a distance equal to the width of the ring.

When this tunnel has been completed it will be given a lining of reinforced concrete. This will reduce its diameter to 4 ft. It is a high-pressure tunnel, and, in common with all the tunnels, is designed to take an ultimate flow of 20,000 gallons of water a day. On completion, all tunnels will be tested at 2½ times the normal working pressure, which, at No. 1 sand tunnel, is equal to a 120-ft. head.

* * *

Gamtoos Crossing: THE crossing of the Gamtoos River has presented probably the most difficult problem of the whole scheme. As mentioned above, up to and beyond the point of crossing, the river has considerable width due to tidal water, and is subject to severe flooding.

In addition to this, the river bed is composed of deep layers of silt and fine sand. The foundations for the concrete caissons supporting the bridge will have to be taken down to a depth of 110 ft. below the river level. Trial borings have already been taken on the site. The first hard sand encountered was 52 ft. below the river level. Below this fairly hard clay was encountered, and below the clay there were large boulders.

During these boring operations an interesting discovery was made. Below the layer of hard clay a natural reservoir of fresh water was encountered. It was untainted by percolation of the salt water in the river, and was used for drinking water during the operations.

Another difficulty is anticipated in the laying of the pipe-line along the south approach to the river. This approach consists of a low-level plain some miles in width. It is composed of a quagmire, varying from 10 ft. to 80 ft. in depth, covered with a thin surface crust of hard clay. The problem here is to obtain sufficient anchorage for the pipe-line. Various methods to achieve this are at present being discussed by the Board of Engineers.

* * *

The Bridge: THE pipe-line is to be carried over the Gamtoos River on a steel suspension-type bridge of unusual design. It is termed a bijib bridge, the distinguishing feature of which is the twin diverging jib legs which replace the more conventional tower.

The bridge will be 855 ft. long. It will be composed of a main central span of 417 ft. 11 in., with two approach spans 211 ft. 6 in. long. The three spans of the bridge resolve the structure into two cantilever units in suspended equilibrium over each of the piers or caissons.

The bridge superstructure will comprise two square I-shaped girders with lateral joists, wind bracing booms and top and bottom cover plates.

Because of the large floods experienced, the pipe-line is to be carried 30 ft. above the water level in the river. The caissons will be of the twin-cylinder type, each being 17 ft. 6 in. in diameter, with a minimum concrete thickness of 3 ft.

The legs of the bijibs spring from the piers at an angle of 60°, and are carried to a height of 75 ft. above the superstructure. At the apex the bijib legs are linked together by 95-ft. linking bars which take a tension of 5·6 tons. The inner and outer members of the legs take 42 tons and 62 tons in compression respectively.

* * *

Expansion Joints: BECAUSE the pipe-line on the bridge will be exposed, extreme care has had to be taken in the design to provide for expansion and contraction. The movement to be provided for in this case will be considerable. Provision is made in the following way:—

The pipe-line will be elevated approximately 35 ft. above its approach beds to the bridge level by right-angle bends. On each of these vertical sections there will be a pair of ball and socket joints with a flange expansion joint in between. This arrangement gives the vertical sections freedom of movement in a plane parallel to the pipe-line on the bridge. The flange expansion joint between the ball and socket joints takes in the shortening or lengthening of the vertical section as the pipe-line on the bridge expands or contracts.

The entire expansion unit is to be housed in a reinforced concrete frame built into the piers. The unit rests on a special roller-carriage, and is firmly held in position by a similar roller-carriage above.

At present it is intended to take two 30-in. pipe-lines with branch lines across the bridge. The bridge is not designed for traffic, but may be used as a foot bridge for inspection purposes. When filled with water, the approximate weight of the pipes over the bridge will be 500 tons.

* * *

THE KROMME RIVER DAM

THE most spectacular construction of the whole scheme, however, is that of the dam wall. This wall is a reinforced concrete structure of the multiple-arch type, being designed as a series of inclined arches between buttresses.

Constructionally, the wall comprises 10 buttresses of a pyramid shape and two abutments, with 11 arches. The arches are inclined downstream from the bottom of the dam at an angle of 60° to the horizontal so that the resultant of the pressure against the wall has sufficient downward direction to prevent any movement of the buttresses in the foundations. The maximum pressure which will occur on the foundations of the buttresses is calculated to be 14 tons to the square foot.

On a plane at right angles to the upstream face each arch is circular in section, and the radius of the upstream face is 34·64 ft. The arches are 10 ft. thick at the bottom and 6 ft. thick at the top. Concrete mixtures to be used are as follows: Abutments and buttresses, 1 : 3 : 6; lightly reinforced arches, 1 : 2½ : 5.

There are a number of interesting features in the construction of the wall. The arches, for instance, are to be cast as separate units from the buttresses, and the only connecting link between them will be a tongue or continuous strip of copper embedded in bitumen. This strip serves as a water-sealing medium at the joints between the arches and buttresses. The buttresses are self-supporting, being linked together only by a lightly constructed roadway supported by a light reinforced concrete arch rib.

In the river bed itself are seven buttresses, with six overflow arch sections spanning between them. Between each of these buttresses at the downstream end or toe, a gravity section wall is to be built. It will be 25 ft. high. Its purpose is to form a stilling pond into which the flood waters, pouring over the six arches, will discharge. This pond will decrease as far as is possible the terrific scouring effect which this falling water would otherwise have.

(*Continued on page* 17.)

Two Examples of Small Post Office Design

By

TURNER NEWHAM.

THE designing of a small village post office is, generally speaking, a problem which calls for considerable ingenuity. It is a problem in which the architect has no opportunity for grandiose conceptions. On the other hand it is one in which many pitfalls abound, for, in seeking an apposite style, he has to resort to the very fundamentals of architecture in order to express, within small compass, not only function, but the dignity and character expected in a public building.

Two attractive post office designs are reproduced here, with commentaries by Mr. Turner Newham. They are the post office at Irene, near Pretoria, and the post office at Caledon, Cape. The Irene post office has already been built. Both were designed by the Union Public Works Department, Pretoria.

Irene Post Office:

IRENE, a small village situated 11 miles south of Pretoria and famed as the home of General J. C. Smuts, has recently acquired a new Post Office and Automatic Telephone Exchange. This building is one of the satellite group of Pretoria post offices. It was designed and executed by the Union Public Works Department at an approximate cost of £2,500.

Although only a small building, this Post Office is of considerable architectural interest, for in a structure of its size it is difficult to create the character and dignity expected in a public building. In achieving a satisfactory solution to this problem the Public Works Department has adopted a " Georgian " style, in which the picturesque has been combined with utility.

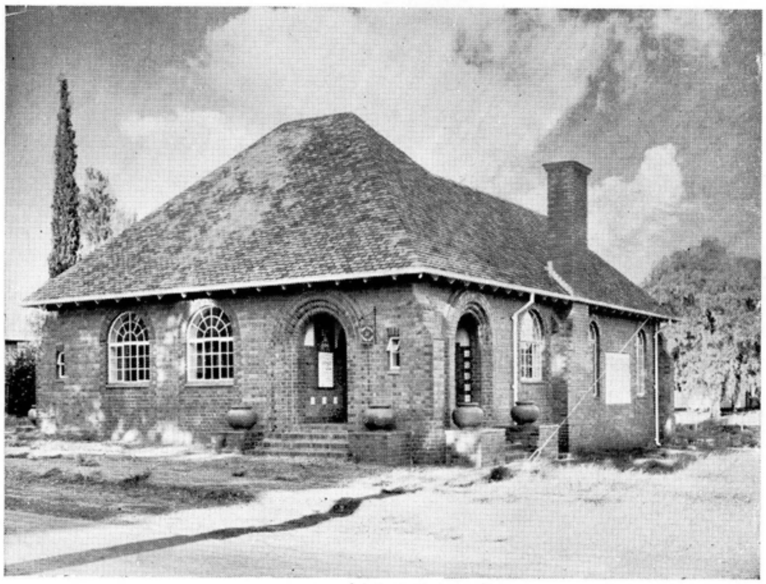
In the design of this building full consideration has been given to maintenance and durability. Construction has been carried out in red face-brick, which, together with the red garden pots, white windows and rough stone pocket-walling, forms a fresh and colourful conception. The multi-coloured " Mazista " slate roof is echoed by that of the railway station situated immediately behind the Post Office.

Embellishments to the new building are directly in keeping with the historic associations of Irene. On the south façade the main feature is a large ceramic panel of glazed coloured tiles. This panel records, in a symbolical scene, the 1938 commemoration of the Voortrekker Centenary, the celebrations of which were held in the neighbourhood. Designed by Miss Rosa Hope, who made drawings of the Voortrekker camps and wagons during the celebrations, the panel was executed at the Ceramic Studio, Olifantsfontein, by Miss G. C. Short, A.R.C.A., and Miss J. Methley, A.R.C.A.

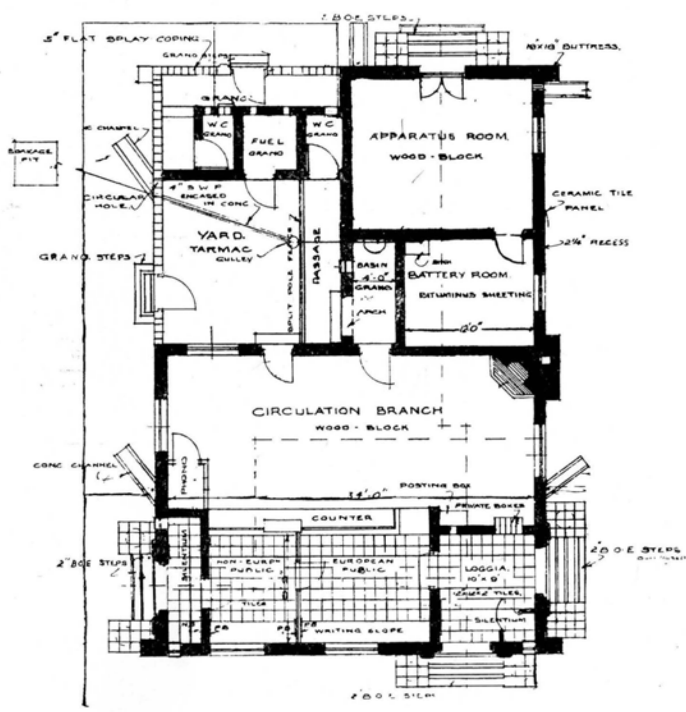
The European and non-European public spaces are on the east side of the building, and the apparatus and battery rooms are situated at the rear.

The corner entrance loggia, containing the public telephone, posting boxes and private boxes, is decorated with picture tiles of old Cape Dutch houses and portraits of General Smuts, Mr. P. J. van der Byl and Mr. Nelmapius, names which are intimately associated with Irene. The village was named after Miss Irene Nelmapius, daughter of the original owner of the farm.

The new Post Office is situated on the main road from Pretoria to Germiston, and forms the central feature of the village.



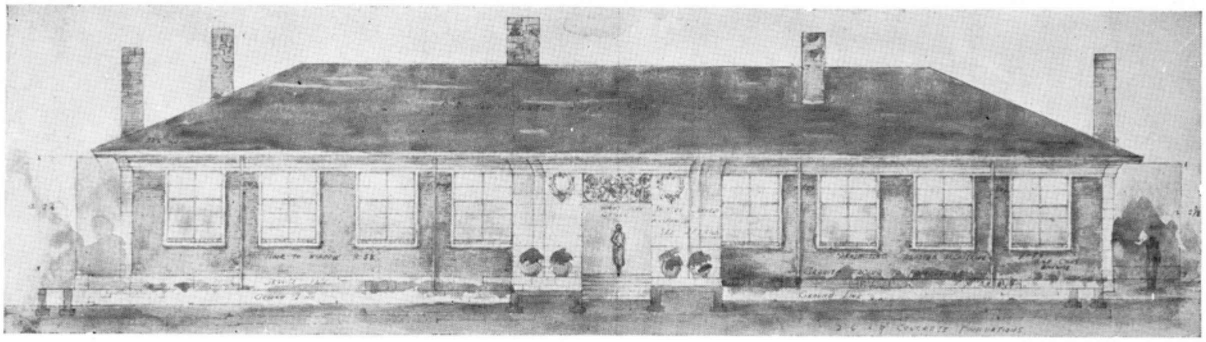
Irene Post Office



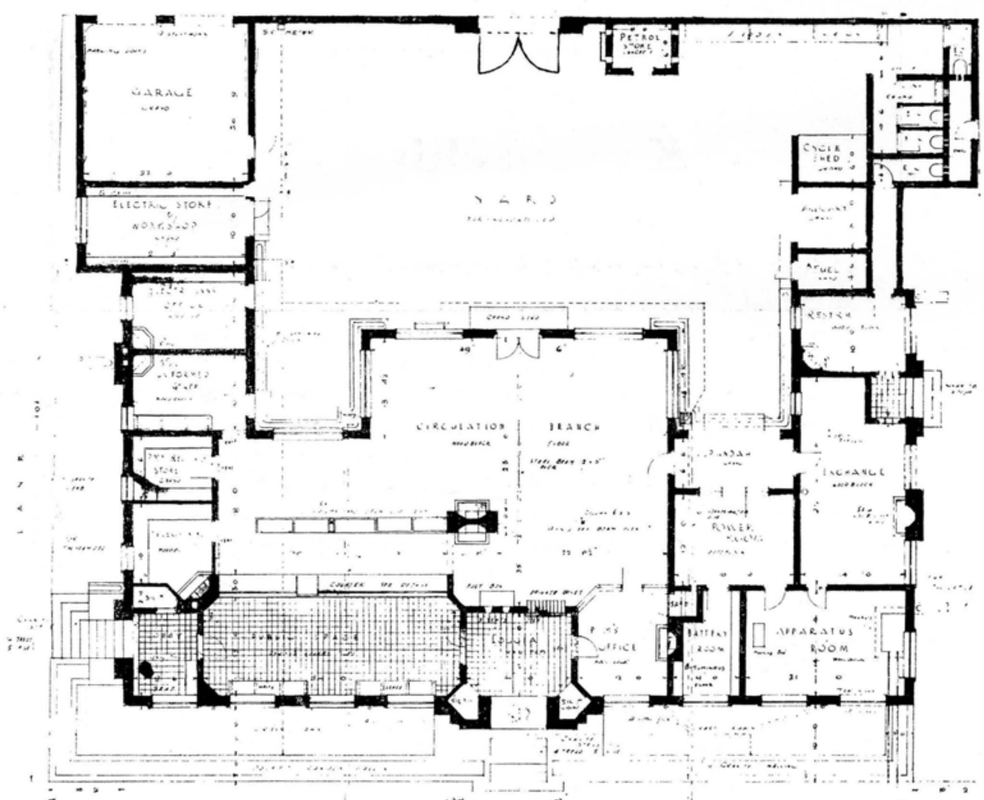
ABOVE: A general view of the Irene Post Office.

CENTRE: The ceramic panel of glazed coloured tiles recording in a symbolical scene the 1938 commemoration of the Voortrekker Centenary. Designed by Miss Rosa Hope.

BELOW: Ground floor plan of Post Office.



Caledon Post Office — Elevation



Plan

Caledon Post Office:

A START is soon to be made on the proposed new Post Office and Telephone Exchange at Caledon, Cape Province. This is also a small building, although larger than that at Irene. Its cost will be approximately £9,500.

Here again the design is on simple lines, incorporating the picturesque with utility. The main body of the structure will be built of golden brown brickwork surmounted by a white plaster cornice. Foundation stonework, main central entrance, subsidiary entrances and chimney breasts, etc., will be constructed of granite. The roof is to be covered with multi-coloured slates from an approvea South African quarry.

The building is a self-contained block. On the east it faces Church Street. The yard entrance is on the west off Plein Street, and there are small lanes on each side of the building. It will be seen from the plan reproduced here that the public spaces lead off from a central entrance loggia reserved for Europeans. On the south there is a smaller entrance lobby for non-Europeans. The large circulation branch forms the main part of the building at the rear. This section is flanked on the right-hand side by the telephone exchange, power, battery and apparatus rooms, etc., and on the left by the electrician staff, telegraph and store rooms, etc.

Surmounting the entrance doors to the public space there are fanlights carved in teak. Over the loggia and exchange entrances are built-in wrought-iron grilles, painted white. On either side of the main entrance doorway are cartouches carved in granite. In addition, a "post office stone," also in granite, will be let into the threshold. This stone will take the form of a carved galleon, similar to the historic stone under which mail was hidden at the Cape in the days of the Dutch East India Company.

The front elevation of the New Post Office is to be attractively finished with stone garden pocket-walling and raised lawns. In the design of this building the idea has been to use colourful materials as far as possible so that the post office will blend with the scenic beauties of this part of the Cape. With its large windows and simple treatment, the new Caledon Post Office should form an attractive addition to the postal buildings of the Cape Province. The building was designed by the Public Works Department, Pretoria.

The Kromme River Dam

(*Continued from page* 13.)

In addition, within the stilling pond and parallel to the buttresses are to be built two 10-ft.-high training walls. These will serve to confine the water, after falling, into a central channel away from the buttresses, which they will consequently protect from scour and the vibration set up by turbulence in the stilling pond.

To make further provision for dealing with flood waters, a spillway channel 40 ft. wide is to be constructed on the left bank of the river. A sluice gate 25 ft. in height will be incorporated in the channel.

Built into the upstream side of the wall there will be a circular hollow concrete tower with five draw-off pipes radiating at various levels off a central down pipe. The draw-off pipes are fitted with screens. The purpose of these draw-off pipes is to enable the top layer of water to be drawn off, whatever the level of the water in the dam, and to reject, if necessary, the water that has not been subject to the direct rays of the sun. A 3-ft. scour pipe is to be included in the tower. Its purpose will be to remove any silt that may deposit around the tower, and also, during periods of flood, to run to waste water unfit for use by reason of long storage. The normal depth of water at the wall will be 120 ft. In times of flood it will be 130 ft.

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