MIDDLESEX COUNTY COUNCIL

INAUGURATION

OF THE

WEST MIDDLESEX MAIN DRAINAGE SCHEME

BY

THE RIGHT HONOURABLE SIR KINGSLEY WOOD, M.P.
Minister of Health

ROYAL SANITARY INSTITUTE

LIBRARY REGULATIONS

1. Books may be borrowed by Fellows, Members and Associates personally or by a messenger producing a written order. The person to whom books are delivered shall sign a receipt for them in a book provided for that purpose.

2. Books may be sent through the post, or by some equivalent means of carriage, upon a written order. All charges of carriage to the Institute shall be defrayed by the borrower.

3. A borrower may not have more than three volumes in his possession at one time.

4. A borrower will be considered liable for the value of any book lost or damaged while on loan to him, and if it be a separate volume, for the value of the whole work rendered imperfect.
Marking or writing in the volumes is not permitted, and borrowers are requested to call attention to damage of this character.

5. Books may be retained for 28 days. Periodicals may be retained for 14 days. Applications for extension of the loan period must be made in writing before its expiry. No book may be kept longer than 3 months.
New books will not be lent until after the expiration of one month from the date of their having been received by the Institute. The current number of a periodical may not be borrowed.

6. Borrowers retaining books longer than the time specified, and neglecting to return them when demanded, forfeit the right to borrow books until the volume or volumes be returned, and for such further time as may be ordered.
Any borrower failing to comply with a request for the return of a book shall be considered liable for the cost of replacing the book, and the Council may, after giving due notice to him, order the book to be replaced at his expense.
No volume may be reissued to the same borrower until at least seven days have elapsed after its return, neither may it be transferred by one borrower to another.

7. Books may not be taken or sent out of the United Kingdom.

8. Volumes returned through the post must be securely packed in a box, or otherwise protected.

Parcels should be addressed :
THE ROYAL SANITARY INSTITUTE,
90, BUCKINGHAM PALACE ROAD,
LONDON, S.W.1.

27 NOV 1947	
27 FEB 1948	

WEST MIDDLESEX MAIN DRAINAGE SCHEME

INAUGURATION

BY

THE RIGHT HONOURABLE SIR KINGSLEY WOOD, M.P.

MINISTER OF HEALTH

AT THE MOGDEN WORKS, ISLEWORTH

ON FRIDAY, THE 23RD OCTOBER, 1936

AT 2.30 P.M.

MEMBERS OF THE MIDDLESEX COUNTY COUNCIL

Chairman :

MAJOR SIR WILLIAM PRESCOTT, C.B.E., D.L., M.INST.C.E., M.I.MECH.E., J.P.

Vice-Chairman :

FORRESTER CLAYTON, ESQ., J.P.

Aldermen :

Mrs. Flora May Baker, J.P.
Sir William Barber, J.P.
Mrs. Gertrude Barnes, J.P.
William Micah Bolton, Esq.
Col. Sir Henry Bowles, Bt., D.L., J.P.
Sir Howard Button, J.P.
William Delhi Cornish, Esq., O.B.E., J.P.
Gilfrid Gordon Craig, Esq., J.P.
Hayward Radcliffe Darlington, Esq., J.P.
Sir Cecil De Salis, K.B.E., D.L., J.P.
Ernest Charles Fawley, Esq.
Basil Holmes, Esq., J.P.
William Walter Kelland, Esq.
Lieut.-Col. Montague Francis Markham Sloane Kittoe, O.B.E. (Mil.), T.D., D.L.
Sir William Lobjoit, O.B.E., J.P.
Major Sir Patrick Malone, J.P.
William Benjamin Pinching, Esq.
Lt.-Col. Sir Charles Pinkham, O.B.E., D.L., J.P.
George Marlow Reed, Esq., J.P.
Owen Russell Serjeant, Esq., J.P.
Sir Montagu Sharpe, K.C., D.L., J.P.
The Right Honourable the Earl of Strafford, D.L., J.P.
Benjamin Todd, Esq., J.P.

County Councillors:

Lt.-Comdr. Theophilus Walker Anderson, R.N. (Ret.).
William Atkinson, Esq.
Sydney Herbert Baker, Esq., F.C.A.
Charles Henry Barber, Esq.
James Percy Bennetts, Esq.
John Boggon, Esq., J.P.
Percival Bond, Esq.
Mrs. Elizabeth Annie Brooks.
Leonard Henry Brown, Esq.
Frederick William Carter, Esq.
John William Catlow, Esq.
Ernest Albert Cawdron, Esq., J.P.
David Ferguson Chalmers, Esq.
Stanley Norman Chapman, Esq.
Thomas Henry Marriott Clarke, Esq.
William Reginald Clemens, Esq., F.C.A.
His Honour John Cusack, K.C., J.P.
Mrs. Miele Eleanora Cecil Dore.
Leon Charles Augustus Dubery, Esq., J.P.
Edward White Edwardson, Esq.
Mrs. Maud Mary Fairfield.
Harry Fear, Esq., J.P.
Mrs. Muriel Rose Forbes.
John Charles Fuller, Esq.
George James Barnard Furness, Esq.
Percy Chase Gardener, Esq.
Robert Grant, Esq., J.P.
Leonard Montague Graves, Esq., J.P.
Albert George Greig, Esq.
Stanley Herbert Halford, Esq.
Frederick Hall-Jones, Esq., F.R.I.B.A., F.S.I.
William Tatton Harris, Esq.
James How, Esq., J.P.
John Rees Hughes, Esq., J.P.
William John Irving, Esq.
Mrs. Louisa Rhoda Ithell.
Francis Eric James, Esq.
Harry Johnson, Esq., J.P.
John Kelly, Esq.
John Kent, Esq., J.P.
Charles Henry Knifton, Esq.
Harold Leigh-Mossley, Esq.
Capt. Wilfred Joseph Lendrum.
Mrs. Kathleen Lovibond, O.B.E., J.P.
Mrs. Jessie Dora Lynch.
Frederick Messer, Esq., M.P., J.P.
William Henry Mills, Esq.
Edward Bernard Montesole, Esq., J.P.
Charles Thomas Muskett, Esq., F.N.A.A.
Sydney Arthur Oades, Esq., M.C.
Sydney George Page, Esq.
Joseph Walter Palmer, Esq.
George Albert Pargiter, Esq.
Ronald Montague James Pendred, Esq.
Richard Henry Powis, Esq.
Mrs. Elizabeth Anne Rhys, J.P.
Frank Cottrell Rice, Esq.
Reginald George Ridge, Esq.
Bernard Harry Rockman, Esq.
John Wilfrid Rowlands, Esq., J.P.
James Scott, Esq.
Geoffrey Maber Sparrow, Esq.
Mrs. Elizabeth Maud Squire.
Frederick James Squire, Esq.
Frank Harold Stollard, Esq.
Harold Joseph Stowell, Esq., M.B.E.
Thomas William Stroud, Esq.
Mrs. Florence May Suggate, B.Sc., M.R.S.T.
Charles Harold Summersby, Esq., J.P.
Dr. Edith Summerskill, M.R.C.S., L.R.C.P.
Dr. Oscar Watts-Tobin, M.R.C.S., L.R.C.P.
Mrs. Ada Mary Weymark.
Philip William White, Esq.
Arthington Worsley, Esq., J.P.
William Newcome Wright, Esq., F.S.I., M.R.San.Inst., J.P.

ORDER OF PROCEEDINGS

Upon arrival, the Minister of Health will be received at the Main Entrance of the Administration Building by County Alderman Major Sir William Prescott, C.B.E., D.L., J.P., M.Inst.C.E. (*Chairman of the County Council*), who will present :—

Mr. County Alderman Gilfrid Craig, J.P. (*Chairman of the West Middlesex Drainage Committee*).

Mr. County Alderman Forrester Clayton, J.P. (*Vice-Chairman of the County Council*).

Mr. County Councillor J. R. Hughes, J.P. (*Vice-Chairman of the West Middlesex Drainage Committee*).

Mr. John D. Watson, Pres.Inst.C.E. } *Consulting Engineers.*
Mr. David M. Watson, B.Sc., M.Inst.C.E. }

Mr. C. W. Radcliffe, M.A. (*the Clerk of the County Council*).

Mr. F. W. Rattenbury, F.S.A.A., F.I.M.T.A., F.S.S. (*County Accountant*).

Major W. H. Morgan, D.S.O., M.Inst.C.E. (*County Engineer and Surveyor*).

Mr. C. B. Townend, B.Sc., M.Inst.C.E. (*Engineer-in-Charge*).

The following Members of the West Middlesex Drainage Committee :—

County Alderman Mrs. F. M. Baker, J.P.

County Alderman Sir Howard Button, J.P.

County Alderman Lieutenant-Colonel M. F. M. S. Kittoe, O.B.E. (Mil.), T.D., D.L.

County Alderman Lieutenant-Colonel Sir Charles Pinkham, O.B.E., D.L., J.P.

Mr. County Alderman O. R. Serjeant, J.P.

County Alderman Sir Montagu Sharpe, K.C., D.L., J.P.

County Councillor Lieutenant-Commander R. W. Anderson, R.N. (Ret.).

Mr. County Councillor L. H. Brown.

Mr. County Councillor H. Fear, J.P.

Mr. County Councillor P. Chase Gardener.

Mr. County Councillor L. M. Graves, J.P.

Mr. County Councillor A. G. Greig.

Mr. County Councillor J. How, J.P.

County Councillor Mrs. K. Lovibond, O.B.E., J.P.

Mr. County Councillor W. H. Mills.

Mr. County Councillor G. A. Pargiter.

Mr. County Councillor R. H. Powis.

Mr. County Councillor R. G. Ridge.

Mr. County Councillor B. H. Rockman.

Mr. County Councillor F. H. Stollard.

County Councillor Mrs. F. M. Suggate, B.Sc., M.R.S.T.

Mr. County Councillor A. Worsley, J.P.

The following Members of the Staff of the Consulting Engineers:—

Mr. R. A. T. Anderson.

Mr. C. D. C. Braine, B.Sc., Assoc.M.Inst.C.E., A.M.I.Str.E.

Mr. C. Hogg, B.Sc., Assoc.M.Inst.C.E., A.M.Inst.W.E.

Mr. H. D. Manning, B.Sc., Assoc.M.Inst.C.E.

Mr. P. G. Smales, Assoc.M.Inst.C.E.

The following Members of the West Middlesex Administrative Staff:—

Mr. H. H. Kelley, Assoc.M.Inst.C.E. (*Chief Assistant Engineer*).

Mr. W. T. Lockett, M.Sc. (*Chief Chemist*).

Mr. W. Parker, M.Inst.C.E. (*Chief Mechanical and Electrical Engineer*).

Mr. W. F. Freeborn (*Chief Clerk*).

Representatives of the following Contractors:—

Sir Robert McAlpine & Sons (London) Ltd

C. Isler & Co., Ltd.

Tarmac Ltd.

Messrs. A. Waddington & Son.

Wm. Moss & Sons, Ltd.

Howard Farrow, Ltd.

W. & C. French, Ltd.

Messrs. Bentley & Wardman.

The Cleveland Bridge & Engineering Co., Ltd.

Thos. Bugbird & Sons Ltd.

The Ham River Grit Co., Ltd.

Edmund Nuttall Sons & Co. and John Mowlem & Co. (Joint) Ltd.

Paterson & Dickinson Ltd.

Harland & Wolff Ltd.

Worthington Simpson Ltd.

RECEPTION MARQUEE

The Chairman of the County Council to invite the Minister of Health to declare the Works open.

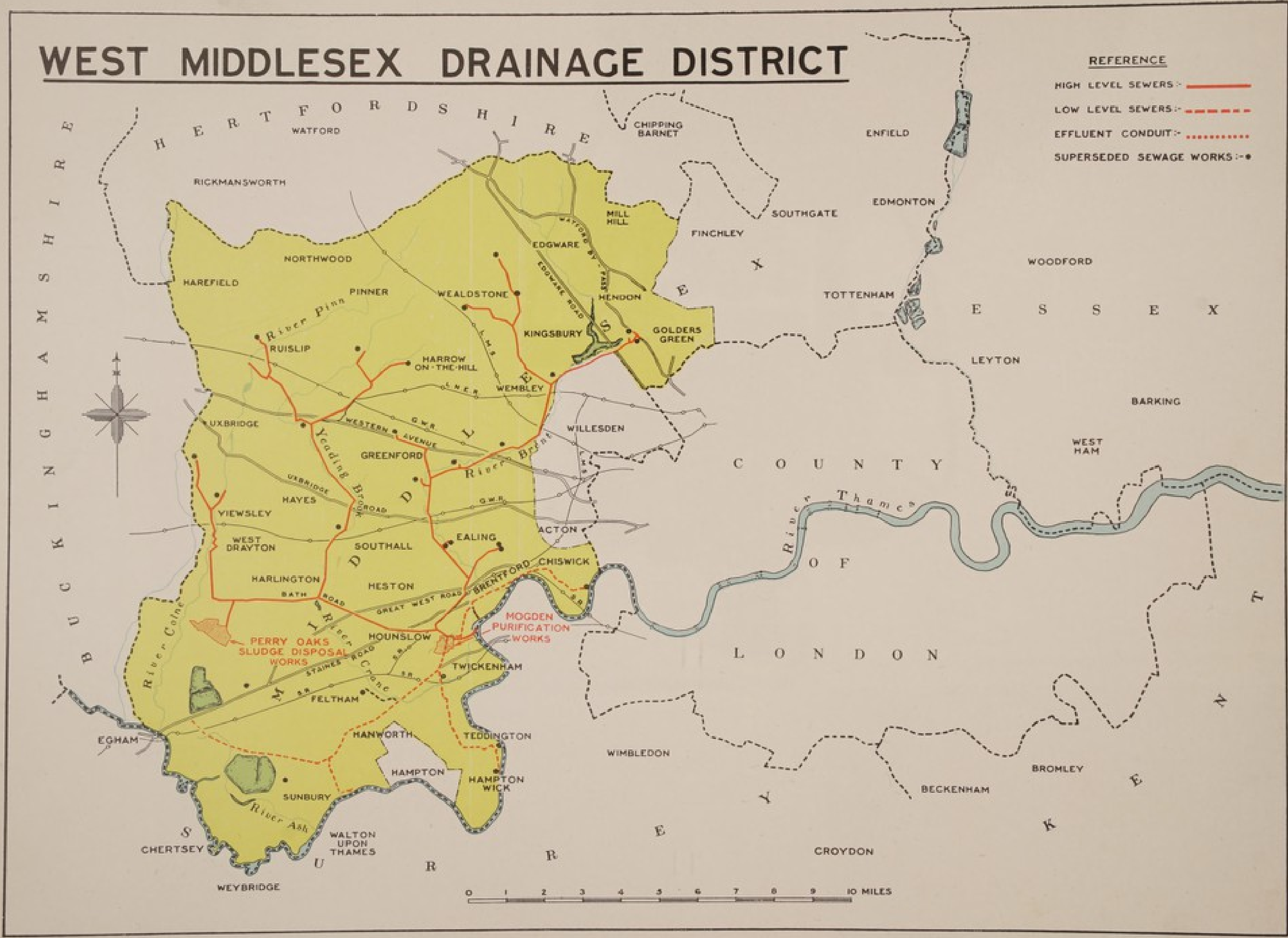
Reply of the Minister of Health.

The Chairman of the West Middlesex Drainage Committee to propose a Vote of Thanks to the Minister of Health and the Vice-Chairman of the Committee to second the Vote.

A Tour of Inspection of the Works to be made.

Tea to be served in the Marquee near the Entrance to the Works.

WEST MIDDLESEX DRAINAGE DISTRICT



THE MAIN DRAINAGE OF WEST MIDDLESEX

HISTORICAL

Introductory. Of all the amenities enjoyed by civilised communities, none is of such vital importance as the provision of an abundant supply of water, in its turn necessitating an efficient drainage system. Under modern conditions, not merely is water needed for the support of life itself but, since the introduction of the water-carriage system, its use has been extended as a vehicle for the hygienic transport of contaminating matter, derived not only from domestic sources, but also from industrial processes of every kind, on an ever-increasing scale.

Equally important to the actual removal of these waste products is their final treatment and disposal in a hygienic, innocuous, and inoffensive manner.

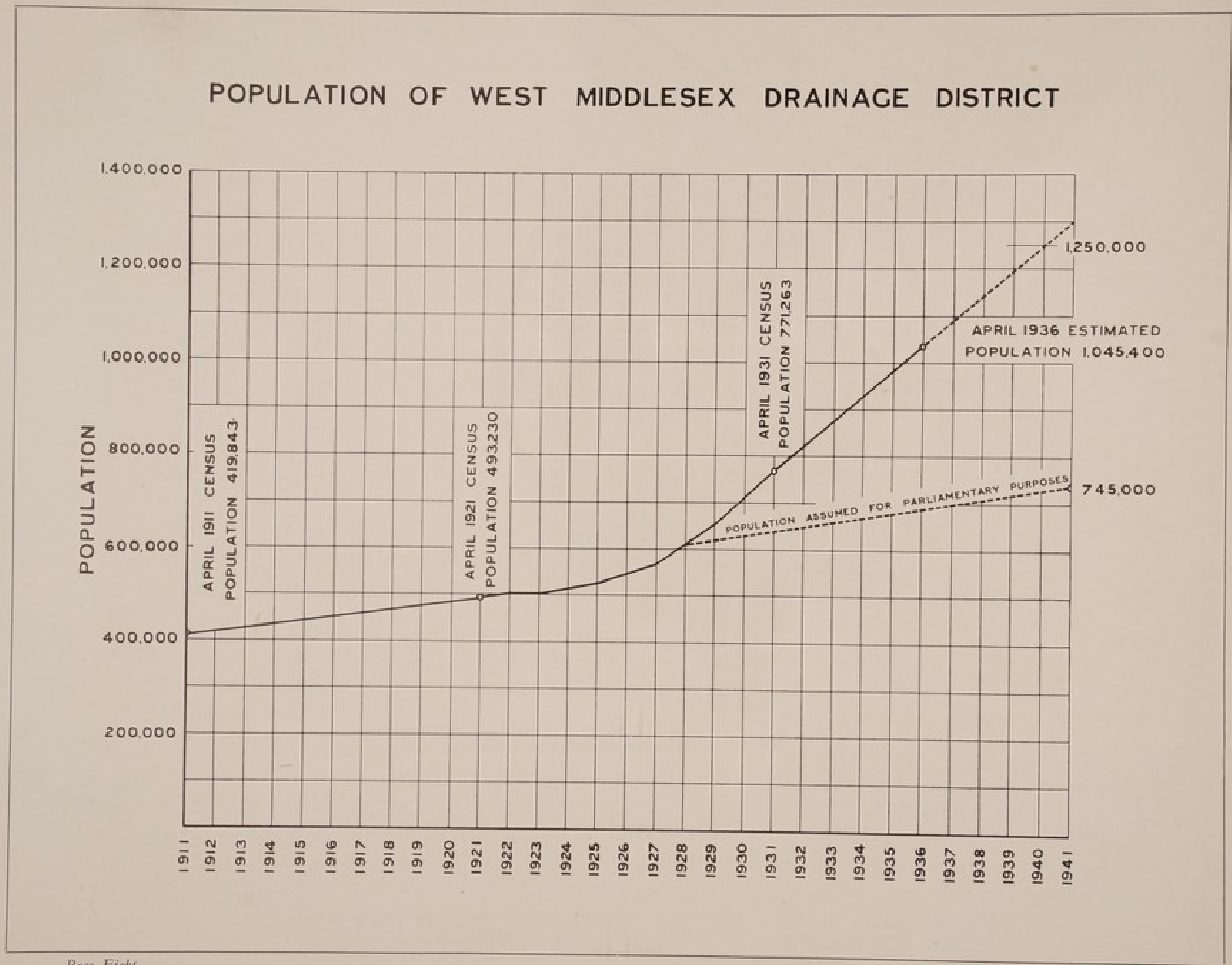
It is gratifying to reflect that this great service, of such vital importance to the health of the community, and on which perhaps the very existence of great cities depends, can be carried out at what must be termed a trifling liability to the average citizen.

The completion of the West Middlesex Main Drainage Scheme marks the culmination of several years of intensive effort, not only from the point of view of the actual engineering and construction work involved but also in respect of the Parliamentary, legal, and financial tasks which have had to be carried through before the translation of the scheme into concrete form.

One of the largest schemes of its kind in the world, it represents the result of successful co-operation between adjacent local authorities, widely differing in population, size and wealth, but working harmoniously together to achieve benefits common to all concerned.

Development of West Middlesex. In the history of the development of the Greater London area, nothing has been more remarkable than the phenomenal increase in population during the years following the Great War of the district outside the Metropolis known as the " Outer London Ring." Of this ring, the most intensive growth has occurred in the western portion of the County of Middlesex.

Not many years ago, West Middlesex was predominantly rural in character. The comparatively small towns which then existed were separated by tracts of more or less open country. It is now being rapidly converted into popular urban districts, attracting many thousands of residents from the Metropolitan area, and at the same time


POPULATION OF WEST MIDDLESEX DRAINAGE DISTRICT
POPULATION
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
APRIL 1911 CENSUS POPULATION 419,843
APRIL 1921 CENSUS POPULATION 493230
APRIL 1931 CENSUS POPULATION 771,263
APRIL 1936 ESTIMATED POPULATION 1,045,400
1,250,000
POPULATION ASSUMED FOR PARLIAMENTARY PURPOSES
745,000
1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941

manufacturers are being induced by the advantages which certain localities afford to erect numerous factories of all kinds on most modern lines.

West Middlesex Drainage District.

The Middlesex County is divided into two main watersheds by the high ridge of ground upon which Finchley and Chipping Barnet are situated. The area to the east of this ridge slopes towards the Lee Valley and drains into the Thames below London, while, on the other hand, the area lying to the west of the ridge is drained into the Thames above London by the smaller rivers, Brent, Crane, Colne, and Ash.

The area known as the West Middlesex Drainage District embraces almost the whole of this western section of the county. It includes the complete districts of sixteen local authorities and has a total area of approximately 160 square miles, that is to say, an area about thirty-five per cent. greater than that of the County of London.

Until the coming into operation of the new scheme during the early months of 1936, the district was served by twenty-eight separate sewage works occupying a total area approaching 1,000 acres.

The population of the Drainage District was recorded by the 1921 census as 493,230. By the census of 1931 it had risen to 771,263, while at the present time it is estimated to have reached 1,075,000. The phenomenal increase of more than a quarter of a million, or 56·4 per cent., during the ten years 1921—1931 compares with 30·8 per cent. for the entire County of Middlesex and 5·44 per cent. for England and Wales as a whole.

At a rate of increase of population of well over 60,000 per annum, which is at present being experienced, it is expected that a population of 1,250,000 will be reached in 1940 or thereabouts.

Consulting Engineers' Report.

During the early years of this abnormal development, strenuous efforts were made by the authorities concerned to keep pace with the rapid development of their individual districts by the provision of additional sewerage and extensions to sewage works plant, but it became increasingly obvious that the difficulties of the area as a whole could not be overcome without assistance and some form of co-ordination.

The Middlesex County Council therefore resolved, in 1928, to instruct their Consulting Engineers to make a comprehensive report on the whole question of sewerage and sewage disposal of the district. This report, dated January, 1929, suggested that the whole of the existing works should be abandoned and that a series of main trunk sewers should be constructed to convey the sewage from the local sewers in each district to the most suitable site available near the Thames where it would be treated by up-to-date methods until the resulting effluent should be brought to a high standard of purity.

Parliamentary Proceedings.

After consideration of the report and consultations with the authorities interested, it was referred to the County Solicitor, Mr. C. W. Radcliffe, M.A., to promote a Bill for submission to Parliament for the Session 1930-31.

The Bill, which received the Royal Assent on 11th June, 1931, provided for the construction of a system of main intercepting sewers to convey the sewage of the whole district to a central purification works to be established at Mogden (the site of the then existing sewage works of the Borough of Heston and Isleworth), situated between Hounslow and Isleworth. Provision was made for pumping the resulting sludge for final disposal to a large isolated site at Perry Oaks, near Longford.

As a result of prolonged negotiations, in which Mr. County Alderman Gilfrid Craig, as Chairman of the Parliamentary Committee of the County Council, took the leading role, the project was approved by the Government as suitable for the relief of unemployment, and a grant equivalent to fifty per cent. of the capital cost was agreed by the Unemployment Grants Committee, subject to the exception of certain items of expenditure, the effect of these stipulations being to fix the maximum amount on which grant would be reckoned as £4,290,000.

As a condition of this financial assistance, it was stipulated that the work should be commenced by 31st October, 1931, and be completed by 1st October, 1935. Thus it has been necessary to organise the complete work of design and construction on a programme covering a little over four years. It was further stipulated that 90 per cent. of the men employed on the works should be obtained through the employment exchanges, 70 per cent. of whom should be drawn from distressed areas.

Expenditure.

The Parliamentary Estimate for the 1931-1935 programme was £5,250,000. This included £3,250,000 for main sewerage and £1,287,000 for sewage purification and sludge disposal works for a population of 750,000.

Actually after these estimates were framed, the population was found to be increasing at such a rapid rate that provision has now been made for a present plant capacity to serve a population of 1,250,000.

The main sewerage, on the other hand, has been constructed with a capacity sufficient for the requirements of the ultimate population of the district, which it is estimated may reach 2,000,000.

In the changed circumstances, the total capital expenditure on the scheme entailed by the present programme is likely to be approximately £5,500,000.

The whole of the expenses incurred by the County Council in pursuance of the Act will be defrayed by a special rate levied on the Drainage District. The rate charge for the year 1936-37 has been fixed at sixpence in the pound, or equivalent to a little more than one penny per week per head of population. This charge covers not only loan charges and operating costs in connection with the new scheme, but also the indemnification of outstanding loan charges on superseded sewage works, demolition of such works and compensation of redundant staff. The special rate will not form an additional charge on the local authorities concerned but will be in lieu of what they were formerly spending on sewage disposal; in most cases an actual saving will be effected by the scheme, particularly when consideration is given to the heavy capital expenditure which almost in every case would otherwise have been urgently necessary on the old works. Indirectly, by the existence of the new main sewerage system, large sums of money will be saved in the future by many local authorities when carrying out extensions to the local sewers in their districts, and in many other ways.

Completion of Scheme.

The work of construction was divided into thirty-six contracts, which were let at the rate of nearly one per month over a continuous period of rather more than three years. The average value of these contracts was about £130,000, but the amounts ranged from comparatively small sums up to a maximum amount for one contract of over £500,000. Thus it was found possible to utilise the services of a variety of classes of contractors for the work.

In spite of a construction programme much heavier than that originally contemplated, so energetically was the design undertaken and so hard were the operations of the contractors pressed forward, that at the end of the four years stipulated by the Unemployment Grants Committee work to a total value of £4,775,000 had been completed, as compared with £4,537,000 allowed in the original five-year plan.

With the exception of one length of fifty yards delayed by abnormally wet ground, the seventy miles of main trunk sewers were complete on the appointed day, while at Mogden, where the construction work had been increased by sixty-six per cent. over the Parliamentary requirements, completion was sufficiently advanced to make the first diversion of sewage into the new purification plant on 14th December, 1935, or only about ten weeks later than the date laid down.

Operation of New Plant.

After a pilot run of the new works, the programme of main diversion from the existing systems was successfully carried out between February and May of this year, since when the old works have been thrown entirely out of commission.

Although much remains to be done in tuning up the operations of the plant to achieve the maximum efficiency, the results so far obtained are exceedingly satisfactory and give every confidence in the future ability of the works more than to fulfil the duty expected from them.

Although the effluent is discharged into the tidal portion of the Thames, no advantage has been taken of that fact as the standard of purity laid down by the Act is the same as would be required for a small inland fishing stream. Since the works have been in operation, the effluent produced has been regularly sampled by the Port of London Authority. Every sample taken has been found to be within the prescribed standard and in many cases the oxygen demand of the effluent has proved to be less than one-quarter of that allowed.

Administration of Construction.

The direction of the formidable task entailed by the bringing into operation of the entire scheme was undertaken by the West Middlesex Drainage Committee under the Chairmanship of County Alderman Major Sir William Prescott, C.B.E., D.L., M.Inst.C.E., while the design and administration of the construction work has been carried out by their Consulting Engineers, Messrs. J. D. and D. M. Watson, MM.Inst.C.E., of Westminster.

The Consulting Engineers' staff was headed by Mr. P. G. Smales, Assoc.M.Inst.C.E., and Mr. C. B. Townend, B.Sc., M.Inst.C.E., while the principal assistant engineers for the design of the main sewerage system were Messrs. C. D. C. Braine, B.Sc., Assoc.M.Inst.C.E., A.M.I.Str.E., and H. D. Manning, B.Sc., Assoc.M.Inst.C.E.; for the design of the Mogden Works, Messrs. R. A. Elliott, B.Sc., Assoc.M.Inst.C.E., D. C. McCormick, Assoc.M.Inst.C.E., C. A. Stewart, Assoc.M.Inst.C.E., M. W. Summers, Assoc.M.Inst.C.E., A.M.Inst.W.E., and G. W. Wilkinson, Assoc.M.Inst.C.E., A.M.Inst.M. & Cy.E.; and for the design of the Perry Oaks Works and other general works Mr. C. Hogg, B.Sc., Assoc.M.Inst.C.E., A.M.Inst.W.E. Mr. W. Parker, M.Inst.C.E., was responsible for the mechanical and electrical work, while Messrs. P. L. Dickinson and F. Norman undertook the architectural design. The supervision of contract work was organised by the late Mr. H. R. M. Macmillan, V.D., M.Inst.C.E., succeeded since 1934 until the completion of the work by Mr. R. A. T. Anderson, while the chief resident engineers included Messrs. W. E. L. Adams, Assoc.M.Inst.C.E., L. B. Aylen, Assoc.M.Inst.C.E., F. J. Crabb, B.Eng., Assoc.M.Inst.C.E., H. H. Hunt, Assoc.M.Inst.C.E., F. W. Ireland, M.Inst.C.E., B. E. Ireland, Assoc.M.Inst.C.E., J. A. Jameson, the late Mr. A. F. St. J. Kinsey, Assoc.M.Inst.C.E., Mr. J. H. Mair, B.Sc., Assoc.M.Inst.C.E., the late Mr. A. Pinkham and Mr. A. G. Wilbond, B.E., Assoc.M.Inst.C.E.

Future Administration.

The future administration of the scheme, including both the main sewerage system and the two purification works at Mogden and Perry Oaks, has been undertaken by the County Engineer and Surveyor, Major W. H. Morgan, D.S.O., M.Inst.C.E., while Mr. C. B. Townend, B.Sc., M.Inst.C.E., has been appointed Engineer-in-Charge.

HIGH LEVEL MAIN OUTFALL SEWER.
Visit of Drainage Committee to Works under Construction.

MAIN SEWERAGE

Although the chief interest of the visitor will be centred at the purification works, the expenditure on that item alone represents only about one-third of the total cost of the scheme, and by far the largest part of the construction operations have been involved in the main sewerage, all work now buried out of sight, on which a sum of about £3,150,000 has been spent.

At the time the Parliamentary scheme was prepared, the average daily dry weather flow of sewage at the twenty-eight existing works had reached a figure approaching 40 gallons per head. The County Council under the Act assumed the responsibility for accepting from each district a maximum rate of flow in wet weather equivalent to 240 gallons per head per day.

In order to meet these obligations with reasonable margins of safety, the main sewerage has been designed to discharge at the new purification works a total maximum flow of 575,000,000 gallons per day.

About seventy-five per cent. of this volume is conveyed by gravitation in the high level sewers serving the valley of the Brent and the upper valleys of the Crane and Colne. The remaining twenty-five per cent. of the flow is derived from the Thames Valley low level area extending from Staines in the west to Chiswick in the east, and, after gravitating to the pump well at Mogden, it is lifted about 50 feet and discharged into the purification plant with the incoming high level sewage.

The total length of main intercepting sewers constructed under the scheme (including the effluent conduits from the purification works to the Thames) is 67 miles, of diameters ranging from 21 inches to 12 feet 9 inches. In addition 3 miles of connecting sewers of smaller diameters have also been undertaken. Of the total length, about 21 miles have been constructed in open trench and the remainder of 49 miles in tunnel.

Construction Details.

In general, sewers up to 3 feet 9 inches in diameter are of aluminous cement concrete pipes, in most cases surrounded by concrete, or of cast iron. Sewers of 4 feet diameter and over in open trench have been constructed of concrete, reinforced where necessary, and lined with brickwork; in tunnel they consist of two, three or four ring brickwork, cast iron segments lined with brickwork, or concrete segments lined with brickwork. The latter method of construction has proved particularly valuable from the point of view of the employment of the type of labour available from distressed areas.

The lines of sewers were carefully located to avoid bad ground or other difficult conditions as far as possible. The work of tunnelling has been carried out for the most part through good London blue clay. However, where such operations have had to be undertaken through poor ground or under valuable property, cast-iron segments have generally been used. In driving the largest sewers of 11 feet in diameter and over, the use of a shield has been

JUNCTION CHAMBER.
9-Feet, 10-Feet 9-Inches and 12-Feet 9-Inches Diameter Sewers.

found advantageous. Where waterlogged strata have been encountered, shields have generally become necessary whatever the size of the sewer, in some cases the work being carried out under compressed air. In three cases, compressed air has been used without a shield, two being in conjunction with cast-iron segments and one with concrete segments. Shields have varied in diameter from 5 feet 4 inches to 13 feet 11 inches in internal diameter. In four cases, a new type of shield (Hunt-Kearney), devised as a result of experience on an early contract, was adopted for working in water-laden ballast without the use of compressed air.

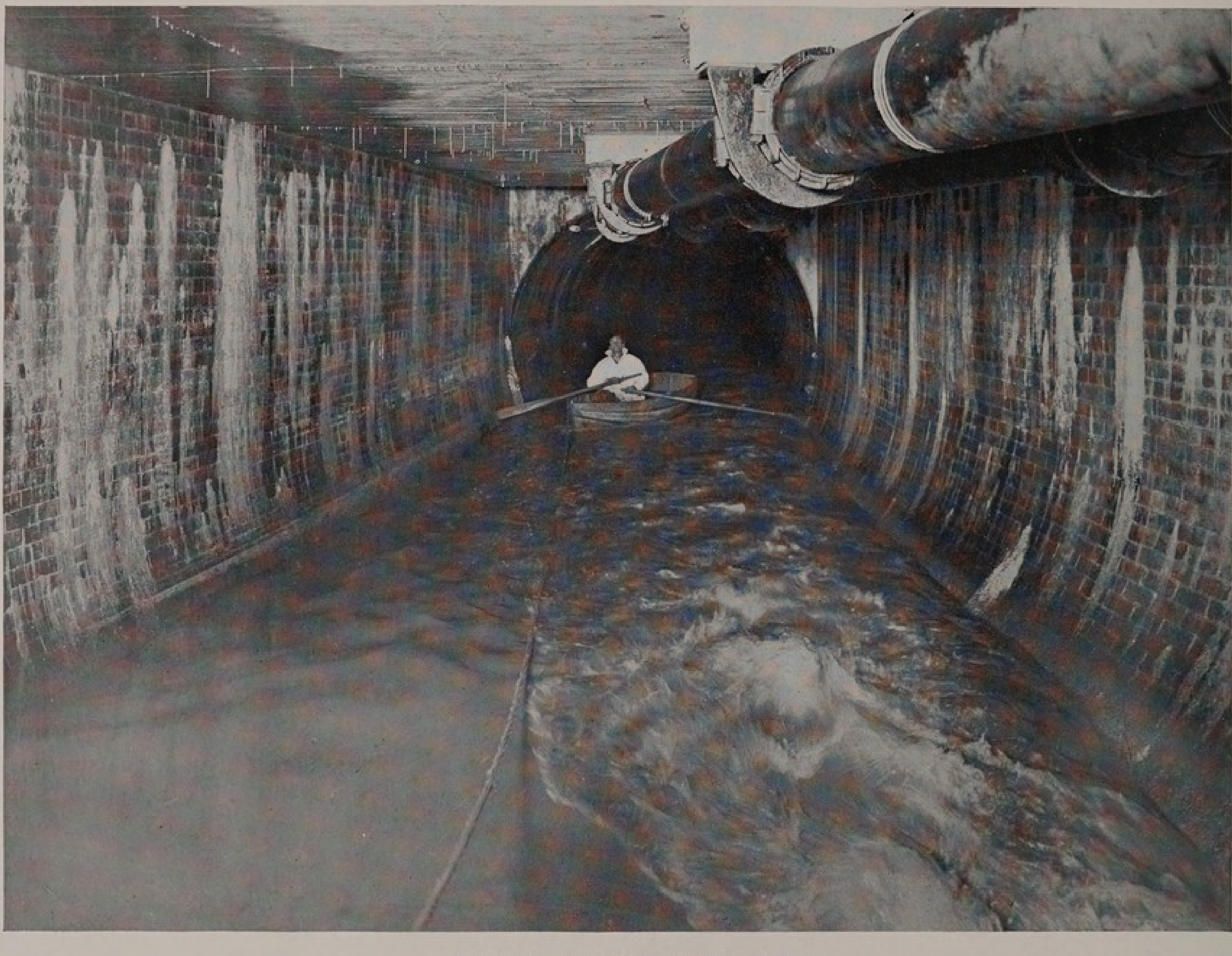
Statutory obligations have made it necessary to gauge all flows discharging into the main sewerage system. On the large connections permanent gauging flumes have been installed, while on the smaller ones, arrangements have been made for metering as and when required. These gauging flumes have necessarily complicated the design of the manholes accommodating them, as the flumes in some cases were at a depth of nearly 80 feet below the surface.

Storm Relief. Although the essential purpose of the scheme is not that of storm relief, the maximum discharge to the works is such that a very considerable spare capacity will be available in the early years of operation, while many districts are still developing. This spare capacity will be used to relieve areas from the effects of flooding up to the limit of the space available.

In the Brent Valley the main sewer will provide a valuable channel additional to that of the river for discharging floods in times of emergency and in two instances syphon spillways have been constructed at points suitably located in relation to previous floods for the purpose of taking flood water from the river into the sewer at such times as spare capacity is available. These syphons are automatic in their method of operation. Two other syphon spillways have been constructed elsewhere on the system for emergency purposes.

Inverted Syphons. Among other interesting details are five inverted syphons, the largest of which, under the River Brent, is designed to pass 325 cubic feet per second through six separate conduits, the inlets to which are set at different levels. The remaining inverted syphons are also of the multiple passage type designed on the same principle.

Effluent Culverts. After leaving the Mogden works, the purified effluent is discharged into twin culverts, each 11 feet in diameter, which have been driven to the Thames at a depth of about 50 feet under Isleworth. These tunnels terminate at four penstock control chambers, each 22 feet in diameter, sunk in the island known as Isleworth Ait. Three 6-feet diameter outlets have been driven from each



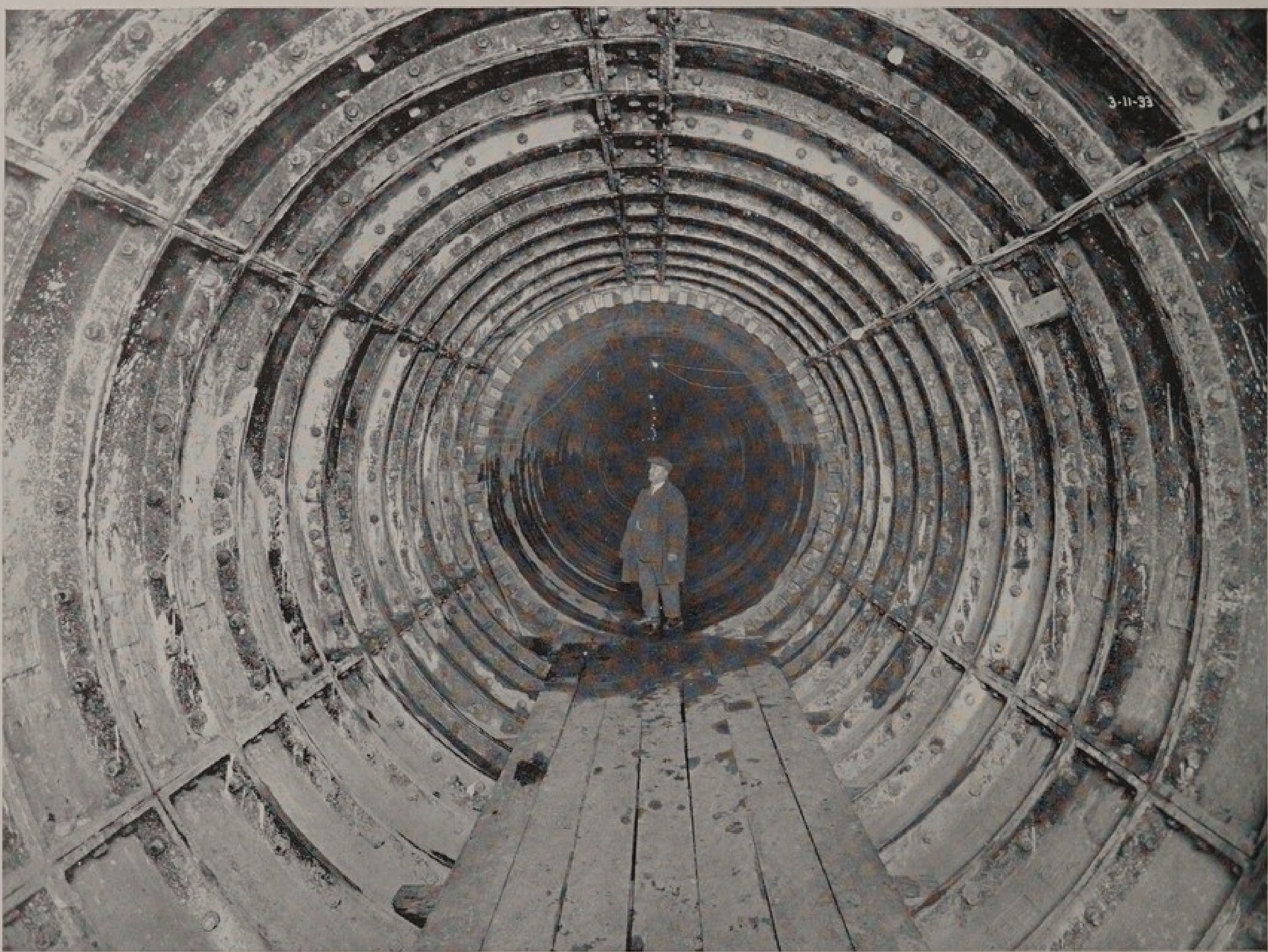
JUNCTION CHAMBER IN OPERATION.
12-FEET 9-INCHES DIAMETER SEWER.
(*Photograph taken October, 1936.*)

shaft (making twelve outlets in all) under the main river channel to terminate in vertical outlet shafts constructed inside steel caissons sunk into the river bed. This arrangement will ensure a diffusion of effluent into the main stream of the river over a length of about 400 yards.

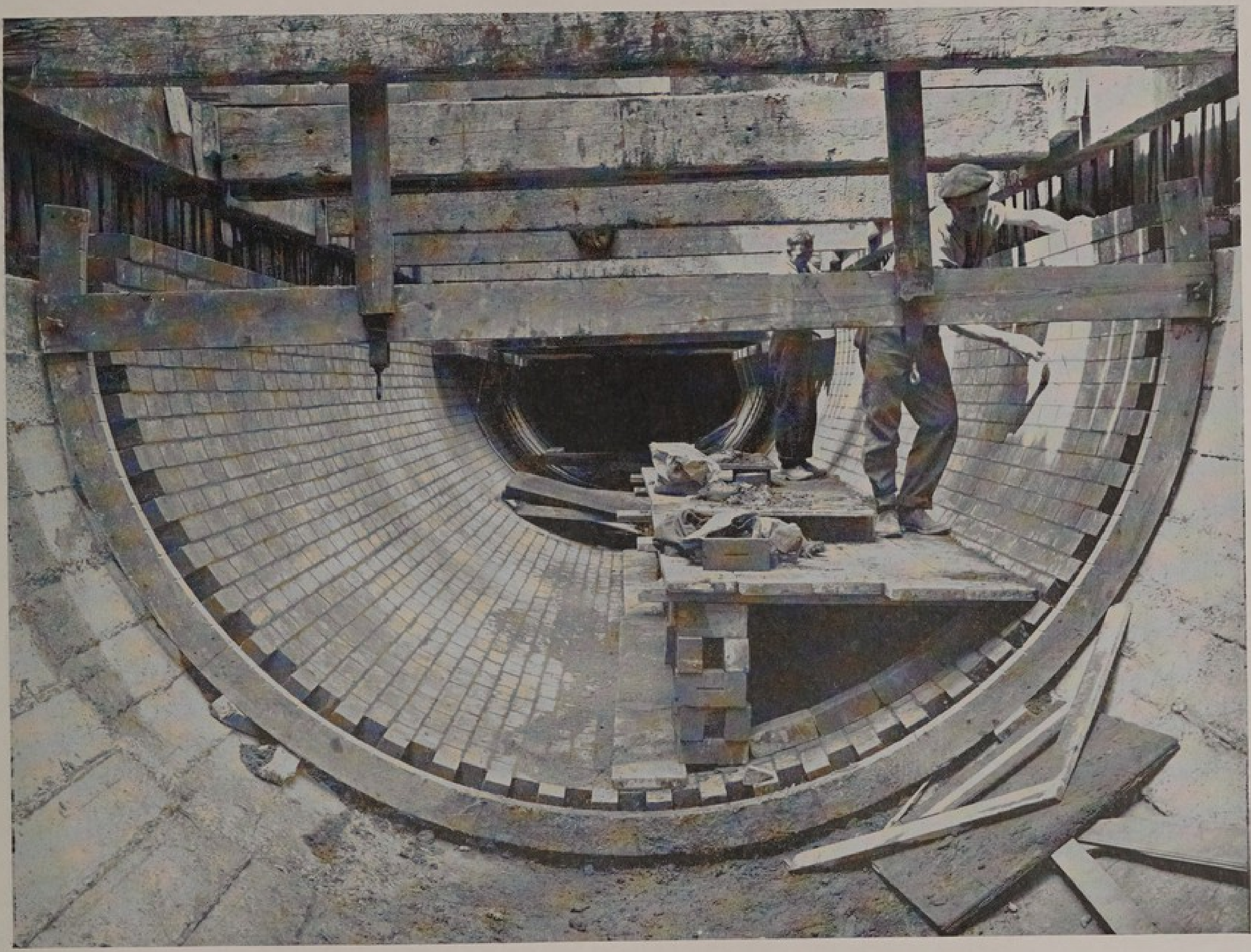
Main Sewerage Contracts.

The work of construction of the main sewerage system was carried out under twenty-nine of the thirty-six contracts previously mentioned. These were awarded to the contractors named in the Appendix. The work commenced in September, 1931, and proceeded expeditiously under well-organised conditions at an average rate exceeding one and a half miles per month.

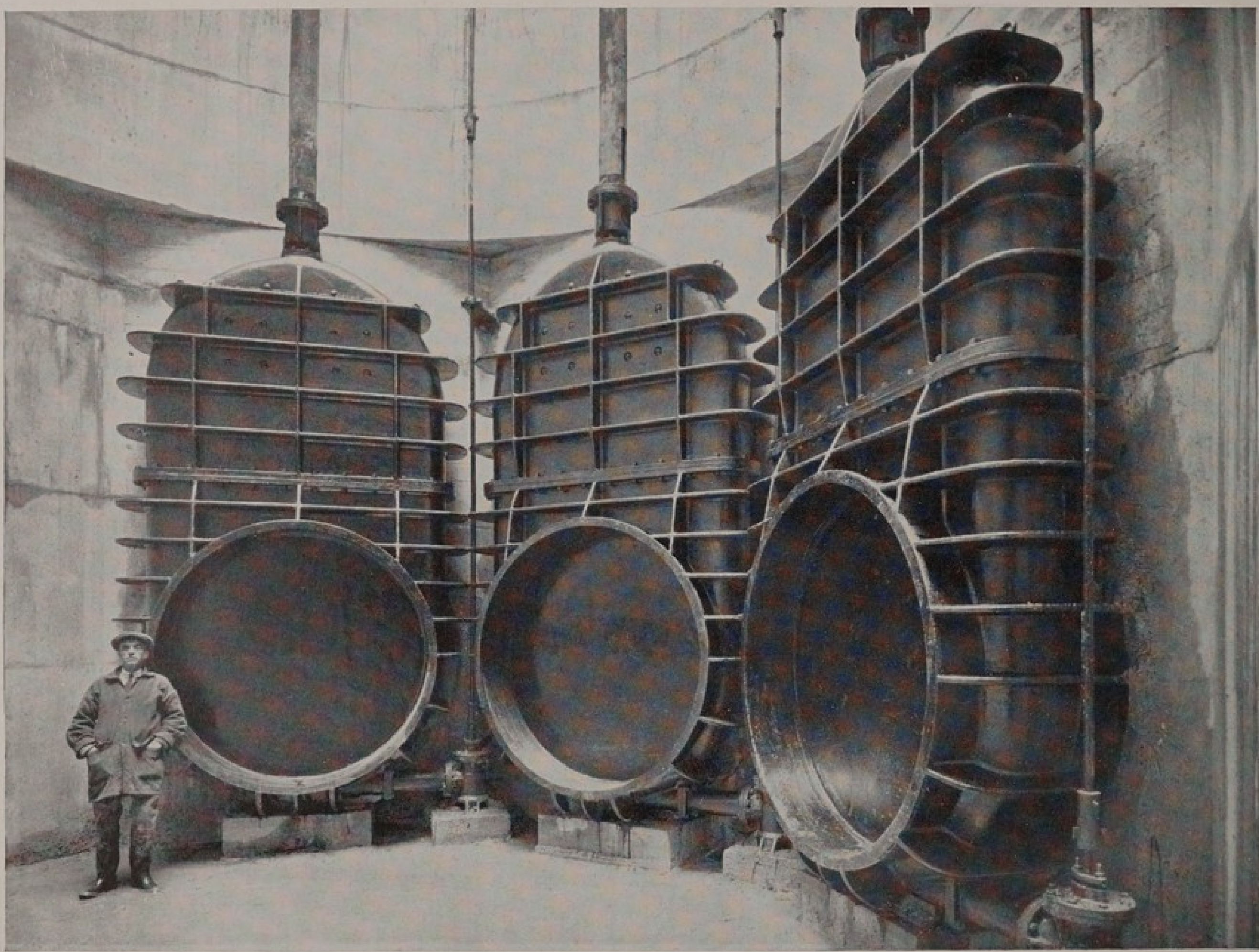
The work has involved a total of 1,100,000 cubic yards of excavation and the placing of 375,000 cubic yards of concrete. The materials used have included some 75,000 tons of Portland cement, 35,000,000 bricks, 45,000 tons of cast-iron and 10,000 tons of steel.



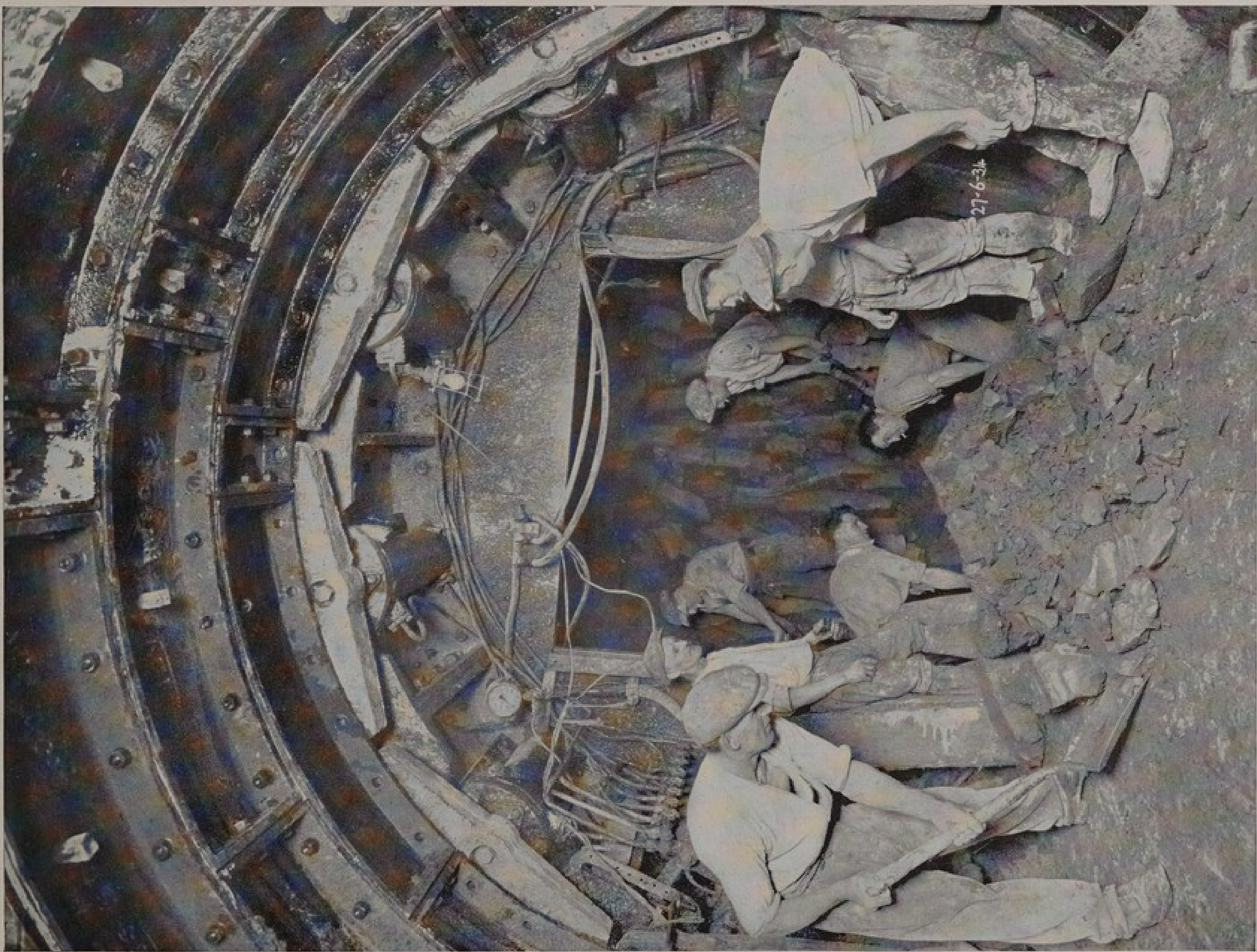
CAST-IRON SEGMENT TUNNEL FOR 10-FEET 6-INCHES DIAMETER SEWER.



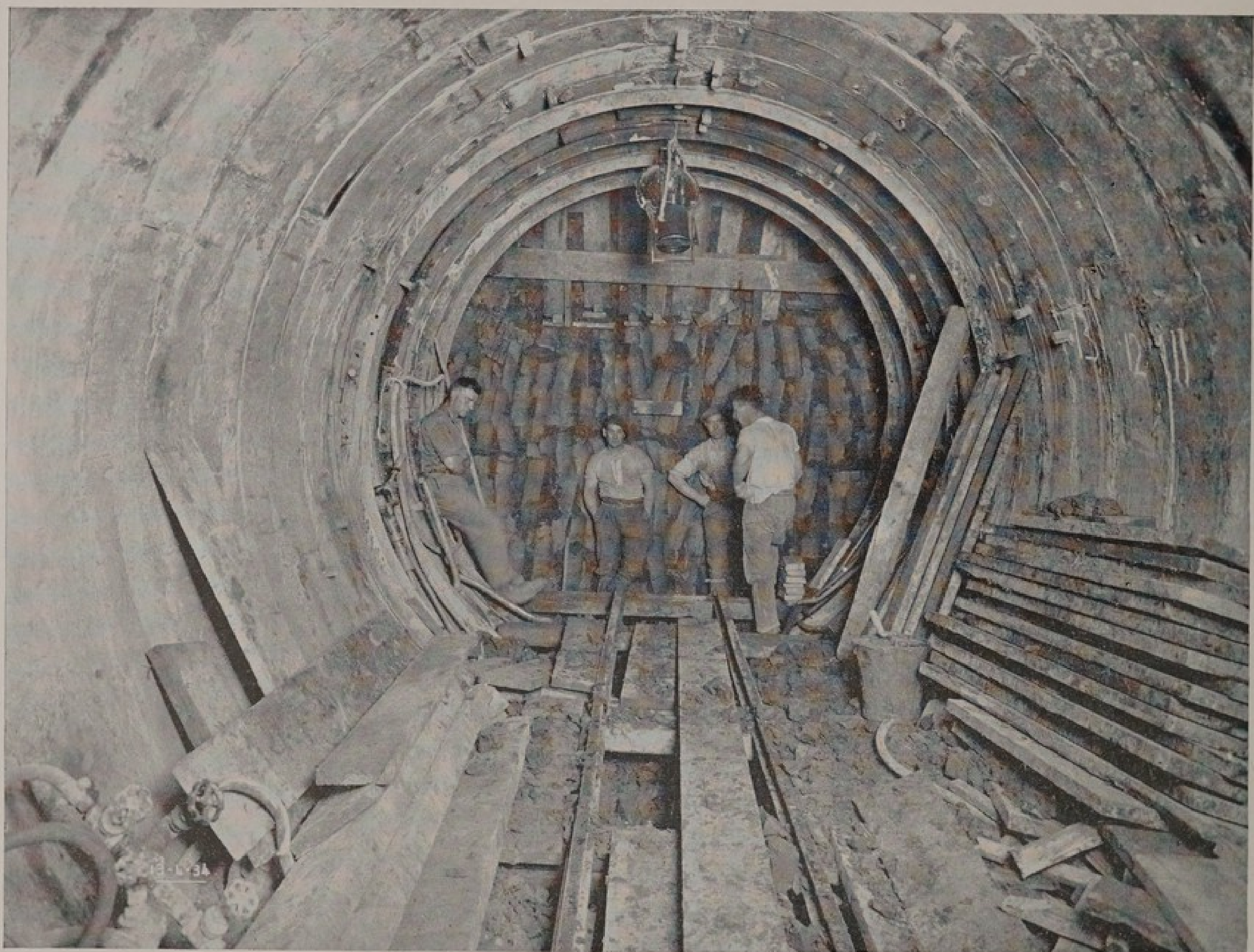
BRICKLAYING IN OPEN TRENCH FOR 10-FEET 6-INCHES DIAMETER SEWER.



6-FEET DIAMETER EFFLUENT CONTROL PENSTOCKS UNDER ISLEWORTH AIT.



SHIELD-DRIVEN TUNNEL
FOR 11-FEET DIAMETER EFFLUENT CONDUIT UNDER RIVER THAMES.



CONCRETE SEGMENT TUNNEL FOR 9-FEET DIAMETER SEWER.

MOGDEN PURIFICATION WORKS — PANORAMIC VIEW

PRIMARY SEDIMENTATION TANKS — SECONDARY SEDIMENTATION TANKS — AERATION TANKS

MOGDEN PURIFICATION WORKS

DEVELOPMENT OF PURIFICATION PROCESSES

Bacterial Energy.

Great progress has been made in the science of sewage purification since it first became realised that there existed in nature forces capable of performing this work when properly controlled and directed.

Probably the most important of these forces is the energy of bacterial life, by the harnessing of which most extraordinary changes can be brought about in the physical and chemical characteristics of the materials to be dealt with.

In a modern purification plant, the bacteria work under conditions calculated to furnish them with a suitable environment, enabling them to achieve their allotted tasks in the most intensive manner and in the minimum of time. By their assistance, not only is sewage converted into a clear sparkling effluent, fit to discharge into any stream, but also the resulting liquid sludge which remains to be disposed of, and which at Mogden will amount to over 600,000 tons per annum, can be entirely changed in character into an inoffensive form which may be easily dried in the open without causing nuisance.

It is of further interest to note that during this treatment of sludge, bacterial energy is responsible for the conversion of about one half of the solid organic matter originally present in the crude material into an odourless gas (methane) which is used for providing power required on the works.

Composition of Sewage.

Contrary to popular conception, the concentration of polluting matter in sewage is extremely small, being normally of the order of one part of solid matter to 2,500 parts of water by weight.

The accompanying diagram gives the correct representation of these two components of the sewage received from West Middlesex. The small black square in the middle of the diagram indicates the actual weight of polluting matter in the large mass of clear water represented by the outer square.

DIAGRAM SHOWING THE APPROXIMATE RELATIVE PROPORTION OF POLLUTION IN SEWAGE FROM WEST MIDDLESEX.

WATER :—100,000 PARTS.
POLLUTING MATTER :—50 PARTS.

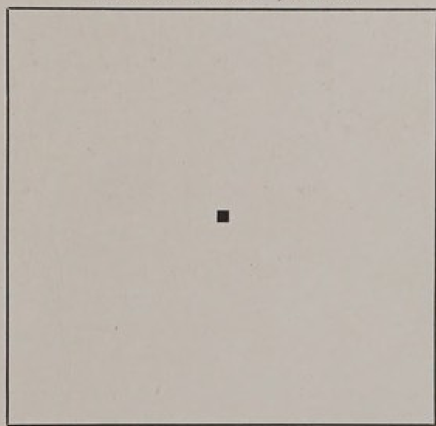
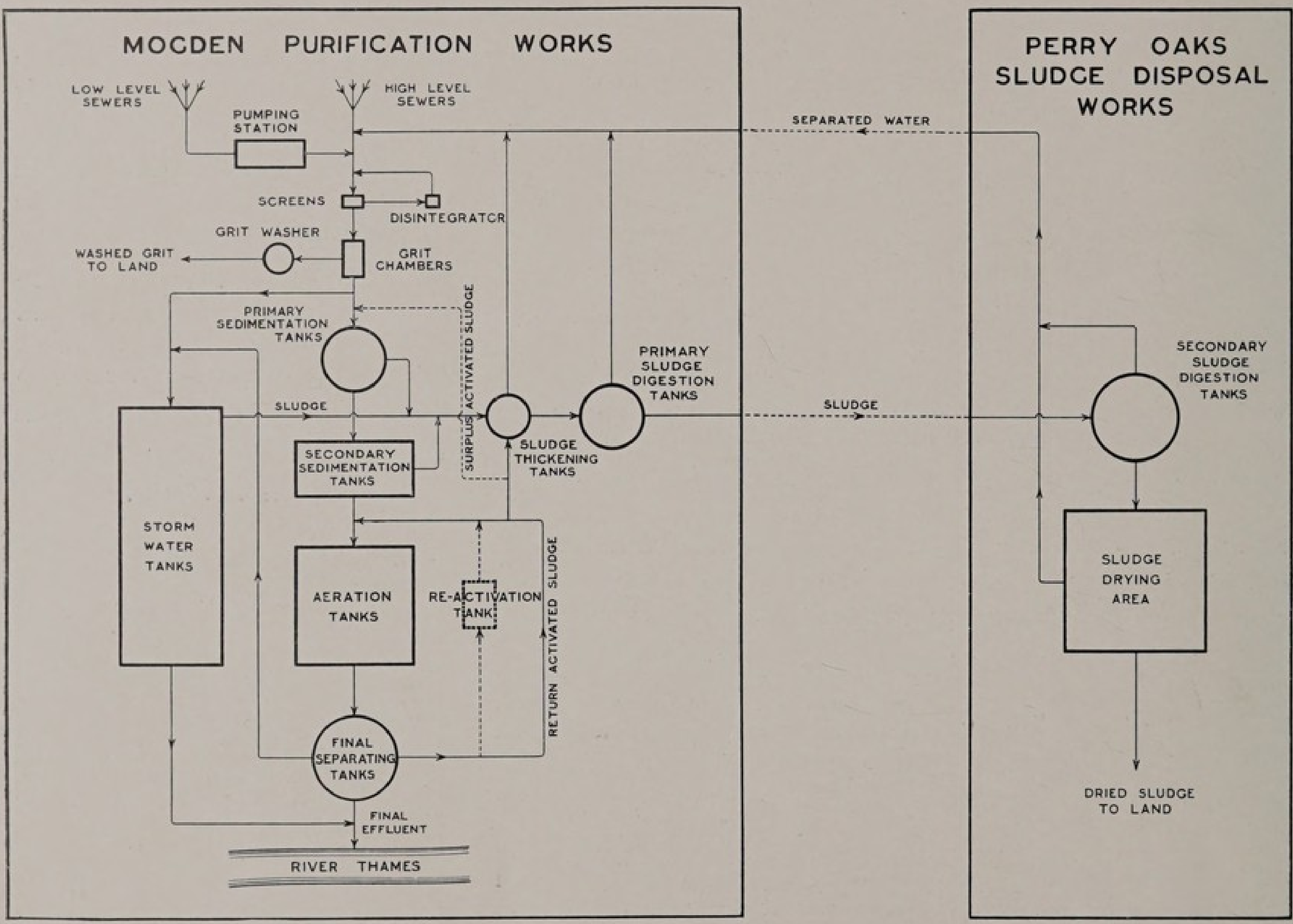


DIAGRAM ILLUSTRATING SEWAGE TREATMENT OPERATIONS



Yet the combined liquid as it arrives at the purification works is in a highly complicated state and many decades have been occupied in evolving the processes at present in use for effectually purifying the liquid and for transforming the resulting sludge into an innocuous condition for final disposal.

Removal of Polluting Matter.

The removal of grit and heavy solid matter is a comparatively easy task and is accomplished by means of gravitation to the bottom of the sedimentation tanks of various kinds. For the more difficult work of attack on the fine suspended matter, colloidal matter and organic matter in true solution, bacterial processes have been selected as the most suitable.

The Activated Sludge Process.

It is now well over twenty years since Dr. E. Ardern and Mr. W. T. Lockett (now Chief Chemist to the West Middlesex Main Drainage Department) published an account of the historic discovery at Manchester of a new process of sewage purification utilising liquid sludge brought into a condition of aerobic bacterial activity by continuous agitation in the presence of diffused air. This process became known as the "Activated Sludge Process."

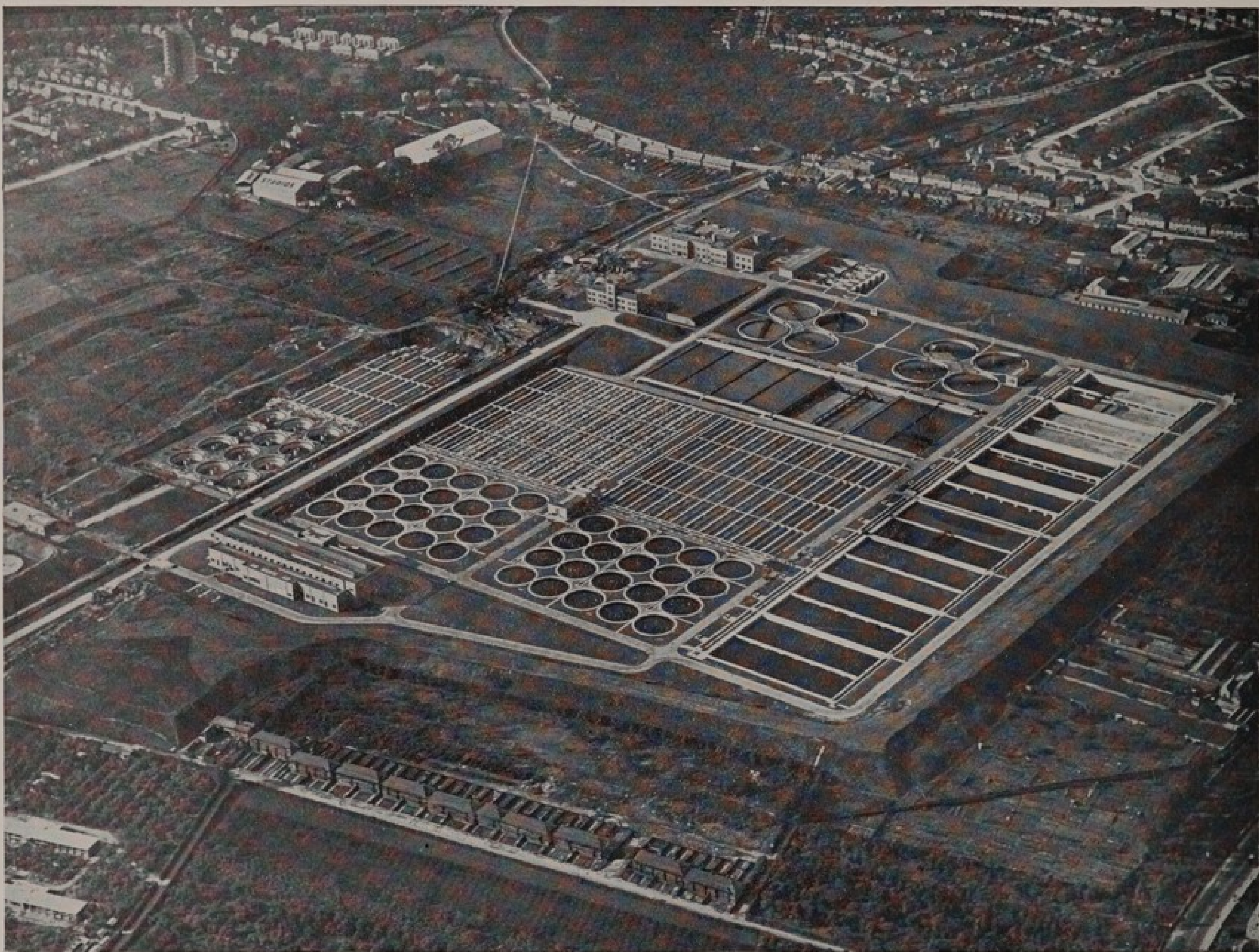
Although progress along these lines was seriously held up by the war, this revolutionary method of purification achieved a world-wide reputation in the years which followed, and now that extensive experience has been gained in design and operation of large-scale plants, the process has become well established and deservedly popular where conditions are suitable for its adoption.

The activated sludge process is noted for its complete freedom from nuisance, both from odours and flies. In addition, it effects great economy in the area of plant required and can be operated with very low hydraulic losses. It is largely for these reasons that it has been adopted for the Mogden Works and the visitor will doubtless be impressed by the tremendous advance which has been achieved since the days of what he remembers as the "Sewage Farm."

The Sludge Digestion Process.

Even more striking in some ways are the present-day methods of handling sewage sludge, the material which is separated from sewage during the processes of purification. At Mogden the hand cleaning of tanks has been entirely superseded by the removal of the sludge from under water by mechanical means. The sludge is then pumped underground into covered sealed tanks, converted into an innocuous product by the digestion process, and finally pumped away, again underground, for a distance of seven miles to the point of final disposal, all without ever having been exposed to the atmosphere.

The possibility of such methods dates from the evolution of the sludge digestion process at the works of the Birmingham Tame and Rea District Drainage Board in the years 1909—1911 and the subsequent development by



MOGDEN PURIFICATION WORKS,
AERIAL VIEW.

Mr. John D. Watson, Pres.Inst.C.E., then Engineer to the Board, of the large-scale plant which now exists at Birmingham to deal with the sludge produced from a population of over one million.

The successful evolution of this process is undoubtedly one of the most important changes in sewage purification methods which have occurred within the last fifty years, and latterly the incorporation of the process into modern plants has been almost universal throughout the world.

Utilisation of Methane Gas.

The popularity of the digestion process has received a great impetus by the possibilities more recently opened up of its intensification and acceleration by the application of heat, and further, of the generation of power by the utilisation of the methane gas given off as a result of the destruction of solid matter by bacterial energy.

Following the successful working of a small engine installed at Birmingham in 1921 to operate on methane gas as fuel, the Drainage Board proceeded in 1926 to construct on a large-scale their well-known power plant which has since been extended to include a total of some 1,850 horse power.

The power plant installed at the Mogden Works represents the latest practice evolved from these earlier pioneering efforts and is the largest of its kind in the world. It is described in more detail in later paragraphs, but it may be mentioned here that from this plant approximately 800,000 cubic feet of gas per day, having a heating value of about thirty per cent. above that of ordinary town's gas, are being produced from the digesting sludge and consumed by gas engines developing 50,000 horse power hours daily.

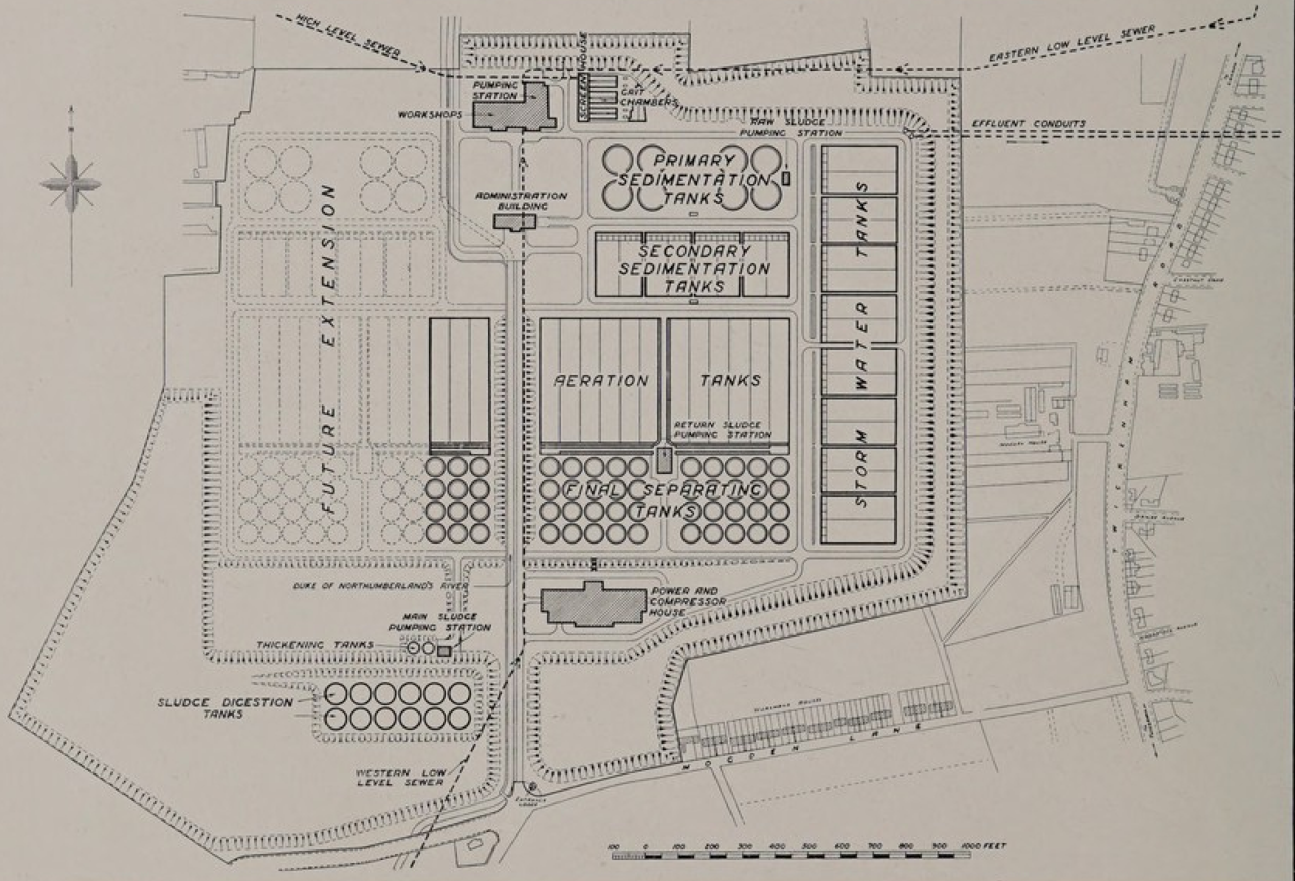
This energy would be capable of supplying the domestic requirements of electricity for a town of 75,000 people.

The extraordinary nature of this power may be well illustrated by the fact that if the whole of the contributing population of over 1,000,000 people could be placed on a gigantic lift, the power could be used to raise the lift 900 feet every day! Even then the energy of the gas would not have been exhausted for the waste heat recovered from the engine cooling water and exhaust gases for the digestion process purposes would be sufficient to provide 250,000 people with a hot bath every week.

PURIFICATION WORKS AS CONSTRUCTED

The area of the site for which compulsory powers of purchase were obtained under the Act was approximately 100 acres, which will provide ample accommodation for the works ultimately required, including generous margins encircling the site which have been used for the tipping of soil. The embankments so formed are being planted with trees and shrubs. In addition to this site, the County Council have acquired such additional land immediately adjoining the works as has become available, and now have control of a total area of about 150 acres.

MOGDEN PURIFICATION WORKS — GENERAL PLAN



Of the whole site, the ultimate plant will cover an area inside the margins of about 70 acres only, of which about 45 acres have so far been utilised. The works as they exist to-day occupy a square plot of approximately one quarter of a mile in each direction.

In the lay-out and design of the works, much thought has been given to the appearance of the completed plant and it is anticipated that when the work of landscaping has been accomplished, the general effect will be pleasing.

The dry weather flow at the commencement of operations has been found to be just over 40,000,000 gallons per day from the present population of rather more than 1,000,000 and is expected ultimately to reach double that volume when the district is fully developed. As previously indicated, the total discharging capacity of the sewers is approximately 575,000,000 gallons per day.

As mentioned in earlier paragraphs, purification is effected by the activated sludge process using compressed air and the purified effluent is discharged into the Thames at Isleworth, at a distance of about three quarters of a mile from the works.

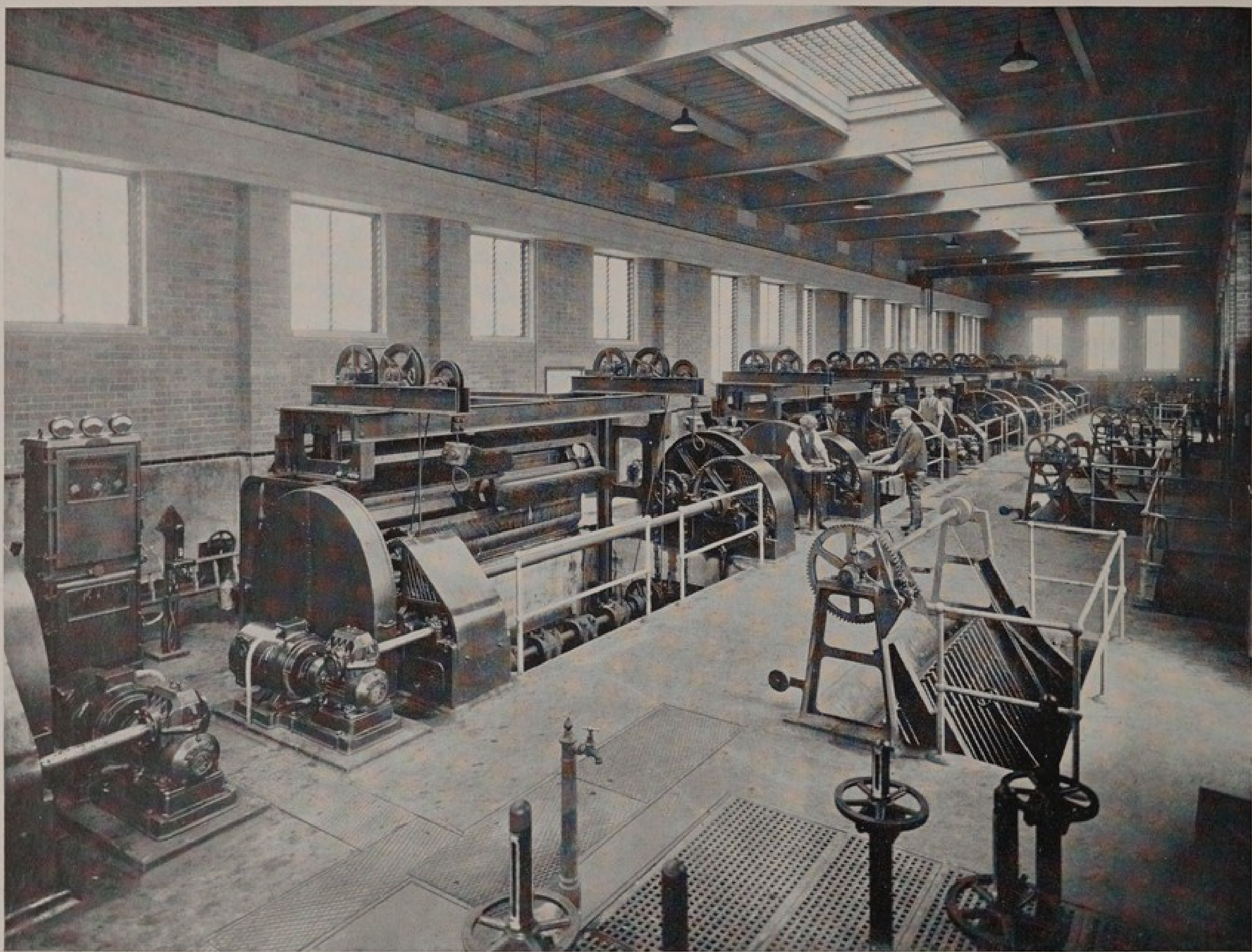
Complete treatment will be given to all volumes of sewage up to a rate of three times the dry weather flow and partial treatment by sedimentation in stormwater tanks to all volumes in excess of this rate. There is no stormwater relief weir discharging direct to the river.

The works have been designed to facilitate their gradual extension as the population increases, but those portions of the plant which cannot readily be enlarged have been constructed to meet the ultimate requirements. Such plant includes the Main Pumping Station and Workshops, Compressor House, Administration Buildings, Grit Chambers, and Main Sludge Pumping Station, etc.

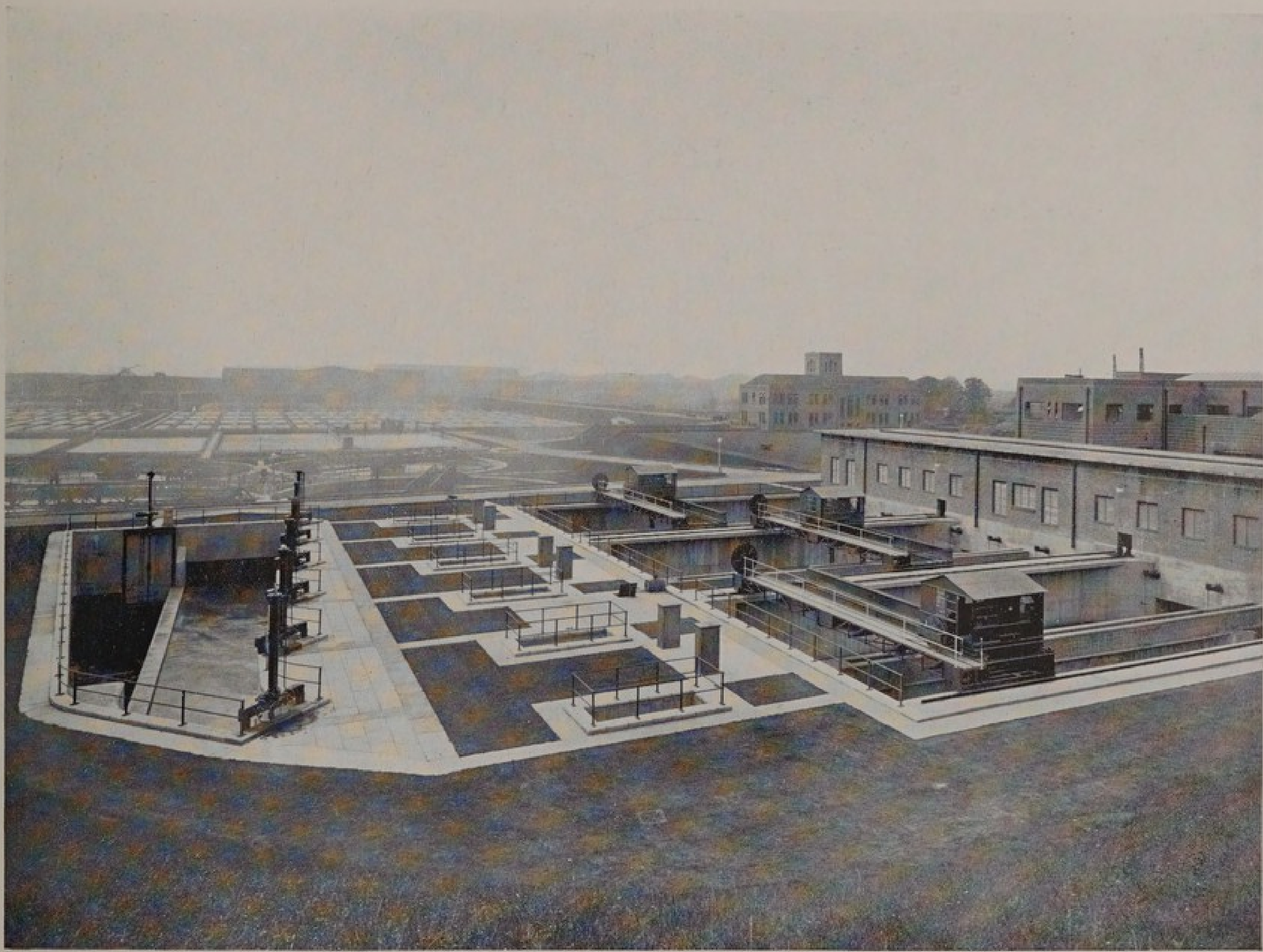
Screening and Grit Removal.

On entering the Works the sewage from the high level area, combined with the sewage lifted at the main pumping station from the low level sewers, first passes through the screening and grit removal plant. This is divided into six independent units, each with a maximum capacity of about 95,000,000 gallons per day, and which are brought into operation successively in accordance with the rate of sewage flow by means of automatically controlled hydraulic penstocks.

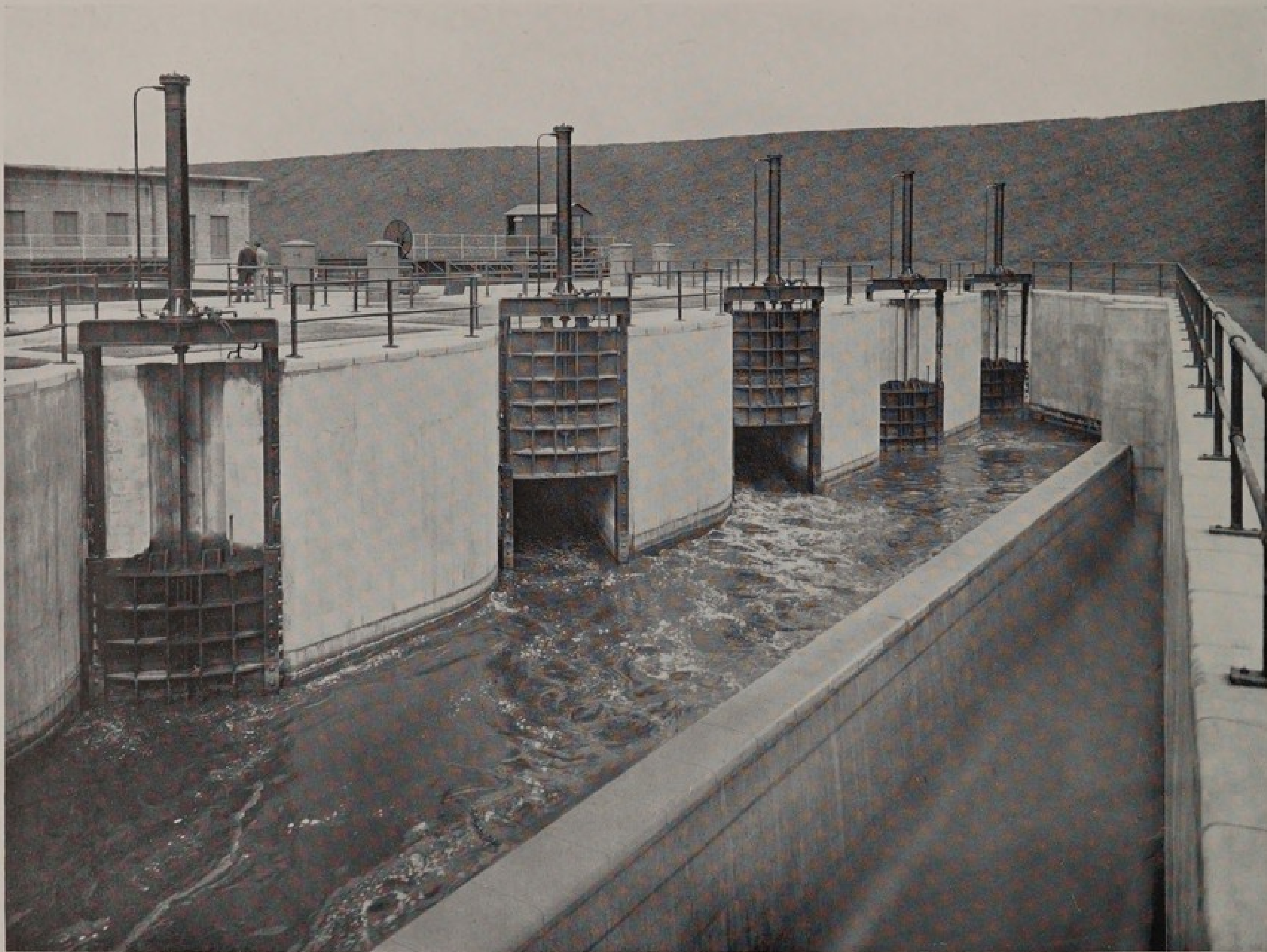
Each unit is equipped, first, with a rack consisting of bars spaced four inches apart, intended to intercept any large objects and requiring occasional cleaning by manually operated mechanical rakes. The screen which then follows has a bar spacing of three quarters of an inch, and is cleaned by electrically driven mechanical rakes, automatically coming into operation when required. The screenings are transported by belt conveyor to the disintegrator plant where they are macerated and passed back into the sewage on the upstream side of the screens.



SCREEN HOUSE.



SCREEN HOUSE AND GRIT CHAMBERS.



STORMWATER OVERFLOW CHAMBER
(Shewing Total Volume of Sewage Flow in Dry Weather).

Each grit chamber is equipped at its outlet with a standing wave Venturi flume which not only records the flow, but also controls the sewage level in the chamber in such a way that by means of the special cross-section given to the channel a velocity of one foot per second is maintained at all flows. At this velocity grit is deposited on the floor of the channel in a comparatively clean condition. The grit is removed by suction dredging and, after further washing, is pumped to settling ponds for disposal. The length of each grit chamber is 90 feet, giving a settling period of one and a half minutes.

After leaving the grit chambers, the sewage passes through the stormwater overflow chamber where any water in excess of three times the dry weather flow is diverted into culverts leading to the stormwater tanks.

Sedimentation Tanks.

The sewage up to a rate of three times the dryweather flow is subjected, after measurement, to two stages of sedimentation. The Primary Sedimentation Tanks, eight in number, have a total capacity of 4,500,000 gallons. They are circular in plan, 95 feet in diameter, 12 feet average depth, and are provided with a central inlet and peripheral weir. The sludge deposited on the sloping floor is scraped to a central well by means of an electrically operated revolving bridge type mechanism, whence it is discharged into the sludge pumping main.

Provision is made for the removal of the lighter solids in the Secondary Sedimentation Tanks. These are four in number, each 200 feet long by 150 feet wide by 12 feet deep, and having a total capacity of 9,000,000 gallons. An electrically operated Mieder-type scraper is used periodically to sweep the sludge by means of a submerged blade into hoppers provided at one end of the tanks, whence it is discharged under hydrostatic head into the sludge main for disposal.

Each tank is divided by a central longitudinal wall into two bays, giving the travelling mechanism a span of 75 feet. The blade is available on the outward journey for removing scum from the surface before travelling in the reverse direction for the sludging operation. One machine is made to serve a number of tanks by the use of a transporter carriage.

In the general lay-out of sedimentation tanks, space has been allowed for the possible introduction in the future of auxiliary plant such as grease skimming tanks or pre-aeration units. In the present plant skimming is provided in both series of sedimentation tanks.

Aeration Plant.

After passing through this preliminary stage of treatment, the clarified liquor passes to the main process of purification in the Aeration Tanks which have a gross capacity of 20,000,000 gallons. This plant is divided into two batteries each containing six units. Each unit consists of four channels, 400 feet in length, 15 feet in width and 12 feet in depth, equipped with compressed air diffusers. One battery is arranged to operate on the " spiral flow " principle with two rows of eight-inch diffusers installed on one side of

AERATION TANKS AND OPERATING GALLERY.

each channel, while the other battery is arranged on the " longitudinal ridge and furrow " principle with three rows of six-inch diffusers spaced at five feet centres. The detailed design of both batteries allows for easy conversion of the whole of the units to one method of operation or the other if the definite superiority of either should be clearly established at a later date.

The sewage arriving at the aeration plant receives a measured volume of activated sludge with which it is freely circulated in an aeration channel before the mixed liquor thus obtained is admitted to the aeration tanks themselves.

The mixed liquor passes along the four channels of each unit in series, the distance travelled being 1,600 feet. Air under pressure is discharged from the diffusers at the bottom of the tank along the whole length of the channels.

Separation and Return of Activated Sludge.

After leaving these channels, the liquor passes on to the Final Separating Tanks where the activated sludge is settled out. There are forty of these tanks, each of which is 60 feet in diameter, having a central inlet and peripheral weir. The total capacity is 10,000,000 gallons, and a maximum rate of upward flow of 7·5 feet per hour will not be exceeded.

The sludge deposited on the sloping floor is moved continuously towards the centre by means of an electrically operated rotating ring type mechanism and is discharged from the bottom under hydrostatic head to the return sludge pumping station. Here it is lifted and returned into the sewage entering the aeration plant previously described. Provision has been made for returning any proportion of activated sludge from fifteen per cent. to fifty per cent. of the dry weather flow, while an additional fifty per cent. of final effluent can also be returned into the incoming sewage liquor at this point.

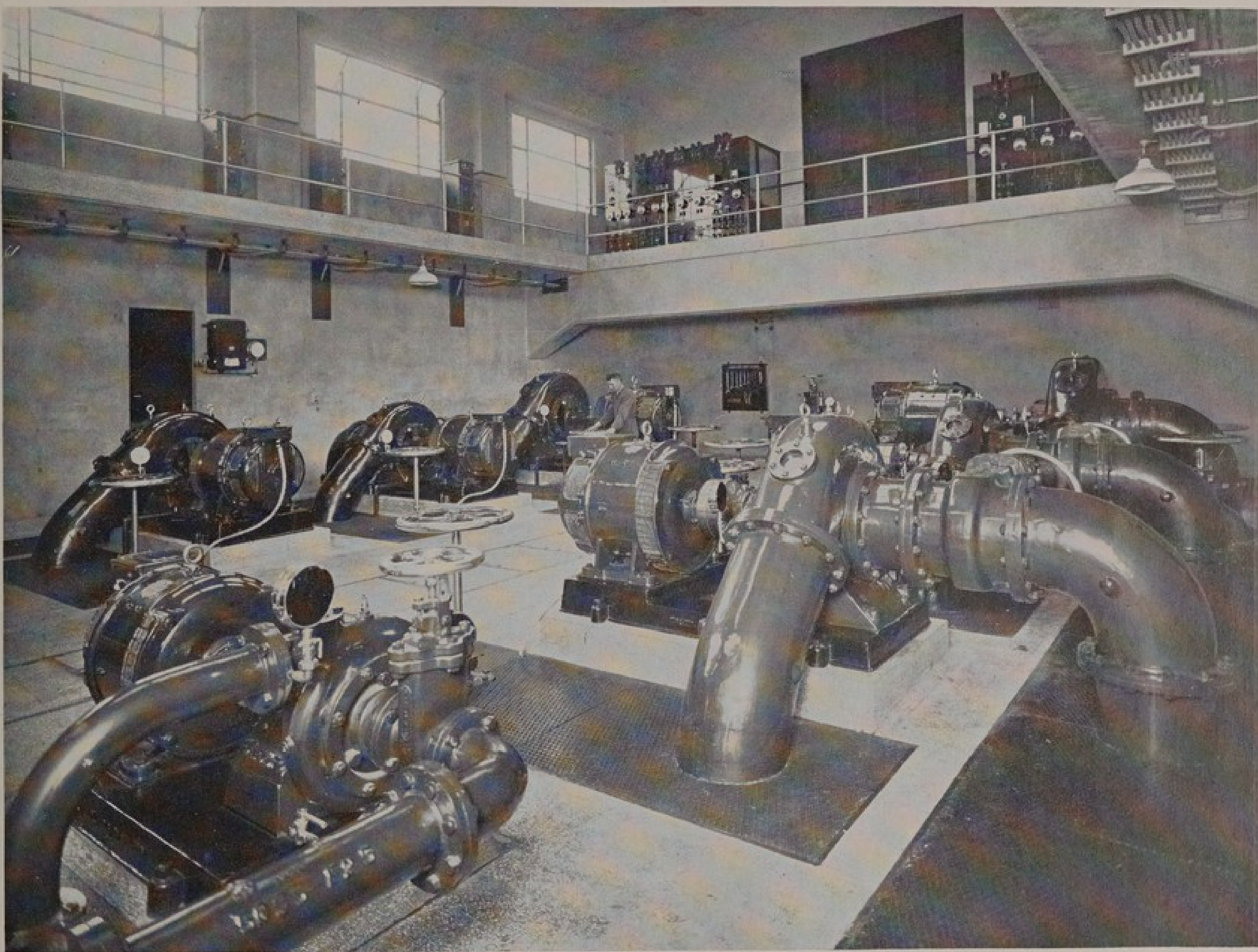
Provision has been made also for the use of any number up to four of the aeration units as sludge reconditioning tanks.

The surplus activated sludge obtained from the aeration plant is pumped back into the main sewage flow at the inlet to the primary sedimentation tanks or alternatively can be delivered to the digestion tanks direct.

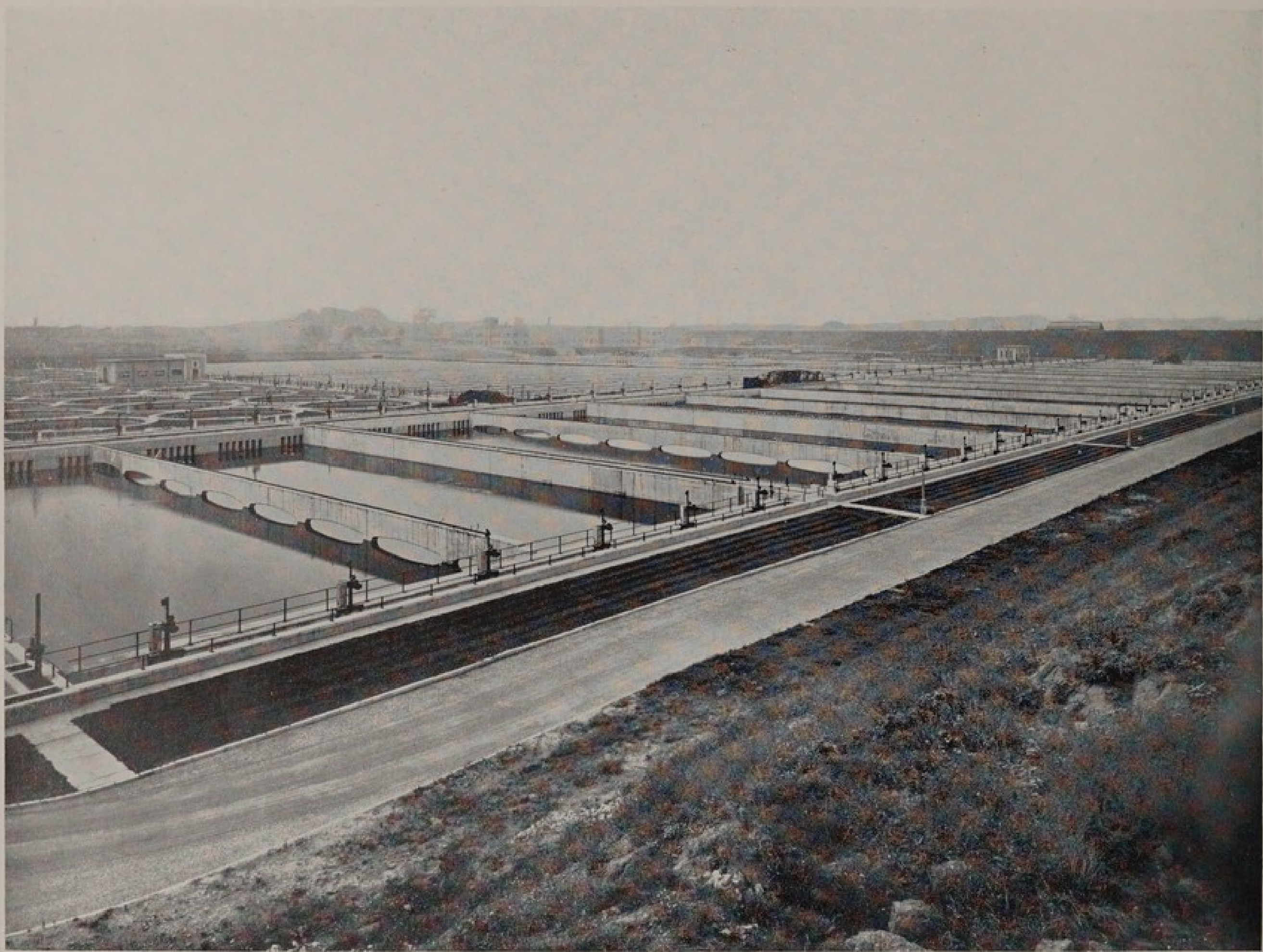
Operating Gallery.

Situated between the aeration tanks and the final separating tanks is the operating gallery in which are incorporated the various supply channels and delivery mains for sewage, return sludge, mixed liquor and compressed air and in which are housed the control penstocks, valves and metering equipment. Meters are provided for measuring the total flow of sewage to the aeration tanks, the mixed liquor and compressed air passing to each unit, and the return and surplus sludge. Centralised indicating, recording and integrating is provided for on a main instrument panel in the return sludge pumping station, which is situated between the two batteries of tanks.

FINAL SEPARATING TANKS.



RETURN SLUDGE PUMPING STATION.



STORMWATER TANKS.

Discharge of Effluent

The clear purified effluent discharged over the weir of the final separating tanks passes through the effluent conduits direct to the Thames. Provision has been made, however, for this effluent in periods of dry weather to pass through the stormwater tanks which otherwise would be empty.

Stormwater Treatment.

Any volume of sewage received at the Works in excess of three times the dry weather flow is diverted to the Stormwater Tanks where it receives sedimentation treatment. The Stormwater Tanks, eight in number, each 230 feet long by 150 feet wide by 12 feet deep, have a total capacity of 20,000,000 gallons. The general design of the tanks is similar in most respects to that of the secondary sedimentation tanks, and here also a Mieder-type mechanism, as previously described, is installed for the removal of the sludge.

Supplemental Plant.

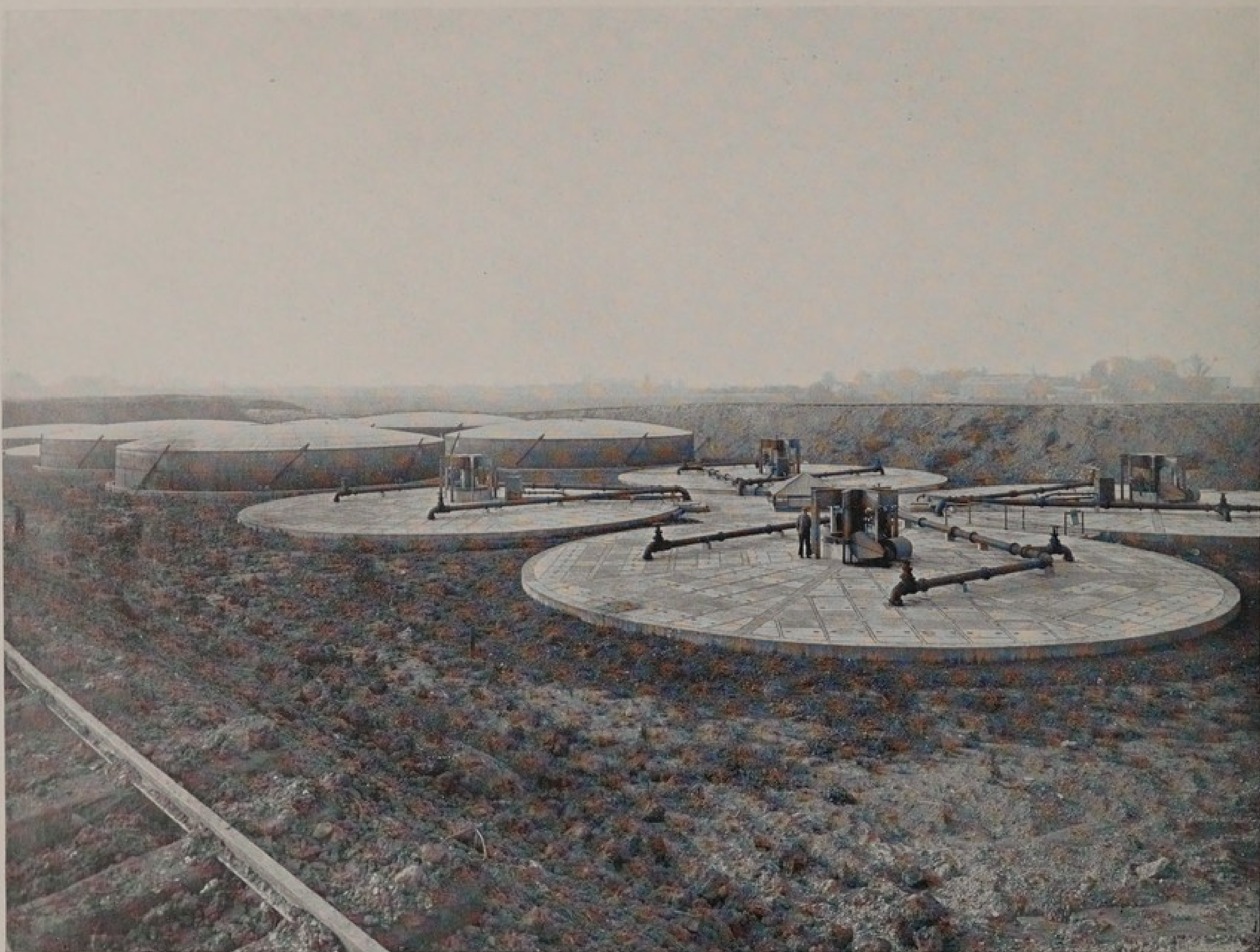
The foregoing description refers to plant, the whole of which is situated to the east of the central main access road. On account of the large increase of population previously referred to, supplemental plant is now being completed on the west side of the central road. This includes a further three units of aeration tanks and twelve final separating tanks.

Sludge Treatment.

The crude sludge obtained from the primary sedimentation, secondary sedimentation and stormwater tanks is all conveyed to the raw sludge pumping station at the north end of the site, whence it is pumped to the extreme south of the site. Here it is delivered to two thickening tanks, each 35 feet in diameter and of 20 feet side water depth, before being passed on for the first stage of treatment in the sludge digestion tanks. These are circular tanks, twelve in number, 70 feet in diameter, having a total capacity of 10,000,000 gallons. Four tanks, each having a side water depth of 32 feet, and centre depth of 34 feet, are equipped with stirring mechanisms and have fixed roofs. The remaining eight tanks, each having a side water depth of 32 feet, and centre depth of 51 feet, are provided with gas holders of the spiral carriage type of a total capacity of 250,000 cubic feet.

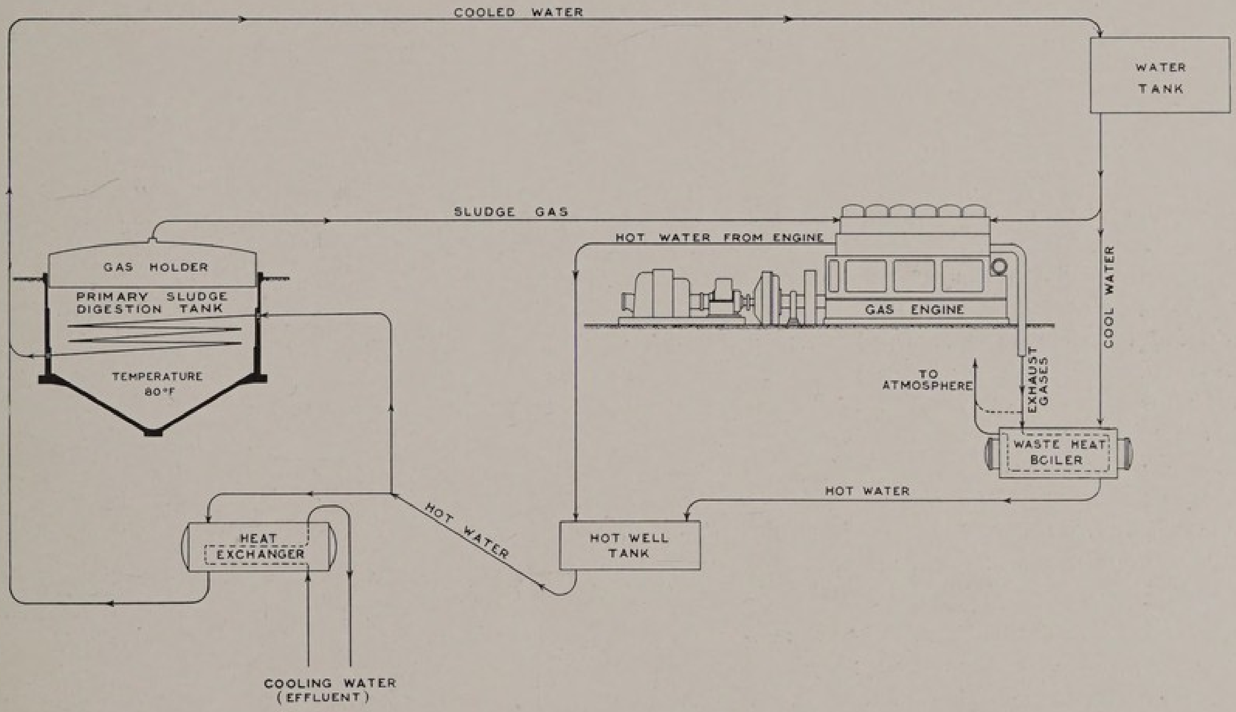
The volume of methane gas produced from this sludge digestion plant is about 800,000 cubic feet per day, having a calorific value of approximately 650 B.T.U.'s per cubic foot. This is used for the generation of power in the Power and Compressor House, the present output having an electrical equivalent of about 15,000,000 units per annum. The saving in annual charges which will be effected by this installation, after making allowance for loan charges, is estimated as at least £20,000.

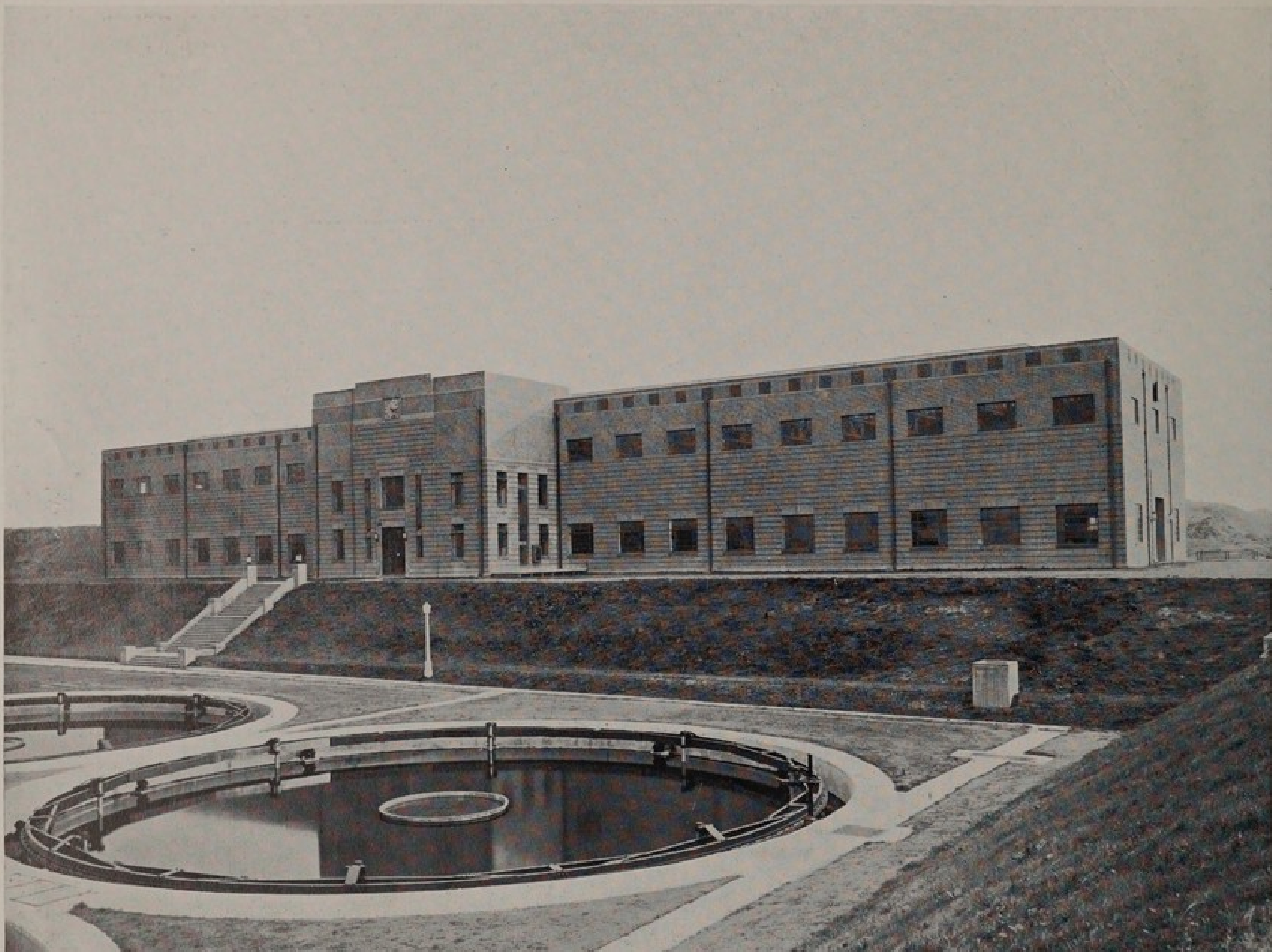
The waste heat from the engines is utilised in turn to heat the sludge in the digestion tanks in order to maintain a temperature of about 80°F., at which the efficiency of the bacterial process is at a maximum.



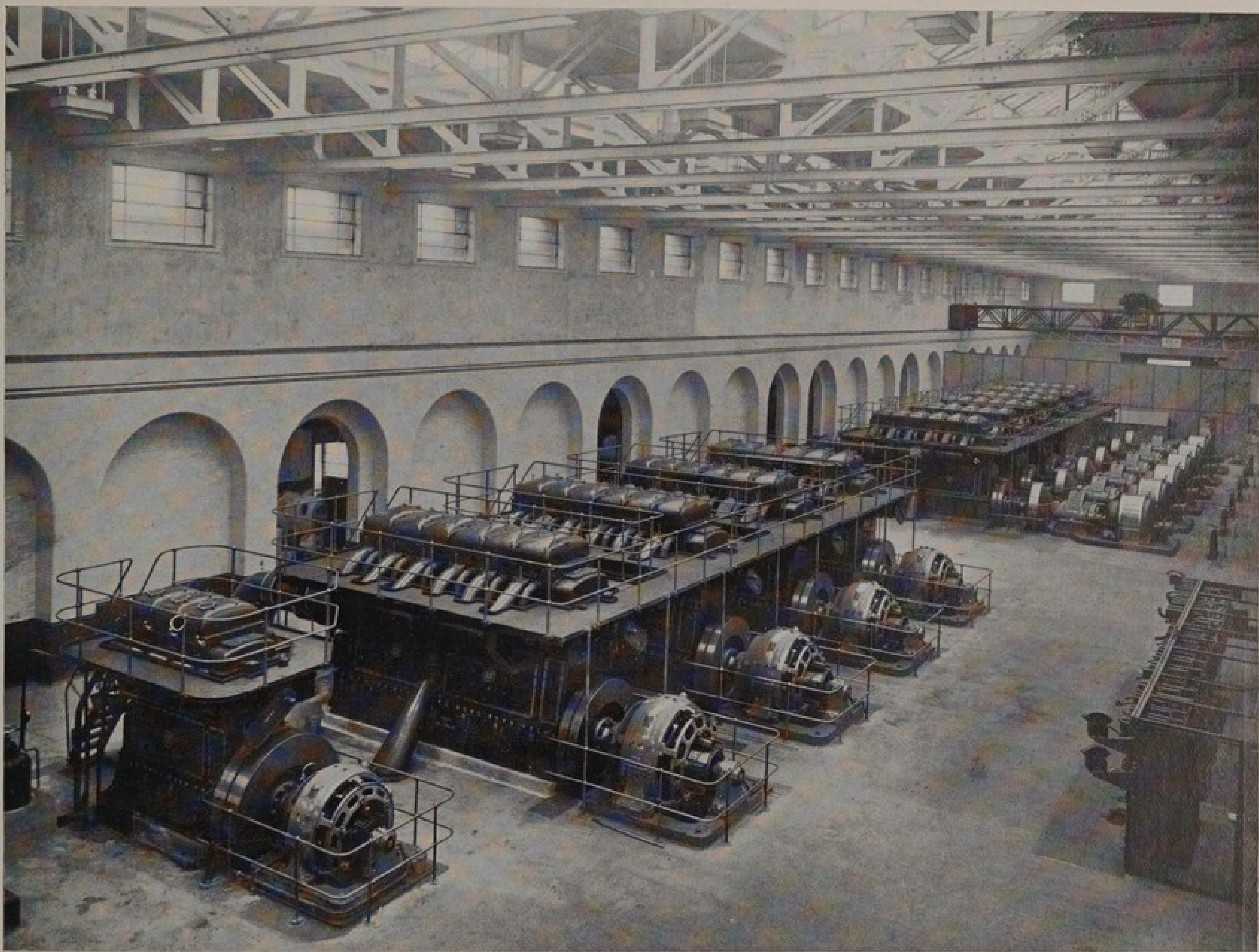
SLUDGE DIGESTION AND GAS COLLECTING PLANT.

DIAGRAM ILLUSTRATING METHOD OF UTILISING SLUDGE GAS AND RECOVERY OF WASTE HEAT

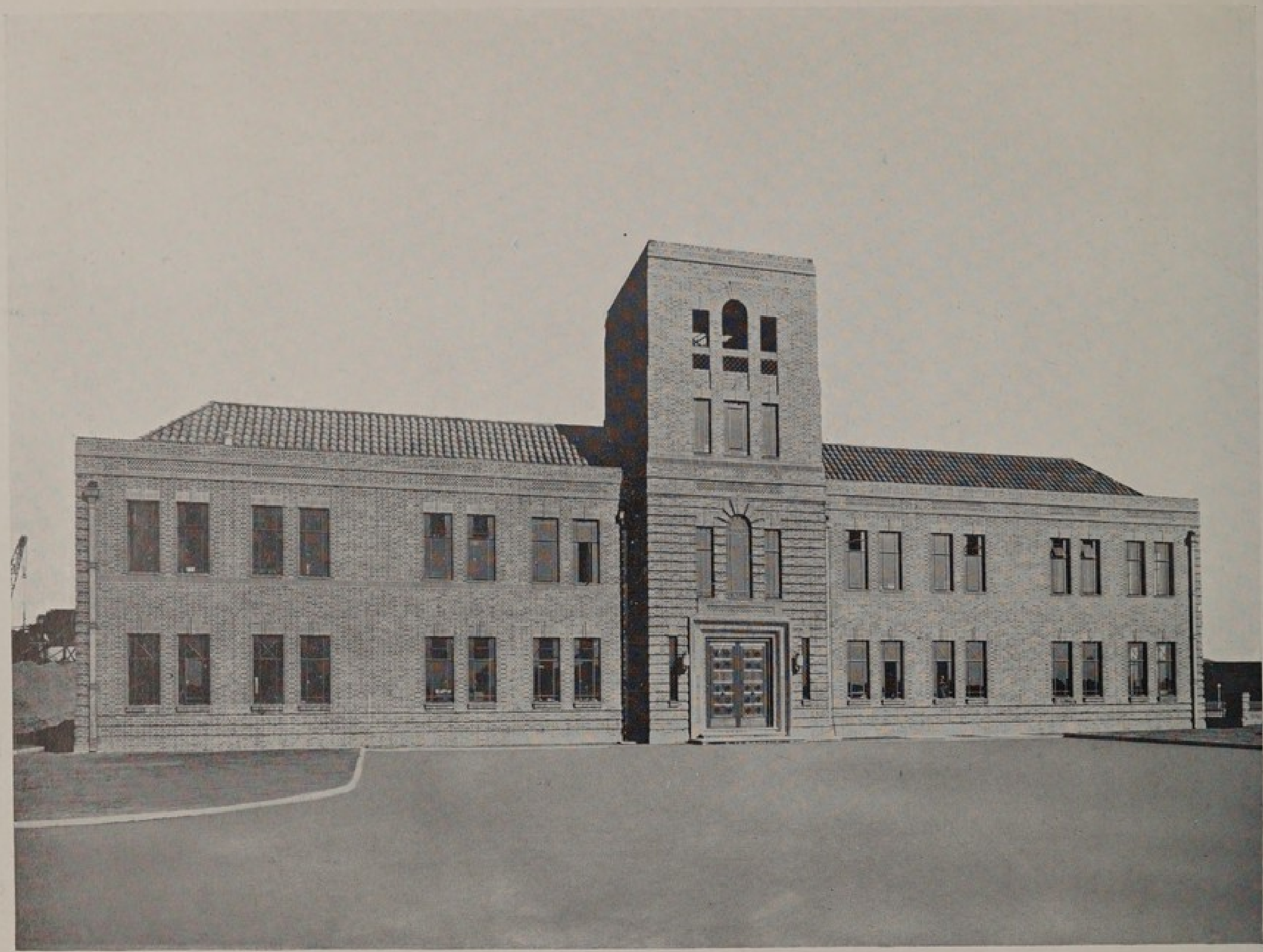




POWER AND COMPRESSOR HOUSE.



POWER AND COMPRESSOR HOUSE.



ADMINISTRATION BUILDING.

The sludge, after remaining in this stage of digestion for about a month, is pumped through a rising main, seven miles long, to the Perry Oaks Works for final digestion and disposal.

Power Generation.

The Power and Compressor House at the southern end of the site is 330 feet long, 105 feet wide, and 45 feet high. It has been constructed of a size sufficient for the ultimate requirements of the works. The present installation of machinery includes eleven Diesel-oil engines of a gross total power of 6,750 B.H.P. Ten of these engines, of 650 B.H.P. each, are convertible to running on methane gas, developing 550 B.H.P. when using gas as fuel. An auxiliary oil engine of 250 B.H.P. has been provided for emergency purposes.

The largest requirement of power on the works is for the supply of compressed air to the aeration tanks. For this purpose six of the convertible engines are coupled to turbo-blowers each capable of compressing 12,500 cubic feet of free air per minute to a pressure of 7-lb. per square inch.

The remaining four convertible engines are direct coupled to electrical generators producing D.C. current at 460 volts, which is transmitted to various points on the works for supplying power to sewage and sludge pumping stations, workshops, tank machinery, lighting and other miscellaneous plant.

Sewage Pumping.

The Main Sewage Pumping Station, situated at the north end of the site, is 150 feet in length by 50 feet in width. Together with the workshops, stores and workmen's quarters, it forms an "L" shaped building, 265 feet long. The gross pumping capacity of the installation is 138,000 gallons per minute (approximately equivalent to 200 million gallons per day), requiring a total power of 3,960 B.H.P. The plant consists of twelve vertical-spindle centrifugal pumps, six of which are of 5,000 gallons per minute capacity, each driven by electric motors of 160 B.H.P. The remaining six are designed for stormwater duty with a capacity each of 18,000 gallons per minute and driven by Diesel-oil engines of 500 B.H.P.

Administration Building.

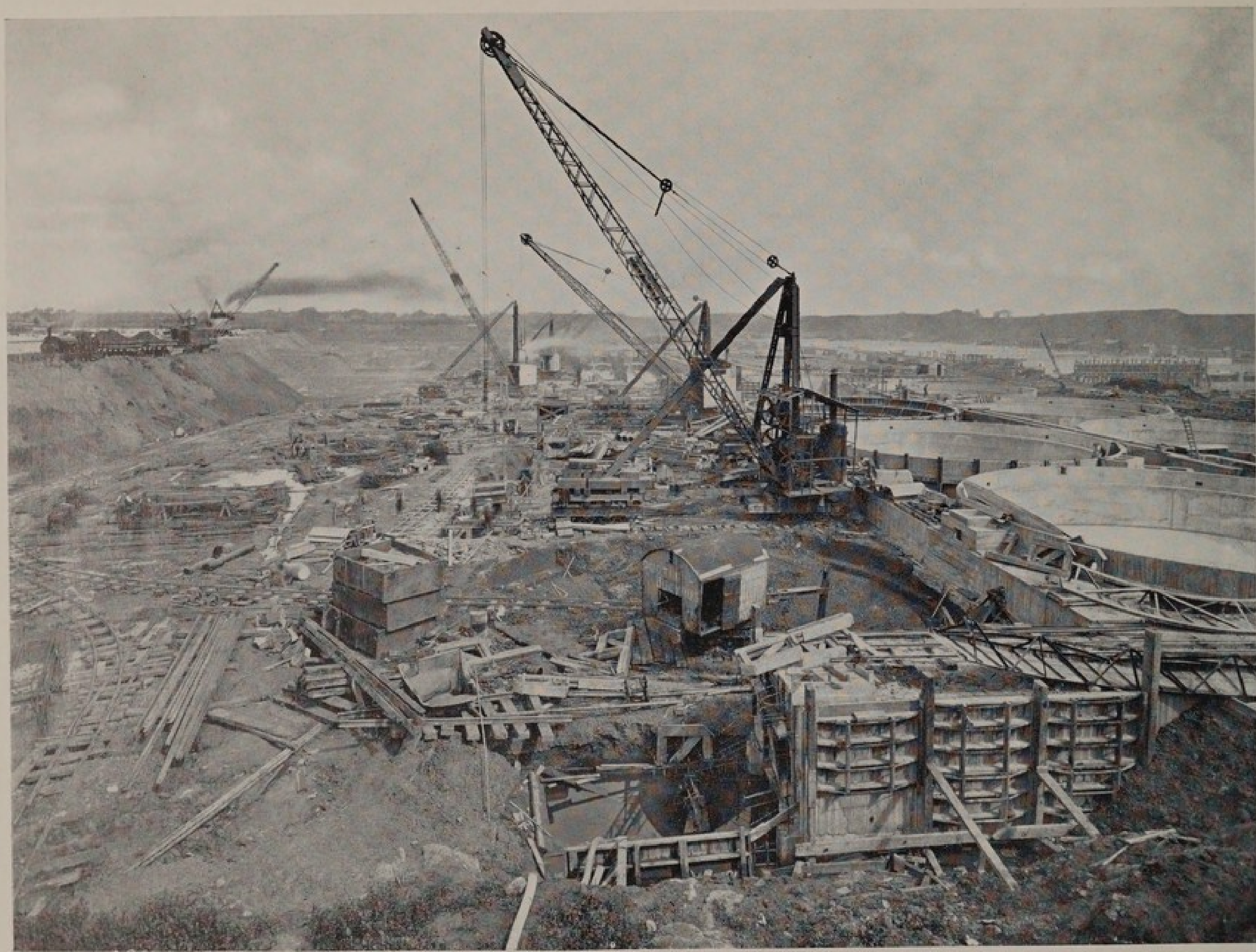
The administrative staff is housed in a two-story building, 140 feet by 40 feet, which includes accommodation for engineering, chemical, and clerical departments.

Construction Details.

The construction of the first instalment of the purification works has involved over 2,250,000 cubic yards of excavation and the placing of 225,000 cubic yards of concrete. The materials used have included some 350,000 tons of sand and gravel, 45,000 tons of Portland cement, 8,000 tons of steel, 4,000 tons of cast iron and 3,000,000 bricks. It has required the demolition of an old sewage works serving 90,000 people, the diversion of half a mile of a local river, and the construction of several miles of roads.

MAIN SERVICE BUILDING
incorporating
SEWAGE PUMPING STATION, WORKSHOPS, STORES, GARAGE, EMPLOYEES' QUARTERS, ETC.

MAIN SEWAGE PUMPING STATION.



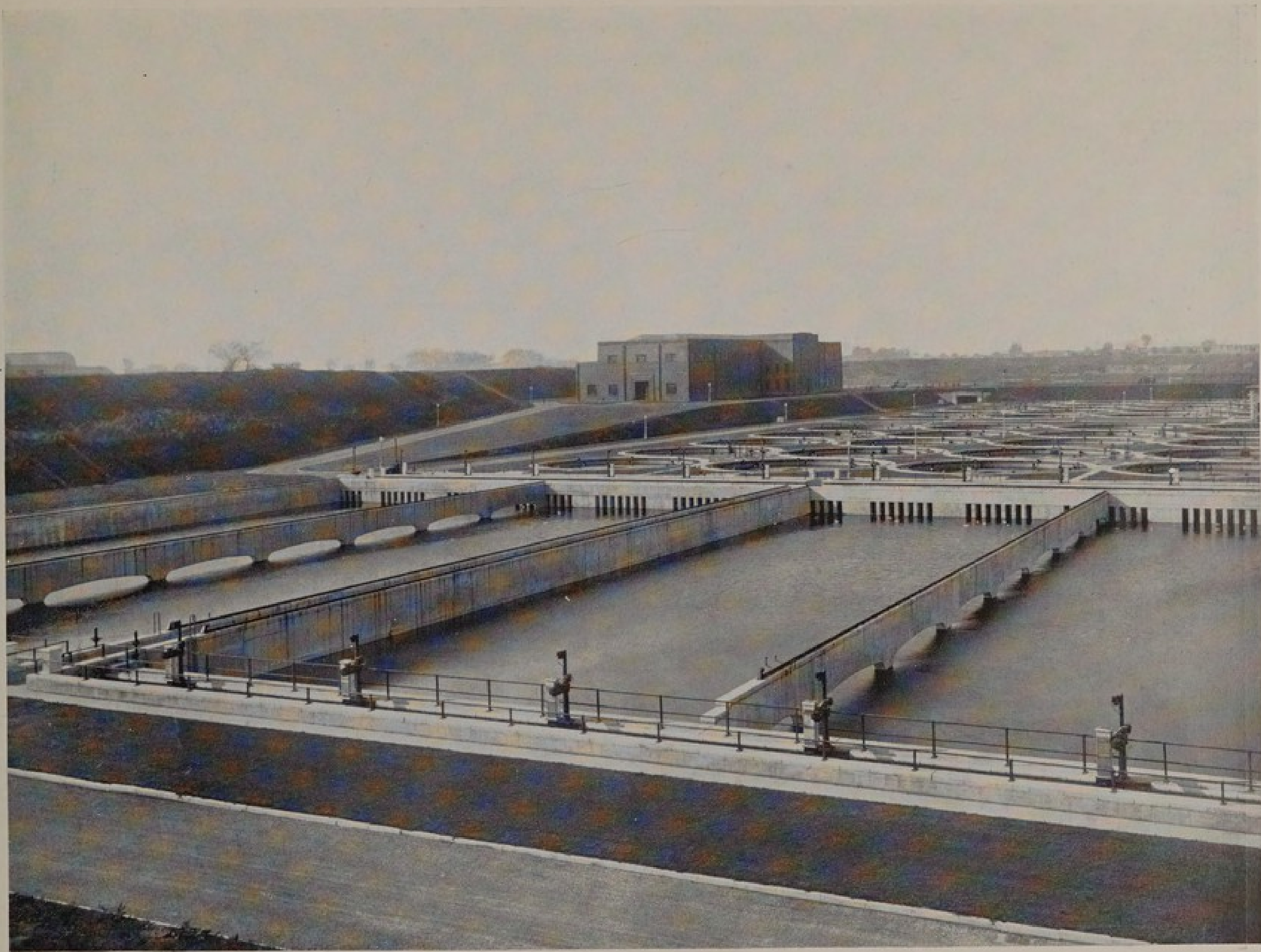
GENERAL VIEW OF CONSTRUCTION WORK FROM THE SOUTH.

The material found on the site consisted of a layer of sand and gravel of an average depth of about fifteen feet overlying a solid bed of blue clay. The sand and gravel have been recovered and disposed of as aggregate, the bulk of this excavation being carried out by gravel pumping from a flooded site. After subsequent de-watering of the area, the excavation of the clay proceeded under very dry conditions, foundations generally proving excellent.

The construction operations on the Mogden site have been divided up into five main contracts which were awarded as indicated in the Appendix. The work proceeded smoothly and with the utmost expedition, the administration being facilitated by the efficient organisation of the contractors. Peak outputs of approximately 1,000 cubic yards of concrete and 8,000 cubic yards of excavation per day were obtained.

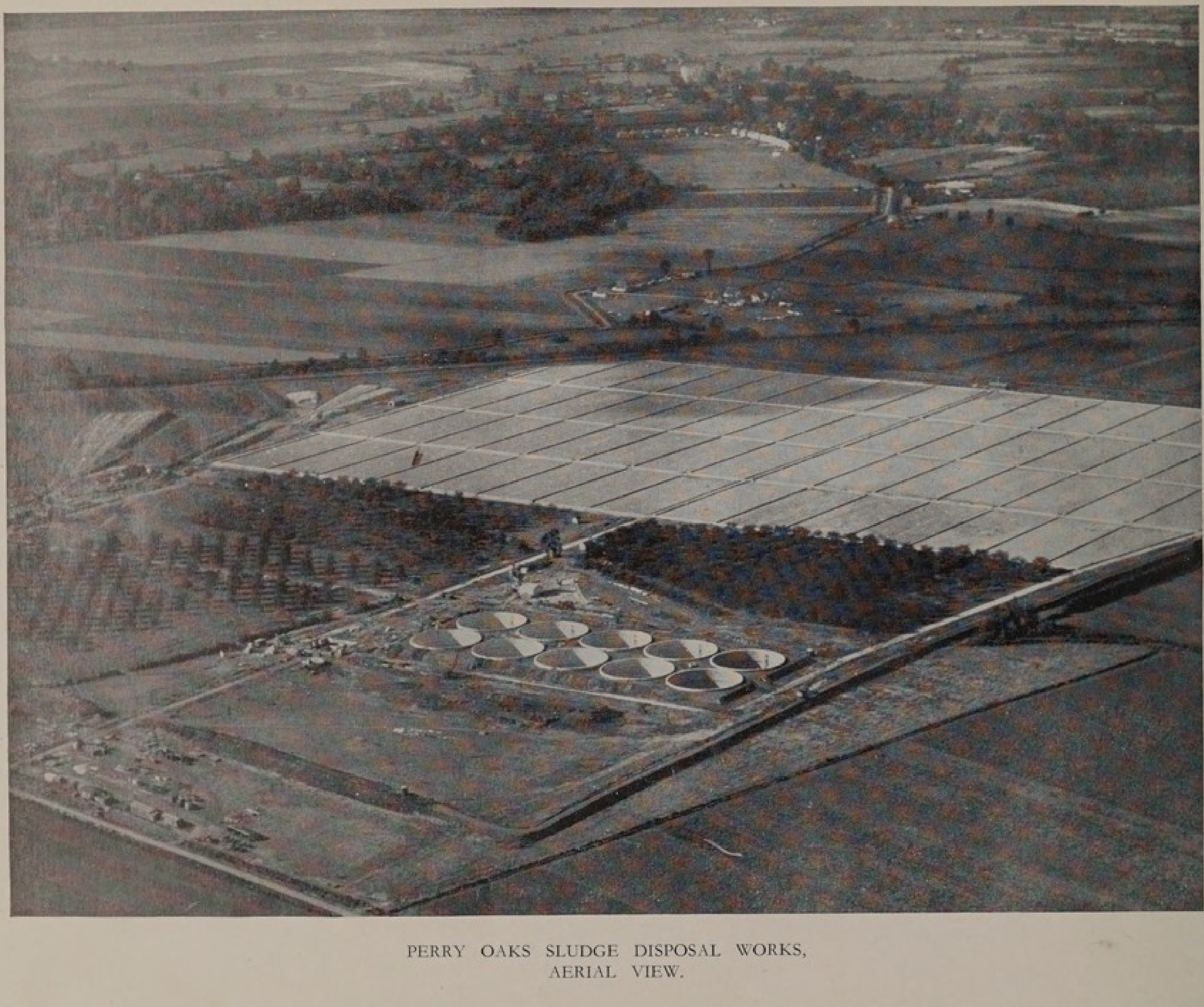
Housing. For the housing of a proportion of the employees, the great majority of whom have been transferred under the Parliamentary Act from the superseded works of the various local authorities, the County Council have recently purchased thirty-eight newly-erected houses fronting Mogden Lane. In addition, the Council have decided to erect six houses, in addition to three cottages already completed, on the Hall Road site for the accommodation of selected key men.

EXCAVATION OF SITE AS IT APPEARED IN JANUARY, 1933, AND—



TWICKENHAM RUGBY FOOTBALL GROUND →

THE COMPLETED WORKS AS VIEWED FROM THE SAME POINT IN DECEMBER, 1935.



PERRY OAKS SLUDGE DISPOSAL WORKS,
AERIAL VIEW.

PERRY OAKS SLUDGE DISPOSAL WORKS

The area of land purchased at Perry Oaks which has been reserved for the sludge disposal works is about 240 acres in extent. Adequate margins have been allowed for a belt of trees encircling the site and for the building of workmen's cottages, of which four are now under construction.

Pumping Mains. The sludge pumping main from the Mogden Works to Perry Oaks consists of 12-inch cast-iron pipes constructed in duplicate for the entire distance. The pipes are accommodated for a distance of about three and a half miles in main intercepting sewers by slinging them from the soffit of the arch; for the remaining three and a half miles they are laid in open trench.

Secondary Sludge Digestion. On arrival at Perry Oaks, the sludge is delivered into a battery of ten circular tanks for the final stage of digestion. These tanks are 100 feet in diameter, with a side water depth of 30 feet and a centre depth of 34 feet, their total capacity being about 15,000,000 gallons, which, in addition to digestion requirements, will give adequate storage for meeting the seasonal fluctuations in the drying of the final product.

Sludge Drying Area. From these tanks the sludge is pumped on to the drying beds, of which there have been constructed about fifty acres, divided into sixty-two plots of approximately 4,000 square yards each. These beds are formed of sand and gravel obtained from the site, the excavation of this material being carried out by pumping. The total thickness of this drying medium is eighteen inches, graded from coarse gravel of two-inch gauge at the bottom to a layer of sand at the top with two intermediate sizes of gravel between.

The plots are separated by dwarf walls of concrete, the general lay-out being prepared to facilitate the manual lifting of the dried sludge and removal to the tipping sites for which an adequate area of land has been reserved.

The whole area of drying beds has been provided with a comprehensive system of under-drainage which is connected to the main intercepting sewer in the Bath Road by a special branch pipe in order that any polluting matter carried off in the drainage water shall be returned to the Mogden Works for treatment with the main flow of sewage. In this connection, an interesting feature of the works is the construction of a wall of puddle clay, encircling the entire site, carried down from the ground surface to the underlying strata of London clay. This impervious wall will prevent any risk of contamination of the sub-soil water in the surrounding gravel and thus form a measure of protection to water supply authorities using this part of the Thames Valley as a catchment area.

Contracts. The construction of the Perry Oak Works was expeditiously carried out under two contracts, awarded as indicated in the Appendix.

The work involved the excavation of 170,000 cubic yards of material and the placing of 22,000 cubic yards of concrete. The materials used included 4,500 tons of cement, 1,300 tons of steel, 650 tons of cast-iron and 40 miles of pipes for underdrainage. The medium used in the construction of the drying beds included 125,000 cubic yards of sand and gravel.

CONTRACTS.

Contract No.		*Subject.*	*Contractor.*
		MAIN SEWERAGE.	
S	1	Boreholes	C. Isler & Co., Ltd.
S	2	Bath Road Main Sewer	Sir Robert McAlpine & Sons (London), Ltd.
S	3	Crane Valley Main Sewer	Ditto.
S	4	Harrow & Pinner Branch Sewers	Tarmac, Ltd.
S	5	Wembley Branch Sewer	A. Waddington & Son.
S	6	Wealdstone & Stanmore Branch Sewers	Wm. Moss & Sons, Ltd.
S	7	Brent Valley Main Sewer—Upper Section	Sir Robert McAlpine & Sons (London), Ltd.
S	8	Hendon Branch Sewer	A. Waddington & Son.
S	9	Bath Road Main Sewer—Upper Section	Sir Robert McAlpine & Sons (London), Ltd.
S	10	Colne Valley Main & Cowley Branch Sewers	Howard Farrow, Ltd.
S	11	Connecting Sewers—Hendon Branch	W. & C. French, Ltd.
S	12	Uxbridge & Ruislip Branch Sewers	Ditto.
S	13	Northolt, Greenford & North Ealing Branch Sewers ...	Bentley & Wardman.
S	14	Chiswick Low Level Sewer—Upper Section	Cleveland Bridge & Engineering Co., Ltd.
S	15	Brent Valley Main Sewer—Central Section	Paterson & Dickinson, Ltd.
S	16	Western Low Level Sewer—Lower Section	Sir Robert McAlpine & Sons (London), Ltd.
S	17	Effluent Conduits—River Section	Cleveland Bridge & Engineering Co., Ltd.
S	18	Ruislip Branch Sewer—Lower Section	Sir Robert McAlpine & Sons (London), Ltd.
S	19	Chiswick Low Level Sewer—Central Section	Ditto.
S	20	Teddington Branch Sewer	Cleveland Bridge & Engineering Co., Ltd.
S	21	Brent Valley Main Sewer—Lower Section	Sir Robert McAlpine & Sons (London), Ltd.
S	22	Effluent Conduits—Land Section	Ditto.
S	23	Chiswick Low Level Sewer—Lower Section	Ditto.
S	24	Sunbury & Feltham Branch Sewers	Wm. Moss & Sons, Ltd.
S	25	Hanwell & South Ealing Branch Sewers	W. & C. French, Ltd.
S	26	Brent Valley Main Sewer—Lower Section	Sir Robert McAlpine & Sons (London), Ltd.
S	27	Isleworth Branch Sewers	Howard Farrow, Ltd.
S	28	Sludge Main & Perry Oaks Branch Sewer	W. & C. French, Ltd.
S	29	Western Low Level Sewer—Upper Section	Thos. Bugbird & Son, Ltd.
		MOGDEN PURIFICATION WORKS.	
M	1	Excavation	Ham River Grit Co., Ltd.
M	2	Stormwater Tanks, etc.	W. & C. French, Ltd.
M	3	Secondary Sedimentation, Aeration and Final Separating Tanks, etc.	Sir Robert McAlpine & Sons (London), Ltd.
M	4	Grit Chambers, Primary Sedimentation Tanks, Pumping Station, Workshops, Administration Building, etc. ...	Ditto.
M	5	Sludge Digestion Tanks, Power & Compressor House, etc.	Ditto.
		PERRY OAKS SLUDGE DISPOSAL WORKS.	
P	1	Puddle Wall	Howard Farrow, Ltd.
P	2	Sludge Digestion Tanks, Drying Beds, etc.	Edmund Nuttall, Sons & Co., & John Mowlem & Co. (Joint), Ltd.

SUPPLIERS OF PRINCIPAL EQUIPMENT.

MAIN SEWERAGE.

Flow Recorders	George Kent, Ltd.
Level Recorders	The Lea Recorder Co., Ltd.
Boring for Vent Shafts and Manholes	LeGrand Sutcliffe & Gell, Ltd.

MOGDEN PURIFICATION WORKS.

Main Sewage Pumping Station :	
Pumps and General Equipment	Worthington Simpson, Ltd.
Diesel-Oil Engines	Harland & Wolff, Ltd.
Metering Installation	Electroflo Meters Co., Ltd.
Screen House and Grit Chambers :	
Bar Rack Equipment	S. S. Stott & Co.
Screening Equipment	Hartley (Stoke-on-Trent), Ltd.
Macerators	Hathorn Davey & Co., Ltd.
Grit Dredging and Pumping Installation	Gwynnes Pumps, Ltd.
Metering Installation	Electroflo Meters Co., Ltd.
Primary Sedimentation Tanks :	
Sludge Removal Mechanisms	Wm. E. Farrer, Ltd.
Secondary Sedimentation Tanks :	
Sludge Removal Mechanisms	Ditto.
Aeration Tanks :	
Air Diffuser Equipment	Activated Sludge, Ltd.
Metering Installation	George Kent, Ltd.
Return Sludge Pumps	Worthington Simpson, Ltd.
Final Separating Tanks :	
Sludge Removal Mechanisms	Hartley's (Stoke-on-Trent), Ltd.
Stormwater Tanks :	
Sludge Removal Mechanisms	Wm. E. Farrer, Ltd.

SUPPLIERS OF PRINCIPAL EQUIPMENT—*Continued.*

Mogden Purification Works.

Sludge Digestion Tanks:	
Stirring Mechanisms	Dorr-Oliver Co., Ltd.
Gasholders	Horsley Bridge & Thomas Piggott, Ltd.
Main Sludge Pumps	M. B. Wild & Co., Ltd.
Auxiliary Sludge Pumps	Gwynnes Pumps, Ltd.
Sludge Thickening Tanks:	
Stirring Mechanisms	Dorr-Oliver Co., Ltd.
Raw Sludge Pumps	Gwynnes Pumps, Ltd.
Power and Compressor House:	
Diesel-Oil Engines and General Equipment	Harland & Wolff, Ltd.
Turbo Blowers	Fraser & Chalmers Engineering Works, Ltd.
Electric Generators	Lancashire Dynamo & Crypto, Ltd.
Miscellaneous:	
Penstocks and Valves	Glenfield & Kennedy, Ltd.
Ditto	Blakeborough & Sons, Ltd.
Ditto	Alley & MacLellan, Ltd.
Ditto	Ham Baker & Co., Ltd.
Electrical Installation and Equipment	W. T. Henleys Telegraph Works Co., Ltd.
Ditto	Electrical Installations, Ltd.
Ditto	J. B. Marr & Co., Ltd.
Ditto	City Electrical Co., Ltd.

Perry Oaks Sludge Disposal Works.

Sludge Pumps	M. B. Wild & Co., Ltd.

KING AND HUTCHINGS, LTD.
PRINTERS :: UXBRIDGE