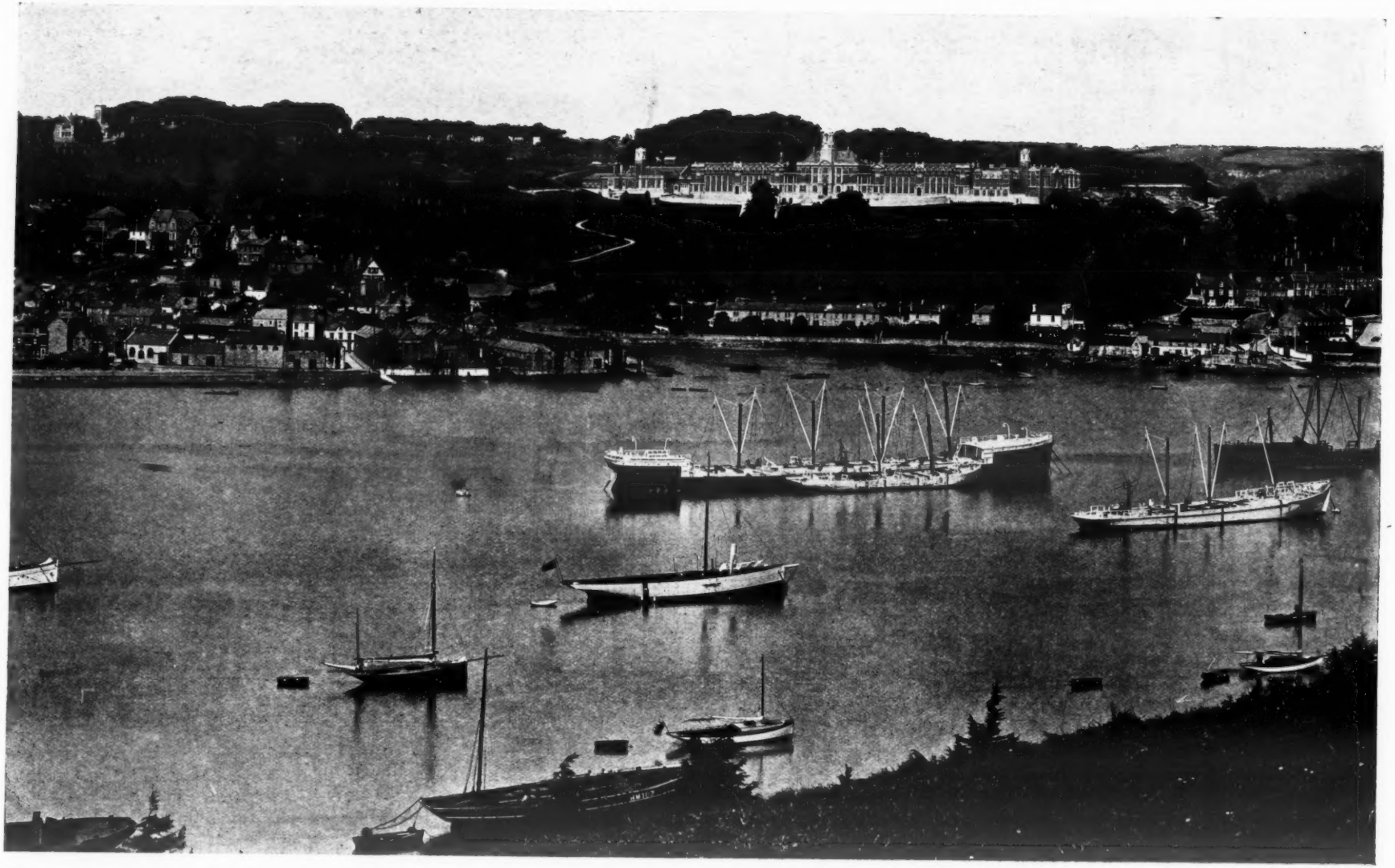
THE ARCHITECTURAL REVIEW, NOVEMBER, 1905, VOLUME XVIII. NO. 108.



THE BRITANNIA ROYAL NAVAL COLLEGE, DARTMOUTH.
GENERAL VIEW OF THE SITE AND COLLEGE FROM KINGSWEAR.
SIR ASTON WEBB, R.A., ARCHITECT.

Photo: E. Dockree.

The Britannia Royal Naval College, Dartmouth.

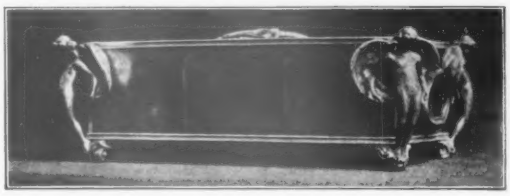
THE Britannia Royal Naval College at Dartmouth has been built to take the place of the old training ship for naval cadets, the *Britannia*, at Dartmouth. The site, a very beautiful one, is immediately above the spot where the *Britannia* is moored, and is 180 ft. above sea level, with beautiful views down the Dart to the mouth of the river. The site slopes rapidly to the south, and is approached by two quadrant roads leading to a terrace 30 ft. wide, running the whole length of the building, and enclosing a sunk garden of formal design. The college was originally designed to accommodate 260 cadets, but is now being enlarged to accommodate 390, being divided into six terms of 65 cadets each.

The main building consists of five blocks connected on the ground and first floors, the general disposition being shown on the plan. The centre block contains the school hall with class rooms, lecture theatre, and lavatories round three sides on two floors, the central entrance and administrative offices occupying the fourth side towards the front.

On either side of this central block are two blocks containing four day-rooms on the ground floor, with eight dormitories for the four terms on two floors over, with annexes on the north side containing changing rooms, bath-rooms, lavatories and latrines on each floor. The extreme block on the west side contains the cadets' dining-hall, kitchens and offices; also the officers' ward-room and mess, with its kitchens and offices, rooms for the ships' company, kitchens, etc., and dormitories for cadets, domestics, etc. The extreme block on the east side consists of the Captain's house and the chapel. To the north of this is a block now being added, consisting of four dormitories and two day-rooms, with sanitary annexe, for two additional terms, and a little to the east of this the head-master's house.

TROWEL USED BY H.M. THE KING TO LAY THE FOUNDATION STONE OF THE BRITANNIA ROYAL NAVAL COLLEGE. EXECUTED BY THE BROMSGROVE GUILD.

In addition to the college there are the sick quarters with sixty-four beds for forty infectious and twenty-four non-infectious cases, the position of which is shown on the general plan. They are provided in three isolated blocks of two floors each, with an administrative and day-room block at one end and nurses' quarters at the other, and also a doctor's house, operating-rooms, dispensary, etc.



CASKET FOR TROWEL USED BY H.M. THE KING TO LAY THE FOUNDATION STONE.

The general design of the buildings is shown in the accompanying photographs. They are constructed externally of Portland stone dressings and Messrs. Lawrence's Bracknell bricks for the facings, the roofs being covered with Cornish Delabole slates. The terrace walls are built of Torquay limestone with Cornish granite parapets.

Internally Bath stone is largely used, and Bracknell bricks again in the chapel. The corridors are lined with glazed bricks. The roofs of the chapel and school hall are sequoia, as also are the chapel fittings. The panelling of the dining hall is oak. The floors are iron and concrete throughout covered with teak and pitch-pine blocks. The staircases are concrete covered with wood, and all dormitories have two exits.

The chapel has the walls lined with marble for a height of 12 ft., composed of Brescia slabs opened out. This, the reredos, and the ambones in Devonshire marble, together with the stained-glass windows by Mr. Kempe, are the gifts of past cadets. The floor of the chancel is also laid with marble.

The college is supplied with fresh water from a spring at the landing stage. The water is raised by pumps to a reservoir 100 ft. above the college, from which it gravitates to a cistern in the central tower, and is from thence distributed over the buildings.

Salt water is pumped up from the river to a reservoir which forms an open swimming bath above the college, and from thence supplies the large plunge baths and the hydrants.

The heating is by steam converted to hot water in parts of the building, the boilers being placed in the power station at Sandquay Quarry, as shown on site plan, where the pumps are also situated, thus avoiding the cartage of coal up the hill and removal of ashes.

Colonel E. Raban, C.B., has been Director of Works at the Admiralty; the buildings have been designed and superintended by Sir Aston Webb, R.A., Mr. S. E. Wallis and Mr. C. H. Hill being the clerks of works, while the contractors for the whole of the works were Messrs. Higgs & Hill, of Crown Works, South Lambeth Road, S.W.

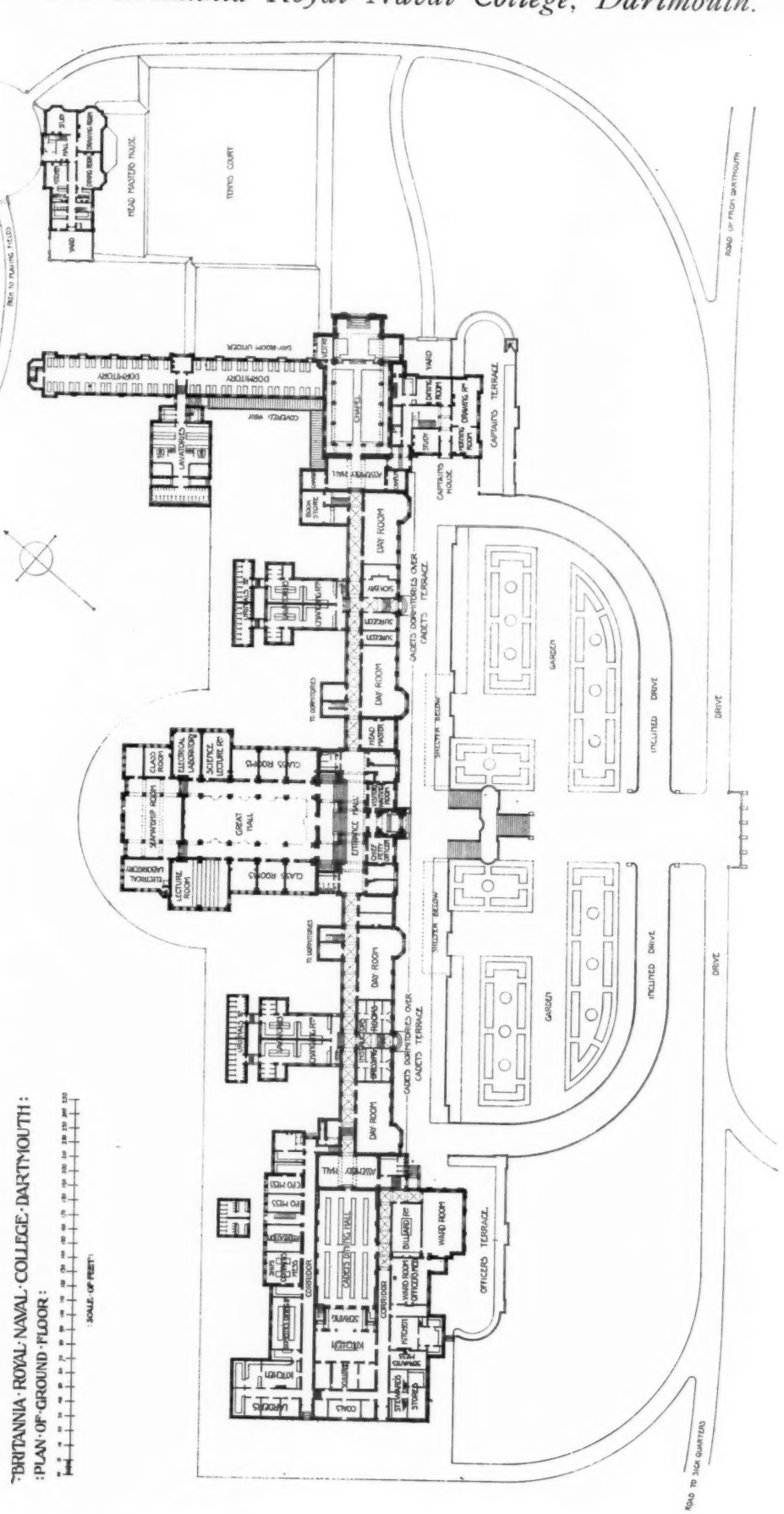
The following are some of the principal sub-contractors:—

Robert Adams, London, W.C., Casement Fasteners, etc.
R. Anderson & Co., London, E.C., Lightning Conductors.
Bath Stone Firms, Bath, Monk's Park Stone for Interior Work.
E. and C. Braby, London, S.E., Cornish Delabole Slating.
Bromsgrove Guild, Bromsgrove, Decorative Plaster-work, Electroliers, Door Knocker, etc.
Burke & Co., London, W., Mosaic Paving.
Clement, Jeakes & Co., London, W.C., Steam Heating.
John Daymond & Son, London, S.E., Reredos in Chapel.
Dent & Hellyer, London, W.C., Plumbing and Sanitary Fittings.
Farnley Iron Co., Limited, Leeds, Glazed Bricks.
Gillet & Johnston, Croydon, Clock and Bells.
Hobbs, Hart & Co., London, N., Locks.
H. T. Jenkins & Son, Torquay, Marble-work in Chapel.

Photo: E. Dockree.

DETAIL OF THE CENTRE OR SCHOOL BLOCK.

George Johnson, London, S.W., Lifts.
Thomas Lawrence & Sons, Bracknell, Facing Bricks.
Walter Macfarlane & Co., Glasgow, Rain-water Heads.
New Expanded Metal Co., London, S.W., Expanded Metal for Ceilings, Floors, etc.
Pilkington & Co., London, E.C., Asphalt Dampcourses, Waterproof Linings, etc.
Potter & Co., Limited, London, S.W., Clips for Fastening Expanded Metal.
Ripolin, Limited, London, W.C., Ripolin Paints.
St. Pancras Ironwork Co., Limited, London, N.W., Iron Staircase.
James Shoolbred & Co., London, W.C., General Furnishing.
Smith & Turner, London, E.C., Door Springs.
Strode & Co., London, N.W., Electric Lighting, Electric Bells, and Telephones.
J. Warner & Sons, London, E.C., Bells.
George Wragge, Limited, Salford, Metal Casements.


BRITANNIA · ROYAL · NAVAL · COLLEGE · DARTMOUTH :
PLAN · OF · GROUND · FLOOR :
SCALE · OF · FEET
TENNIS COURT
HEAD MASTERS HOUSE
ROAD TO PLAYING FIELD
ROAD UP FROM DARTMOUTH
DORMITORY
COVERED WAY
CHAPEL
CAPTAINS HOUSE
CAPTAINS TERRACE
DAY ROOM
CADETS DORMITORIES OVER
CADETS TERRACE
GARDEN
INCLINED DRIVE
DRIVE
SHELTER BELOW
TO DORMITORIES
CLASS ROOMS
GREAT HALL
ENTRANCE HALL
CHIEF PETTY OFFICER
HEAD MASTER
ELECTRICAL LABORATORY
SCIENCE LECTURE RM
SEAMANSHIP ROOM
CLASS ROOM
ADJUTANT
ADJUTANT'S OFFICE
CADETS DINING HALL
MESS
KITCHEN
WARD ROOM
WARD ROOM OFFICERS
BILLIARD RM
OFFICERS TERRACE
ROAD TO SICK QUARTERS

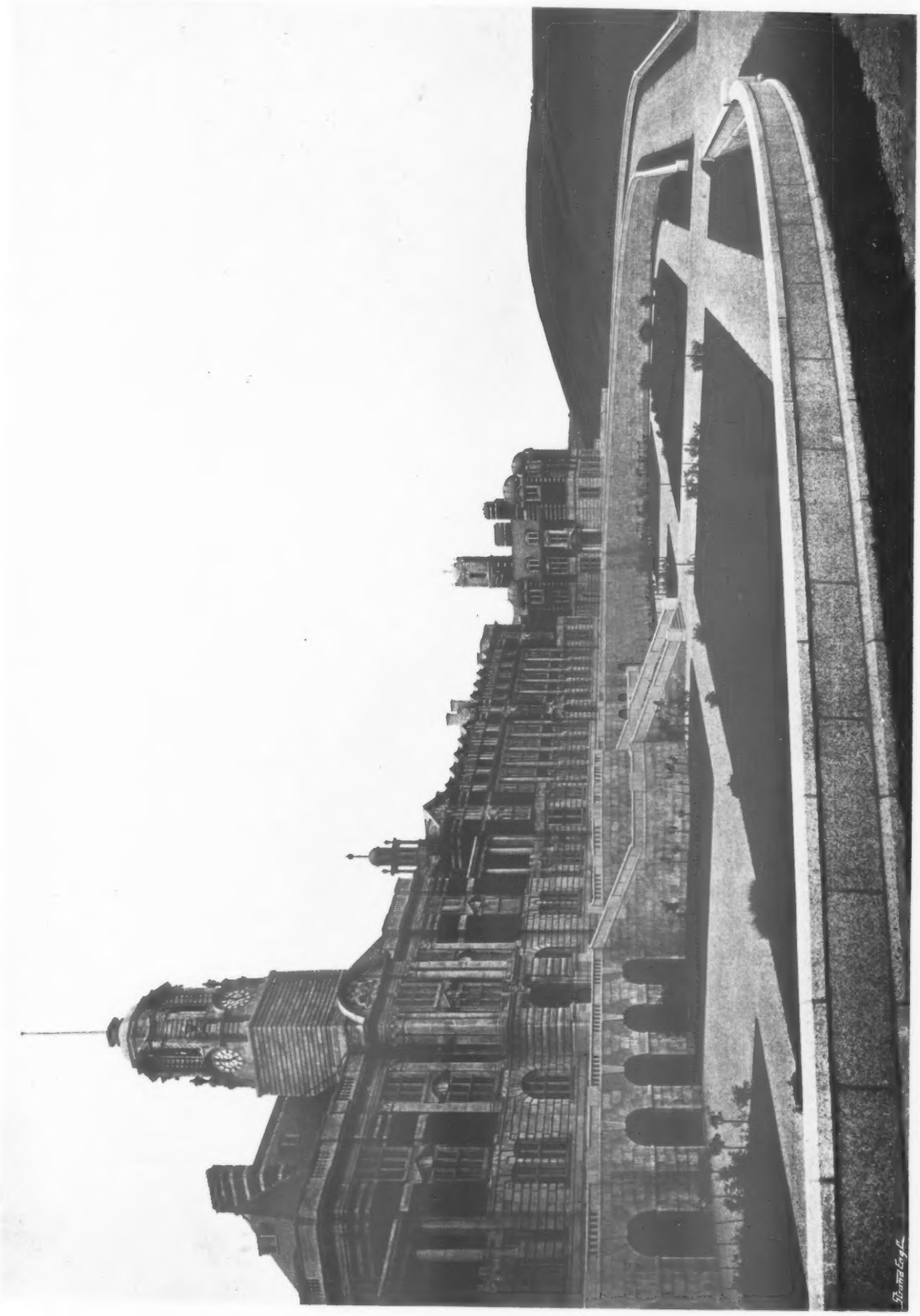


Photo: E. Dockree.

GENERAL VIEW, SHOWING TERRACE AND SUNK GARDEN.

Photo : E. Dockree.

THE CENTRE OR SCHOOL BLOCK.

Photo : E. Dockree.

THE SCHOOL HALL. FROM THE GALLERY.

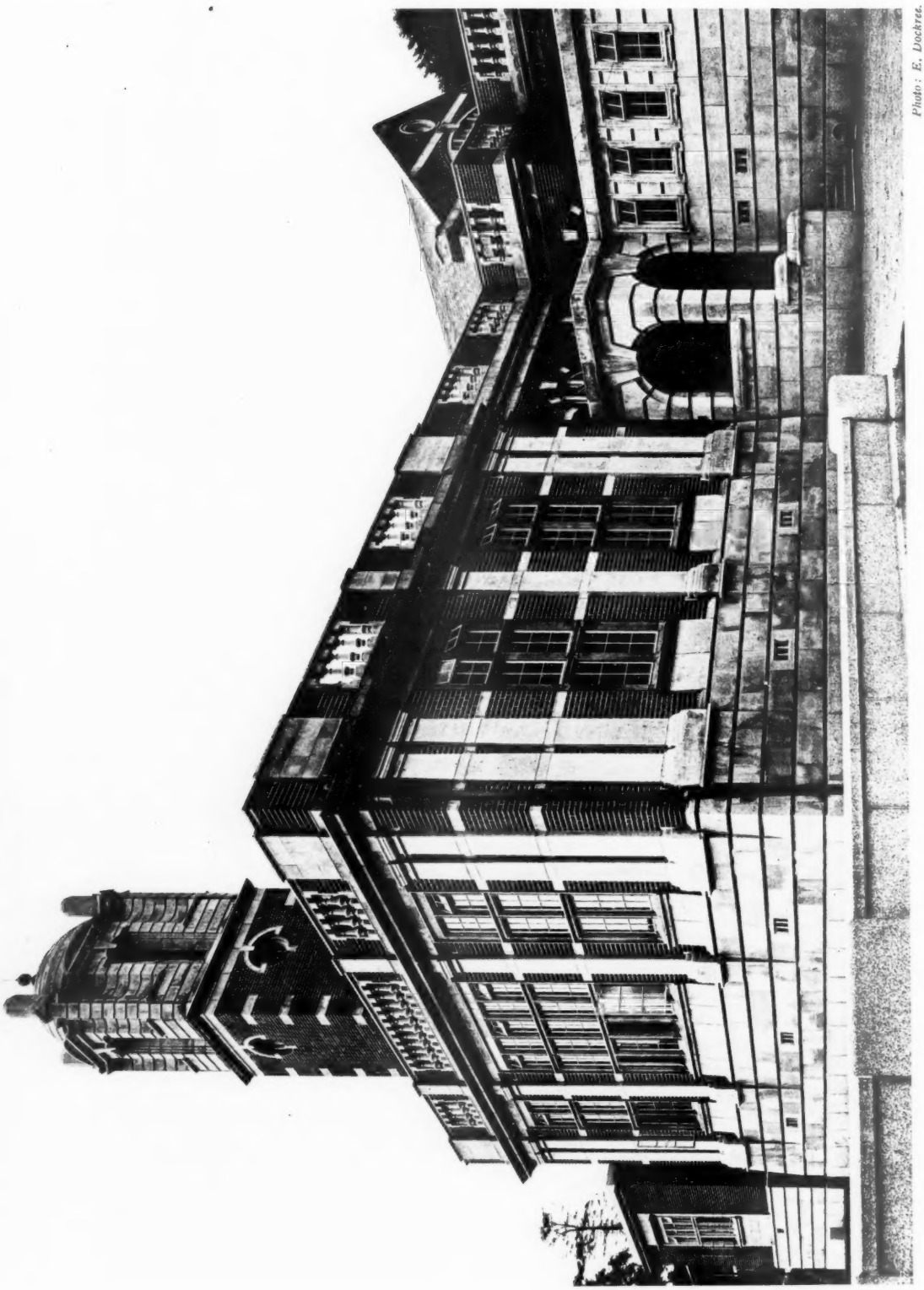


Photo: E. Dockree.

THE WARD ROOM AND OFFICERS' ENTRANCE.

Photo: E. Dockrell.

A DORMITORY AND DAY ROOM BLOCK.

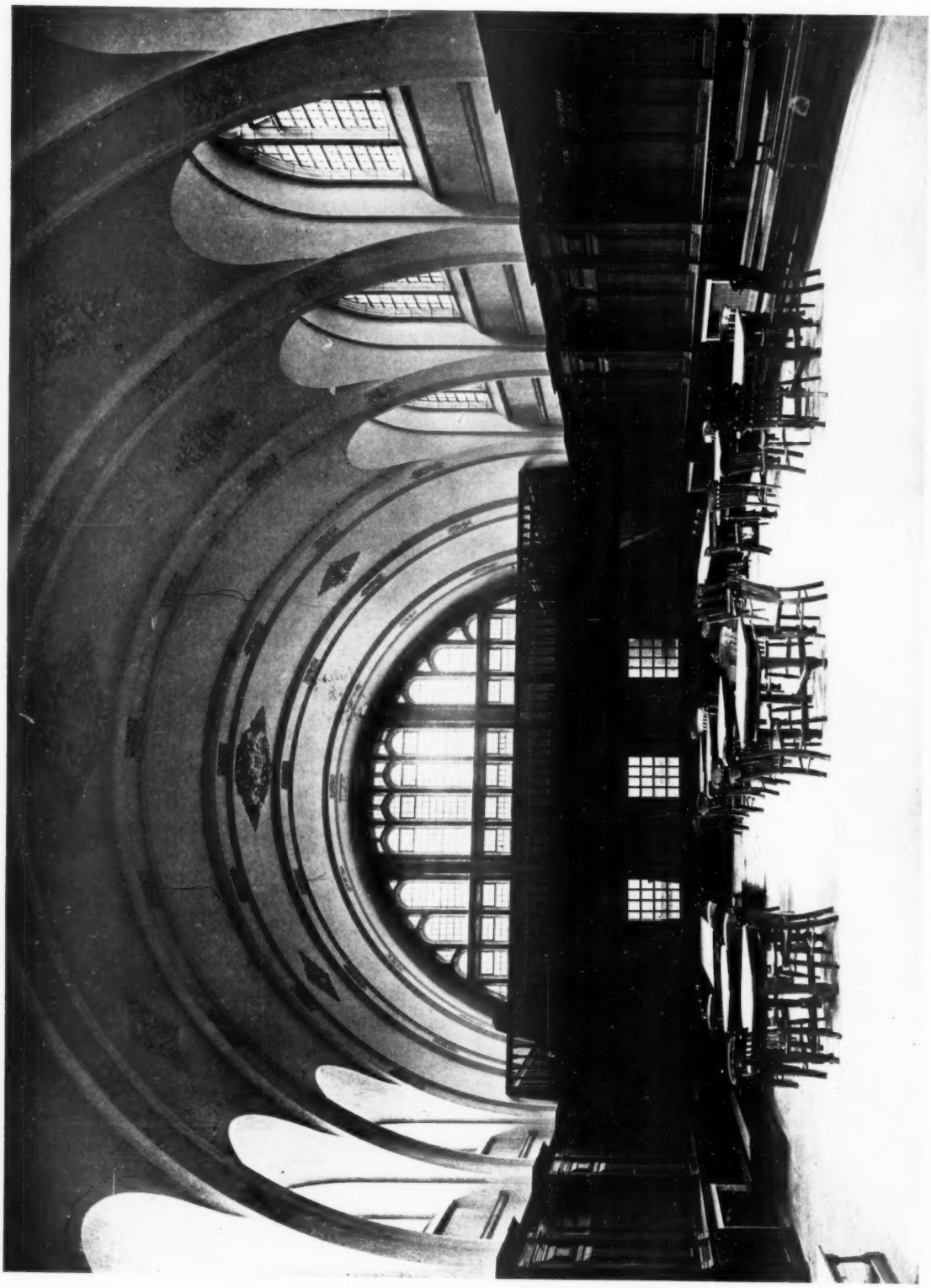


Photo: E. Dockree.

THE DINING HALL.

Note.—The chairs and tables are not those that will eventually be used

Photo: E. Dockree.

THE CAPTAIN'S HOUSE.

Photo: E. Dockree.

THE MAIN CORRIDOR.

Photo: E. Dockree.

THE PRINCIPAL STAIRCASE.

Photo: E. Dochree.

ENTRANCE TO THE CAPTAIN'S HOUSE.

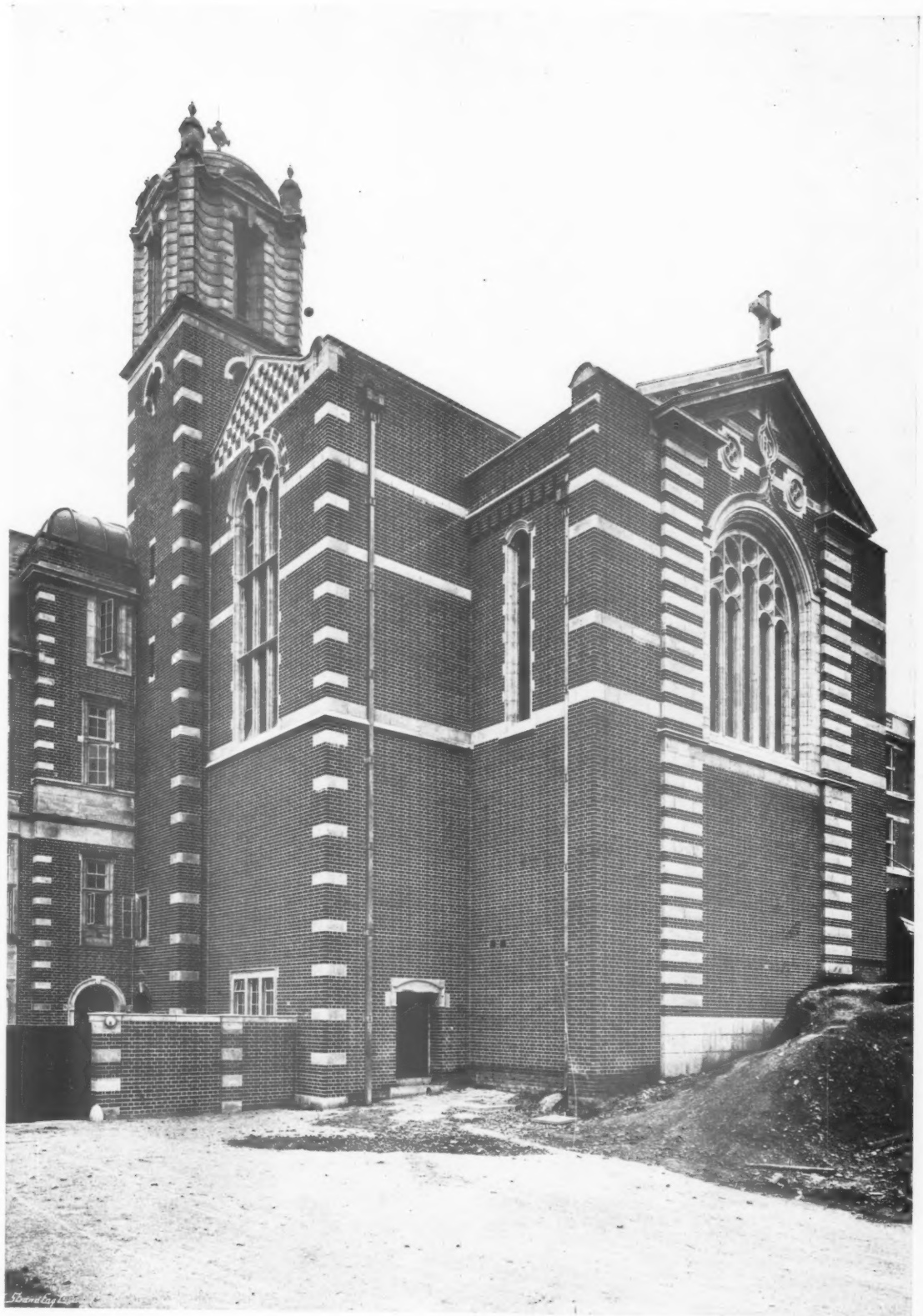


Photo : E Dockree.

EAST END OF THE CHAPEL.

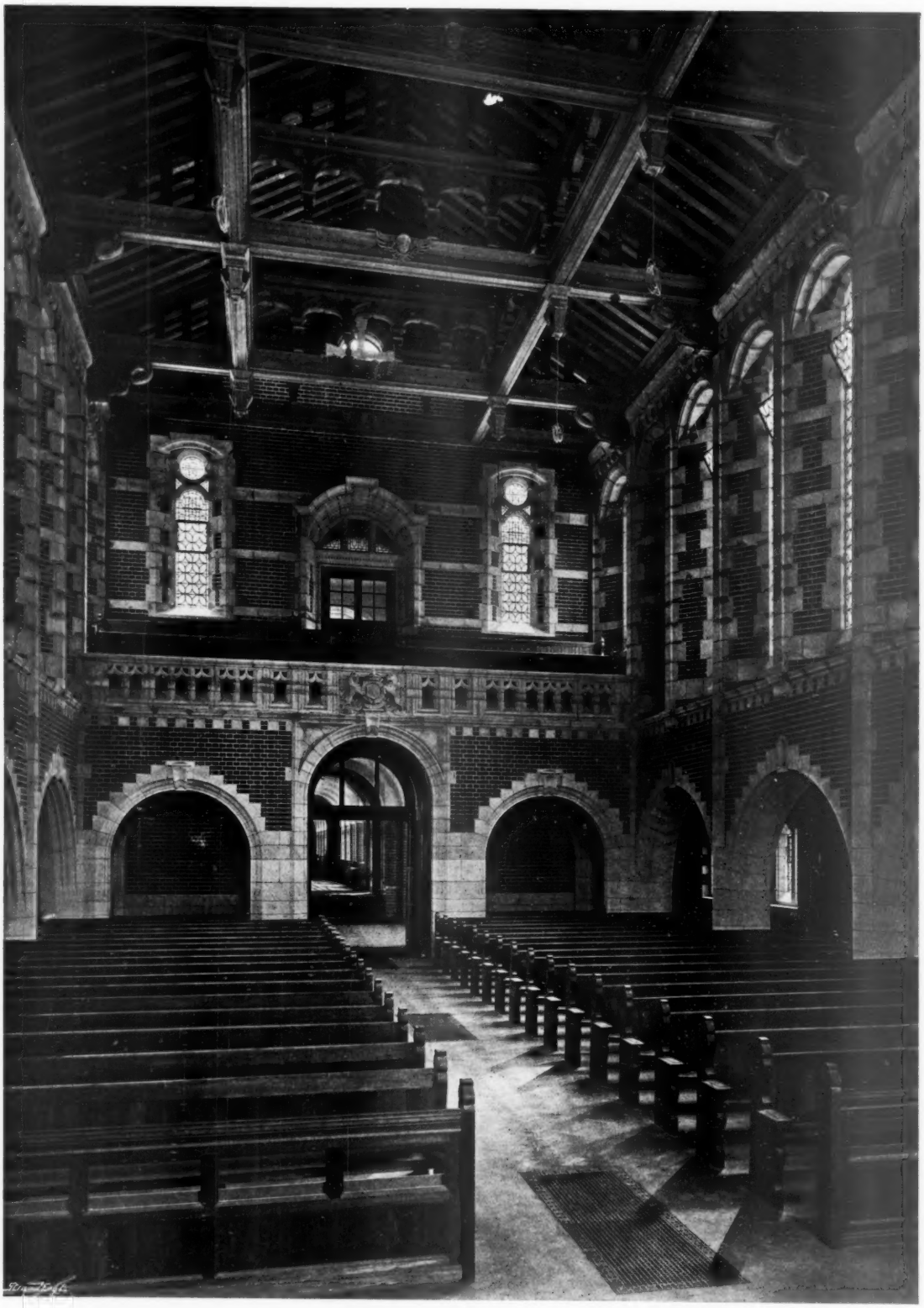


Photo: E. Dockree.

INTERIOR OF THE CHAPEL, LOOKING WEST.

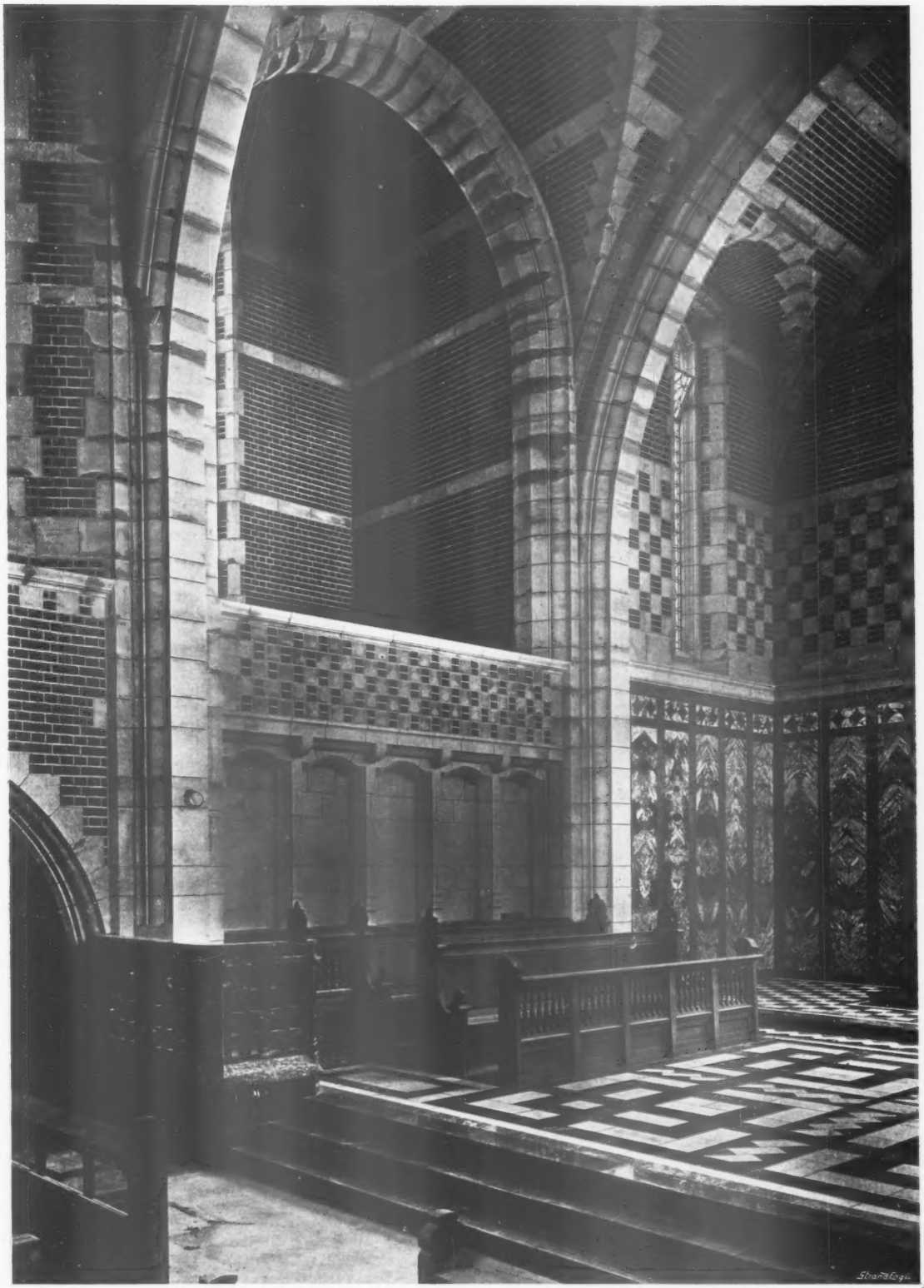


Photo: E. Dockree.

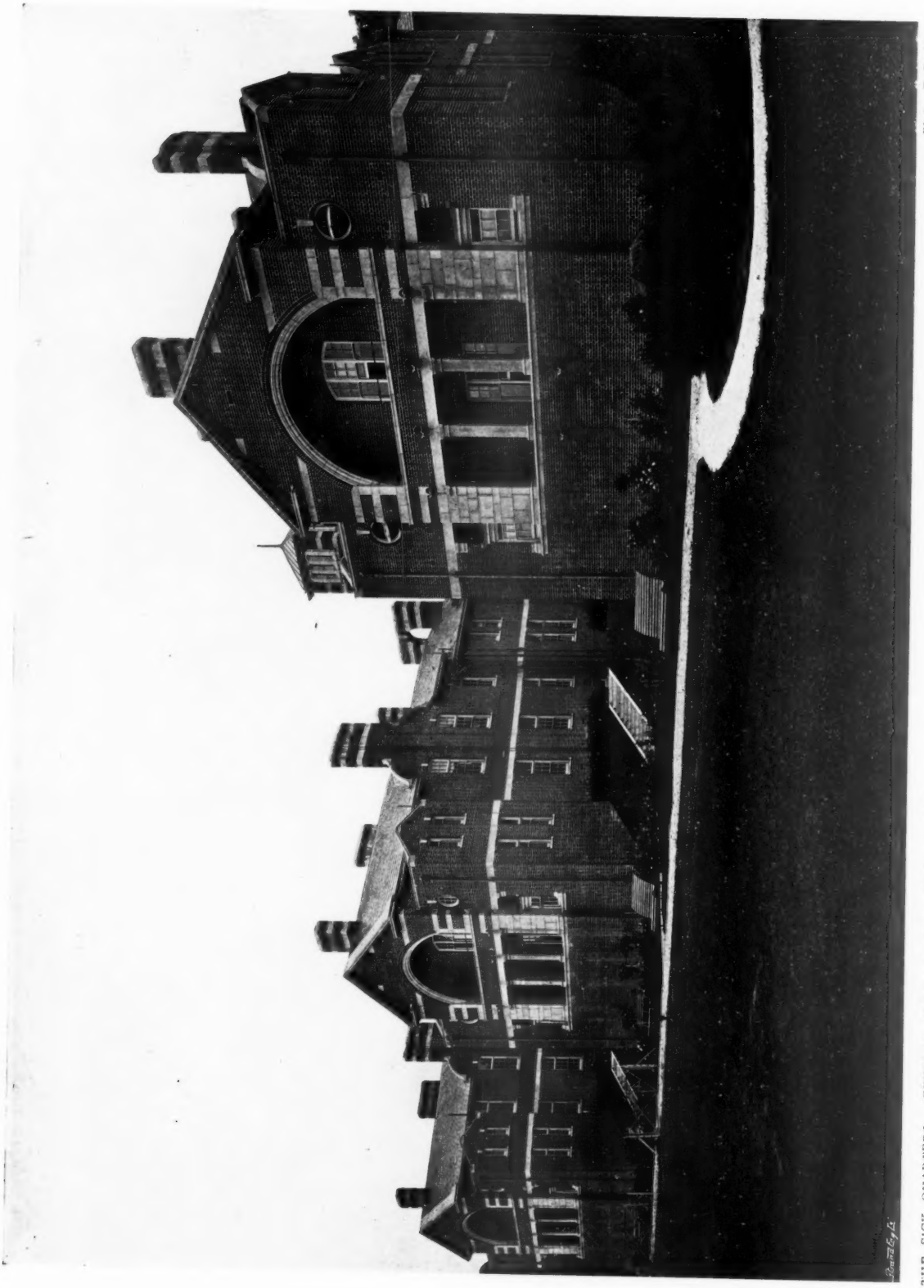
THE CHAPEL: ORGAN CHAMBER IN CHANCEL, LOOKING NORTH-EAST.

Photo: E. Dockree.

DETAIL: A CADETS' ENTRANCE.

Photo: E. Dockree.

THE SICK QUARTERS, SHOWING BALCONIES AT END OF WARDS AND SANITARY ANNEXES.



THE SICK QUARTERS. GENERAL VIEW OF THE THREE BLOCKS. *Photo: E. Dockree.*

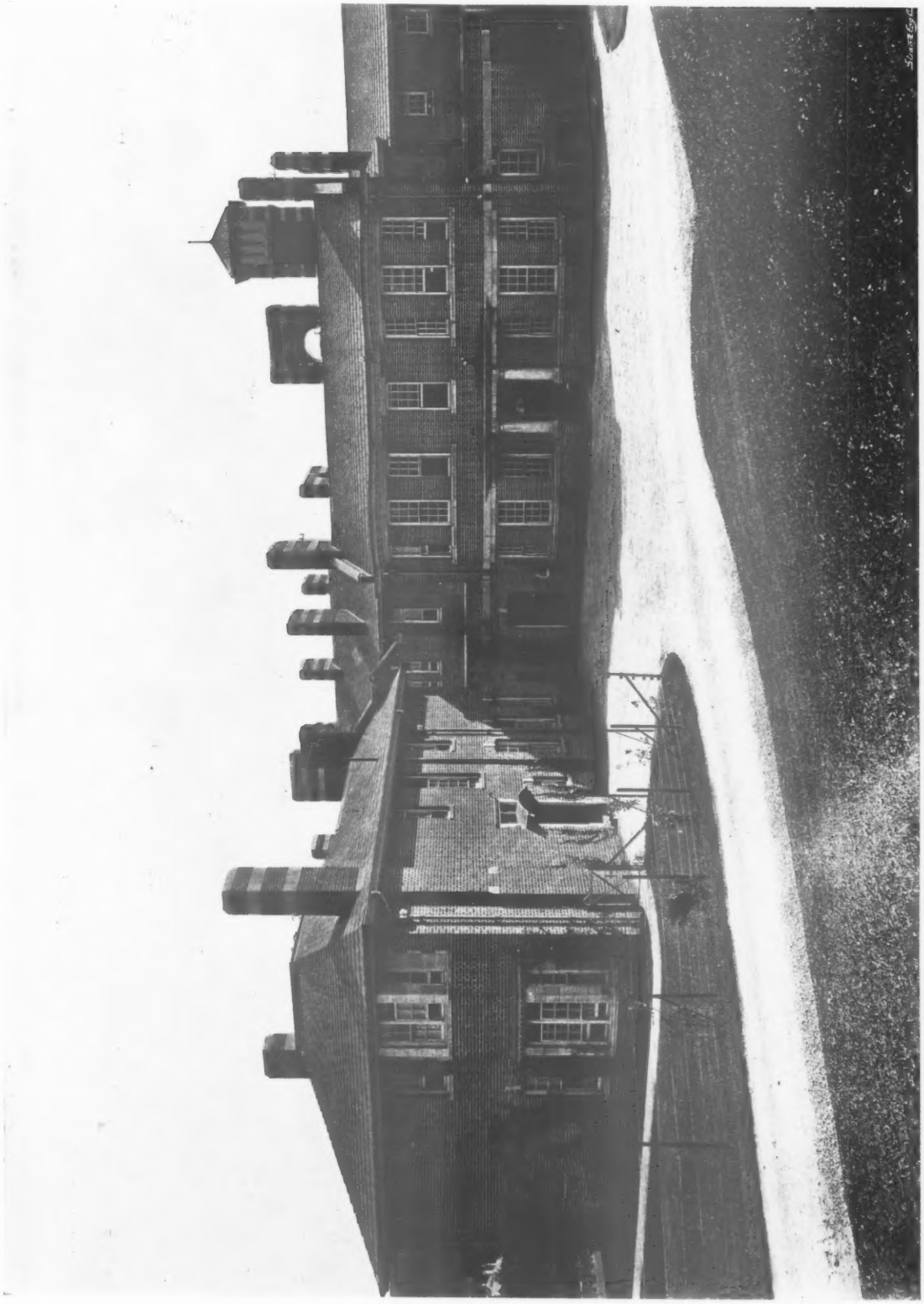


Photo: E. Dockree.

ENTRANCE TO THE SICK QUARTERS AND DOCTOR'S HOUSE.

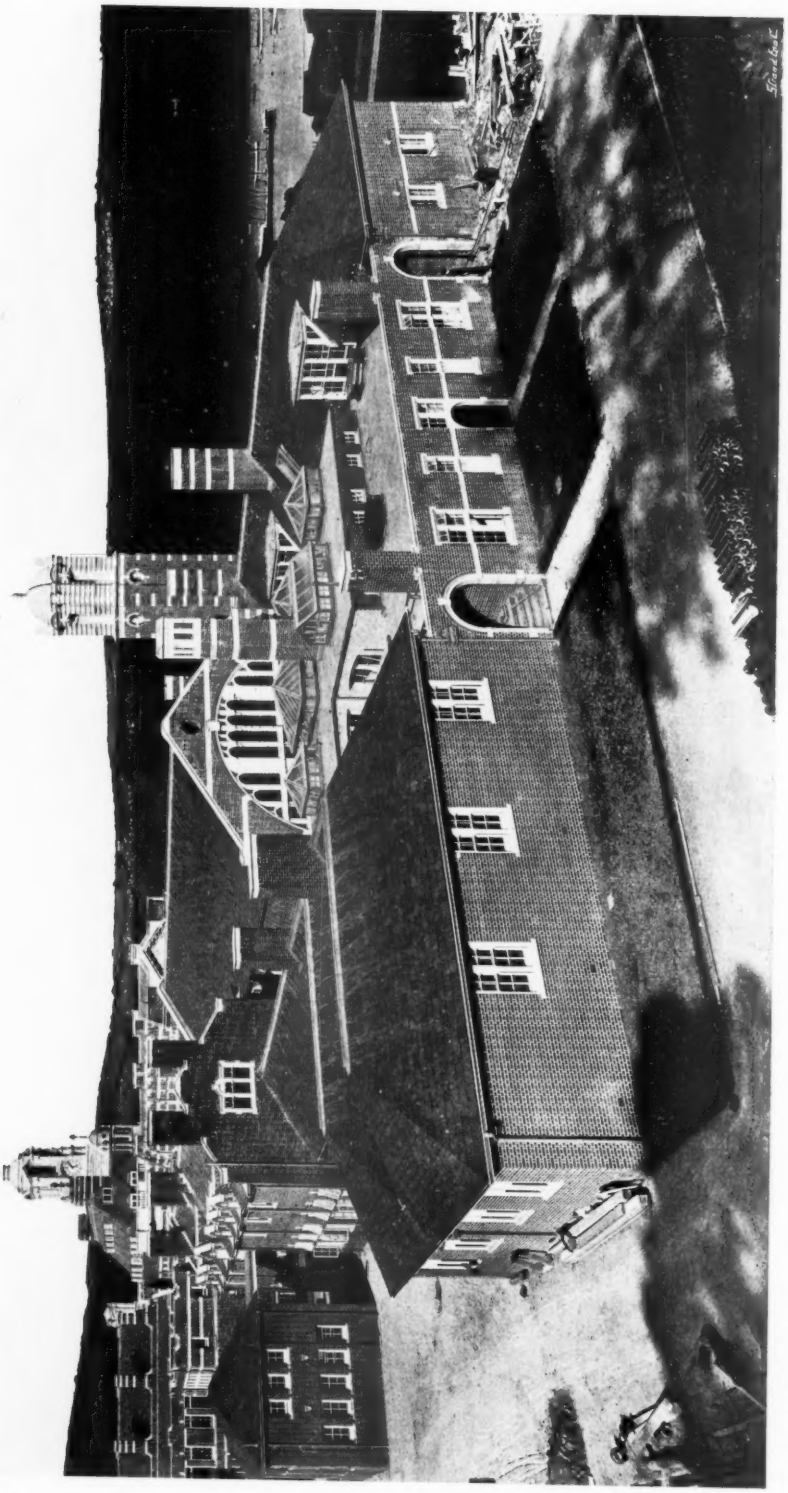


Photo: E. Duckrell.

THE KITCHEN BLOCK.

Notes.

Irish Ecclesiastical Architecture—The Cost of Restoring York Minster—Street Decoration in Dublin.

OWING to unusual pressure on our space it is necessary to hold over the completion of Article IV. of the series on "Irish Ecclesiastical Architecture." The first part of the article (in the October number) had to be printed without the author's corrections, and there are consequently some mistakes which should be noted:—

Page	187,	col. 1,	line 18	*for* Tusk *read* Lusk.
,,	187	,, 2	,, 11, 25	*for* Petric *read* Petrie.
,,	189	,, 2	,, 12	
,,	188	,, 2	,, 13, 14	*for* (though these are so few, they tend to the safety of a party attacked) *read* (though that these are so few tends to the safety of a party attacking).
,,	188	,, 2	,, 31	*for* it *read* its (*in quotation*).
,,	188	,, 2	,, 32	*for* Caeincachair *read* Caeineachair.
,,	189	,, 1	,, 35	*for* Rec *read* Ree.
,,	189	,, 2	,, 5	*for* 1835 *read* 1135.
,,	190	,, 2	,, 29	*for* exat *read* erat.
,,	191	,, 1	,, 4	*for* Roberts *read* Robert.

* * * * *

CORRECTIONS.—In Mr. Middleton's review of Mr. R. F. Sherar's book on perspective, published in the October issue of the REVIEW, a "theodolite" was inadvertently referred to instead of a "centrolinead." The fourth paragraph of the review should therefore be read with this amendment.

In the September issue illustrations were given of a new Kensington church by Mr. G. F. Bodley, R.A., which was named in the REVIEW as All Saints' Church—this being the name given on the note sent by the architect to accompany the illustrations. The name of the church should, however, be Holy Trinity.

* * * * *

THE COST OF RESTORING YORK MINSTER.—The "Occasional Papers" which the Dean of York has issued during the past five or six years describing the progress of the work of repair and restoration at the Minster have now been collected together and issued in volume form. It appears that between 1829 and 1899 the sum of £110,424 was spent on restoration and rebuilding work. In October, 1898, Mr. Bodley reported that another £50,000 would be needed to carry out the essential restoration, and that this would occupy fourteen or fifteen years. The work was undertaken, and has been carried on for five or six years on the lines recommended by Mr. Bodley, though much yet remains to be done. The total amount subscribed towards the restoration fund up to June 17 last was £22,857, and there had been expended £16,238, leaving a balance in hand of £6,619.

* * * * *

LAST month Mr. Lawrence Weaver drew attention to the use which has been made of the derelict gas-lamp standards in Dublin, no longer required owing to the installation of electric light. Mr. Weaver assigned the credit for this to the City Corporation; but the improvement appears to be due, as might be expected, to private effort—the flower-holders having been erected by the New Society in Kildare Street. The baskets are made of cast iron and burnished copper, and are supported upon the pedestals of the now disused gas lamps. Growing flowers with green trailing plants fill the baskets and make a gay show, and a constant supply of blooms, varying according to season, has been arranged for. The effect of the brilliant colours seen against the dark background of the rather sombre street is most striking, and it is believed that the New Society, encouraged by the success of this first experiment, will shortly extend its scheme of decoration to several other Dublin streets.

Mason.

A FLOWER STAND IN KILDARE STREET, DUBLIN.

The London Traffic Commission Report.

II.

IT was with peculiar interest that architects awaited the Report of the Royal Commission on London Traffic; for the question of locomotion in cities is indissolubly connected with that of their laying-out and improvement, subjects to which the greatest artists of all times have continually applied their genius. Greece and Rome—following the dim dynasties of Egypt and Assyria—the Middle Ages, and the Renaissance in nearer times, have furnished us with stupendous examples of that great art which most fitly, and therefore necessarily with most beauty, meets the requirements of its age. For—and this essential truth should be insisted on, urged wherever two or three Philistines are gathered together on Royal Commissions or what not, and driven into their reluctant minds—art is a living force, informing our common life physically, as religion, when true, informs it spiritually. You shall no more attain to the kingdom of Beauty by the mere setting within and about your dwellings of pictures in frames and statuary upon pedestals, than you shall gain that of Heaven by the making of long prayers and the broadening of phylacteries.

Deducing, probably from the maxim of two heads being better than one, that any greater number of heads improves in an ascending ratio, it is the custom of Parliament to refer certain pressing perplexities to some group of persons (not necessarily chosen from among its members) with definite instructions as to the subjects they are to examine and report upon. The relief from tooth-ache experienced by the sufferer who approaches his dentist's door-knocker is proverbial, and a Royal Commission, it would appear, has the analogous effect of allaying public irritation and effecting a kind of false cure, insomuch that further action seldom ensues. The evidence collected remains, however, for the benefit of future investigators, and in this is to be found the real resultant value of a somewhat costly procedure.

In the case of the present Commission this solid residuum of evidence is not yet available, but is promised in the seven volumes to follow that now issued. The first volume contains the Report only, which may be compared to a decanted tincture from the facts deposited with the Commission; and, with all respect to that distinguished body, a remarkably colourless liquid it is.

The Commission was originally composed of thirteen members (including the secretary), three being financial experts; three, railway magnates; one, a representative of the Home Office; one, an engineer; two, lawyers; together with a yeomanry D.S.O., a former official of the Science branch at South Kensington, and an ex-Master of the Buckhounds. The instructions issued to them under the Royal Sign Manual are as follows:—

"To inquire into the means of locomotion and transport in London, and to report—

"(*a*) As to the measures which the Commission deem most effectual for the improvement of the same by the development and interconnection of Railways and Tramways on, or below, the surface; by increasing the facilities for other forms of mechanical locomotion; by better provision for the organisation and regulation of vehicular and pedestrian traffic, or otherwise.

"(*b*) As to the desirability of establishing some authority or tribunal to which all schemes of Railway or Tramway construction of a local character should be referred, and the powers which it would be advisable to confer on such a body."

It will be seen that, from the first, the views of the Government, as indicated both by the composition of the Commission and by the instructions, were curiously narrow. Railways and Tramways with their consequent finance seem to have obsessed their minds to the exclusion of anything beyond the mere regulation and organisation of other means of locomotion; and the terms of the reference would seem almost to prohibit the consideration of the underlying and causative problem, which is the planning of London as a whole. The Report, it is true, touches on this question by way of the sub-report of the Advisory Board of Engineers; but as the instructions to that body are not yet before us, we can form no opinion as to how far it was deemed to fall within the lines of the Royal instructions.

As, however, the planning of buildings and streets is matter for the expert opinion of architects, and no reference was made to representatives of that profession, we may fairly assume that the idea of the main problem being one which a skilled and artistic plan-wright alone could deal with did not occur to His Majesty's advisers.

Yet it is clear that this question of city improvement, which is at the root of all traffic difficulties, is essentially an artistic one—a matter of creative design. Railways and tramways, necessary as they may be, form but a secondary factor of the problem, which is that of the *réseau* or arterial network of thoroughfares. All must acknowledge with fascinated admiration the amazing constructive achievements of our engineers; but they are, by their very training, unfitted for the patient unravelling of the knot into which a city's highways and byways have been tangled by succeeding generations. Their cut-and-thrust methods are magnificent as applied to direct construction, but a different order of mind is needed in the master of planning. Such crude solutions as the thrusting of the unfortunate traveller underground, into "shallow" and "tube" railways, while goods vans and drays continue to enjoy the sunlight and open air secured by heavy expenditure on parks and open spaces, can never be accepted as either satisfactory or final. Such inartistic bludgeon-work as the proposal for a subway from Grosvenor Place to the Marble Arch, running for three-quarters of a mile beneath Hyde Park, needs but mention, one would think, to ensure indignant condemnation.

The plan then—and by "plan" is intended the considered, orderly marshalling of parts to form a homogeneous design—is the essential prerequisite in dealing with locomotion among buildings. Such a plan is in no way to be compared with the casual stringing together of items beloved of the amateur vaguely conscious of many wants. Few, even among trained artists, have the gift of such great conceptions; all worthy of the name realise their beauty when produced.

No artist has been consulted. The banal result of Committee compromise represents all the grain extracted from so prodigious a winnowing of evidence by many Select Committees of the House[1] and Royal Commissions.[2] In the case of the present Commission, indeed, it would seem to have been so smothered by the statistics heaped upon it as to have turned to the outlet offered by the "Traffic Board" hinted at in their instructions, as a welcome means of removing responsibility to other shoulders.

"Un plan de ville," says Camille Sitte in his work, "L'art de Bâtir les Villes," "est aussi une œuvre d'art et non un simple acte de voirie. C'est là le nœud de toute la question." A work of art it is; and no such work, be it cathedral-plan, fresco, or symphony, can ever be produced by a Committee.

Criticism, it may be remarked, is easy. What is the constructive suggestion?

"There is no finality in the question of the best means of locomotion and transport for great cities," remark, truly enough, the Commissioners. For this very reason, that future requirements cannot be foretold, the greatest care should be exercised in disturbing the *réseau* which has automatically developed from the needs of succeeding generations. The violent cleaving of colossal avenues from north to south and east to west is no specific remedy; rather may they make for a vaster congestion at their crossings and delivery points. A road wider than necessary for its definite lines of traffic is merely wasteful, and increased width does not even imply greater dignity or beauty. Judicious and cautious widenings where pressure indicates them, and, above all, the scientific consideration of junctions, are the true means for unravelling the tangle of traffic and setting each line upon its ordered path.

In a recent paper on the subject, which, by the invitation of the Royal Institute of British Architects, the present author had the honour of reading before them, an endeavour was made, by reference to the teaching of the past and by diagrams of traffic routes, to illustrate some of the simple remedies obtainable by artistic planning.

The choice of the artist is the important point. It is a delicate matter to mention names, but in Viscount Esher and Lord Windsor the Government is so fortunate as to possess men in close touch and sympathy with art and its practitioners; and it should not be difficult to select, with their advice, the man whose temperament and genius best fit him for the task of dealing with this insistent question.

There is no need for grandiose schemes. Take a single problem from the tissue of urgent needs—the improvement of communication betwen two given points, with relation to cross traffic and connecting routes; the reduction to ordered disposition of the chaotic jumble which has congested locomotion in Piccadilly Circus—or what not; entrust the solution to an individual designer. The execution of the idea evolved may well be entrusted to the Administration, Traffic Board, what you will, which shall possess the necessary authority for the contingent financial and other matters, and be in a position to regard it in relation to similar schemes for other localities.

But, avoid Committees, Boards, and Officials of all kinds where inventive creation is required, in proportion as you value your money and desire an effective result.

JOHN W. SIMPSON.

[1] Select Committees on Metropolis Improvements, 1836, 1838, 1839, 1840, 1841.

[2] Royal Commissions, 1842, 1905.

FIG. 1.—ST. FAGAN'S. DETAIL.

FIG. 2.—ST. FAGAN'S. DETAIL.

FIG. 3.—ST. FAGAN'S, CARDIFF.

English Lead Cisterns.

RAINWATER cisterns have so obvious a connection with pipe-heads that I take them next in my present series of articles on English leadwork. They are, I think, rather less interesting than heads. The limitations enforced by their uses give them less decorative possibilities, and, because they have lost their main original uses, the study of their treatment is not so valuable as an inspiration for present work. Yet they have an educative value considerable enough, if lead got all its deserts. The use of ornamented lead sheeting on the fronts of projecting bays and in like situations is happily growing, and such leadwork presents the same decorative problems as the front of a large cistern. In cisterns the limitations of form are considerable. They can only take simple shapes. They may be rectangular, polygonal, circular, or segmental on plan, but variety ends there. For practical reasons their sides vertically should be straight and their top edges strictly horizontal and unrelieved by parapets or any like finishes, such as give an unending variety to rainwater heads. Decoratively the aim is suitably to ornament a flat surface of regular outline, and, speaking broadly, there are three main ways of doing this.

1. To treat the surface with some unobtrusive recurring ornament in the same way that a mediæval mason diapered a wall, a method almost entirely neglected.

2. To panel the face by applying moulded ribs, and further to diversify the surface by spotting it with small ornaments such as dates, small figures and heraldic charges, and

3. To model a considerable part of the surface in low relief so as to produce a certain unity of effect not obtained by simple panel treatment. This method obtains only in rich and rococo work.

Most cisterns fall under the second heading. To deal with them in order, apologies are perhaps needful for the somewhat gruesome character of the example given in Fig. 4. Moreover, it is a reliquary and not a cistern. Decoratively, however, the two things are the same, they are both big lead boxes. The example is from St. Eanswith's, Folkestone; the bones are probably those of the saint. I put aside, however, as not germane to my subject, the ecclesiastical significance of this lead box and its contents. Decoratively the idea is excellent. The surface is covered with a network of dots, one lozenge of which has been emphasised by the engraver for the sake of clearness. Each dot is lozenge-shaped, and near the

FIG. 4.—ST. EANSWITH'S.

top of the box the lozenge pattern is crossed by a horizontal line of the same dots. Whether this reticulation is intended actually to suggest a net, or is merely a pleasant combination of dots and lines, seems not to be material. I illustrate it mainly as showing a type of decoration which might well be adopted for relieving flat surfaces in modern leadwork. The box has a rough cover (not fitted to it) which apparently was originally part of a Roman coffin. It has at one end, on the underside, five parallel cable mouldings. The reliquary itself seems to be (for historical reasons too long to be set forth here) of the twelfth century.

The two small lead ossuaries from the British Museum, which are Romano-British, and were found in Warwick Square, E.C., I also illustrate because they have a distinct place in the development of leadwork design. The crossed rods of bead and reel (Fig. 5) are the ancestors of the more sophisticated framing of a seventeenth-century cistern. Sol in his quadriga clears the way with his team for the lively frieze of the tank of Fig. 9. The ossuaries are technically admirable. The joints are burnt, not soldered, and the bead and reel rods, cast hollow to save metal, effectually brace the vessel.

In Fig. 6 is illustrated the exquisite lead cistern which the British Museum possesses. The nature of the ornament dates it as being of

FIG. 5.—OSSUARIES, BRITISH MUSEUM.

the late fifteenth century, but it seems obvious that the disfiguring inlet and outlet pipes are the addition of the Philistine. The conical top also seems to be no part of the original. The second and fourth bands of ornament are particularly interesting owing to their similarity in character to the frieze of the Bovey Tracy tank, and the remaining three bands are of the same family as the frieze of the Lincoln Cathedral example. I mention these parallels as showing the continuity in the nature of leadwork design.

FIG. 6.—CISTERN, BRITISH MUSEUM.

St. Fagan's, Cardiff, is the home of one of the most notable, as it is one of the earliest, lead cisterns (Figs. 1 to 3). It is a delightful feature on its stepped stone base in the middle of a round garden, between the main entrance to the castle and the drive. Save for the battery of time it is quite circular, and about 6 ft. 6 in. across (not octangular and 10 ft. across, as stated by Mr. Lethaby). Speaking generally, the main impression it gives is of a curious likeness in general treatment to the arcaded Norman fonts of which there are six in Gloucestershire. The comparative nearness of these fonts makes it a not too flighty suggestion that they may have influenced the design. Thirty out of the thirty-two panels into which it is divided are cast from the same pattern, which is shown large in Fig. 2. The remaining two give respectively the Royal arms, with the date 1620, and the arms of Sir Edward Lewis of Van, St. Fagan's, Peamark Place, and Llantrithyd. This knight of many places bought the manor of St. Fagan's from Sir William Herbert in 1615-16. Our tank would therefore seem to be one of the things with which he beautified his new estate, unless indeed he brought it from Van, a place near Caerphilly and some six miles from Cardiff. There remain at Van some Tudor work and a large round dovecote. The date does not necessarily deny this, as it may indicate the setting of the tank in its new place rather than its making. The nature of the ornament makes it likely that 1620 was the date of its production. As, however, the panel with the Lewis arms was obviously, from the seams on the inside, inserted after the main part of the cistern was made, a pleasant taste of doubt remains as to its origin. If it was a local production it is a feather (unhappy simile) in the cap of the Welsh plumber of the seventeenth century.

The cistern of Fig. 7, in the possession of Mr. Harry Hems, at Exeter (and there photographed by Mr. Galsworthy Davie), is a particularly good example of simple panelling. It is dated 1696, and is very similar to the still plainer cistern of 1666 at 10, Downing Street, which was illustrated in THE ARCHITECTURAL REVIEW of May 1904. The Downing Street example is very sparing in enrichment. It is divided by ribs into forty-four panels, and only five of them are filled, the

FIG. 7.—EXETER.

ornaments being the date, a crown, and C.R. The Exeter cistern possibly had all panels filled with devices, though two are bare, and the six ornaments repeating at the right and left of the front are especially interesting. Perhaps the second from the right-hand top corner is the happiest, the vine pattern being employed most successfully. The return ends are decorated with the same six ornaments. It will be noted that there are square outlines round these ornaments, which suggest that the ornaments were cast separately and applied. This is not so, however. The outline merely marks the edge of the loose pattern, where it was pressed into the flat bed of casting sand. A word as to the method of making this cistern, which applies to most of this type. The front and sides were cast in one flat sheet, which was bent at the front angles, and also at the back, returning $3\frac{1}{2}$ in. The return pieces are soldered to a sheet-lead backing. Two stays of sheet lead 13 in. deep divide the inside into equal distances; they reach to within 6 in. of the top and stand clear of the bottom. In the middle, tying the front and back, is a circular solid bar of lead $1\frac{1}{2}$ in. in diameter. Other dimensions are:—Length, 6 ft.; height, 2 ft. 4 in.; width, 2 ft.; greatest thickness, $\frac{7}{8}$ in.

There is a vigour about the decoration of Devonshire and Somersetshire cisterns of the late seventeenth and early eighteenth centuries which

FIG. 8.—BOLTON HALL, YORKSHIRE.

FIG. 9.—POUNDISFORD PARK.

FIG. 10.—ST. MARY'S, SCILLY.

cannot be claimed for the London work of the same date. This Exeter example, the Poundisford Park tank (Fig. 9), a fine one at the Deanery, Exeter, dated 1708, and still another at Exeter, dated as late as 1724, all have a delightful variety of flower and animal ornaments which are freshly amusing. Probably they were made by the same plumber. Some of the ornaments which are seen in Fig. 7 are repeated on the 1724 cistern at Exeter. They obviously are cast from the same or duplicate patterns. There is a delightful disregard of scale. In a sporting scene the huntsman is but little larger than the dogs, and the stag has a quiescent air which does not quite match the violent activity of the three dogs (one high in the air) which are after him. But it makes a quite dramatic picture.

Bolton Hall, Yorkshire, has a fine series of lead cisterns, which are of the same period as the pipe-head which was illustrated in THE ARCHITECTURAL REVIEW of September. They stood originally at the foot of the stack pipes, and it will be noted that the cistern at the right of the group in Fig. 8 is angled on plan to suit the angle pipe-head already mentioned. The semicircular plan of the larger ones is unusual, and a pleasant variant of the ordinary rectangular form. The simplicity of their treatment is in contrast to the rather crowded ornament of the pipe-heads. There is no attempt to panel the fronts with ribs. On the larger cisterns the classical leaf moulding which runs round the top and bottom divides the semicircular front vertically with a double band. For the rest they were content simply to apply the coat of arms of the Paulet and Scrope families, with their supporters.

On the small angle cistern the Scrope choughs support the Paulet shield, due probably to

FIG. 11.—NOTTINGHAM CASTLE.

FIG. 12.—CHARLTON HOUSE.

muddled re-fixing at some time after a number of the heraldic ornaments had dropped off, owing to bad work when the cisterns were first made. There are, I think, more applied ornaments missing from late seventeenth and eighteenth century leadwork than from that of the sixteenth and early seventeenth centuries. The later men were more intent on piling on enrichments than in seeing that those they applied were firmly fixed.

The cistern at Poundisford Park, Taunton (Fig. 9), I also show in sequence to my September article (page 100, Figs. 18 and 20). It is dated 1671. The arrangement of the pots of flowers in the panels is formal enough, but fancy has been given rein in the little frieze that surrounds the top. The scenes, as is befitting, have a garden atmosphere. One pleasant-faced urchin is apparently about to help himself from a fruit tree, while another is contemplating a rather weedy dog. Trees mingle with flowers, and altogether the composition is delightfully casual.

The initials W. H. are those of William Hill, the other H. being probably the wife's initial.

In the crest the rising dove, holding an oak sprig, stands on the usual twisted sausage, a rendering of the scarf of a helm, as ridiculous here as it is on the notepaper of the armorially-minded of to-day.

At St. Mary's, Scilly, one expects something rather unusual. I confess I had a vague hope of finding some graceful convention of daffodils on the leadwork that would accord with the sub-tropical atmosphere of the Isles. But London throws its influence afar. The cistern of Fig. 10 is not only of the ordinary London type, but even, which is unusual, bears the name of the maker, "Walker, London," a

name one seems to have heard before. It is a royal cistern, and bears the initials and crown of George I. or II. The cherubs are very fully bewinged, and the arms of the central panel are those of H.M. Ordnance Office, which controlled the castle at St. Mary's.

The round tank, dated 1681, at Nottingham Castle is an admirable example of the plainer sort (Fig. 11). The arms are those of Henry Cavendish, K.G., and the "serpent nowed" is the Cavendish crest. The outward slope of the sides, from the top downwards, adds decorative interest to the tank, but makes it less practical when it comes to cleansing it. After all, if one drinks water from a lead cistern, a few bacteria more or less are not of much account, and seventeenth-century courage was undisturbed by those pleasant creatures whose names make a point of ending in *coccus*.

I have endeavoured that my illustrations shall be as far as possible *ad hoc*, by omitting the surroundings of the leadwork; but the cistern from Charlton House, Kent (Fig. 12), would lose half its charm if divorced from its charming setting. It stands filled with water-lilies in the middle of a rose garden framed in trees. The octagonal tank (each face of which is about 2 feet long) is a particularly happy example of the panelled type, and originally was probably, as it is now, the base of a fountain. The upper part is an addition, and may or may not be genuinely old work. It was but recently acquired, and whether old or merely "antique" (precious word), the swans and Cupid undeniably make with the tank a most agreeable composition.

Fig. 13 shows one of the best of the London cisterns. It is at Child's Bank, and dated 1685. The half panels return round the sides, and in this show a pleasant disregard of the prevailing practices. The ornaments are admirable. The stars are gay and curly, and there is an echo of history in the very small bust of King Charles I. between the 6 and the 8. The little figures are vigorous and interesting. I take those at the right and left of the lower tier to be King David harping on his harp. As to the remaining ornament, which occurs six times, I will not dogmatise. It suggests an exasperated prawn, or perhaps a freshwater relative inhabiting London cisterns, anyhow a watery creature.

The rich example of Lincoln's Inn (Fig. 14) calls for especial notice, and is the most notable example of my third division of this work, viz., the type which has the front partly modelled in low relief. The mask at the bottom and the trophy of fruits above the top line of ribbing are more ambitious than anything I know in London. The vertical strips of ornament at the ends, while good in themselves, seem rather a mistake. One feels that the cistern would have been better if it had stopped short of these strips and finished outside the very good framing of husks. While the

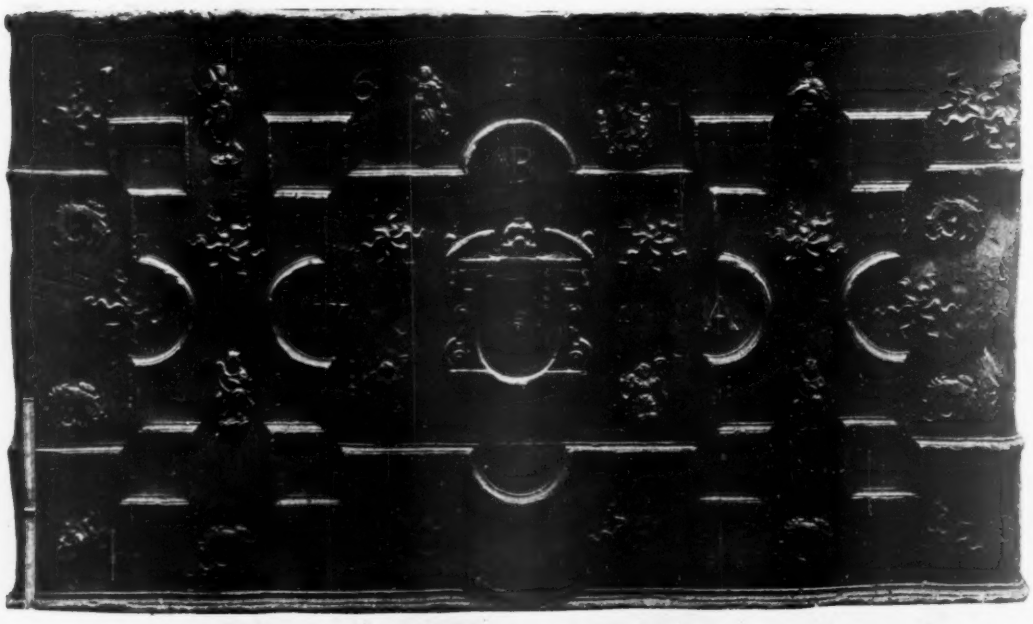


FIG. 13.—CHILD'S BANK, FLEET STREET.

FIG. 14.—LINCOLN'S INN.

proportion of the tank would not have been so good, decoratively there would have been a unity which now it rather misses.

There is another cistern in Lincoln's Inn which has the same general characteristics, but is much plainer. The same patterns were obviously employed.

At the Record Office, in Chancery Lane, near the doorway of the Rolls Chapel, are four eighteenth-century cisterns, one of which is shown in Fig. 15. This surely reaches the zenith of the Marine Store style of decoration. The plumber has made the front of his tank a museum of his patterns. He must have suffered from an acute

FIG. 15.—RECORD OFFICE.

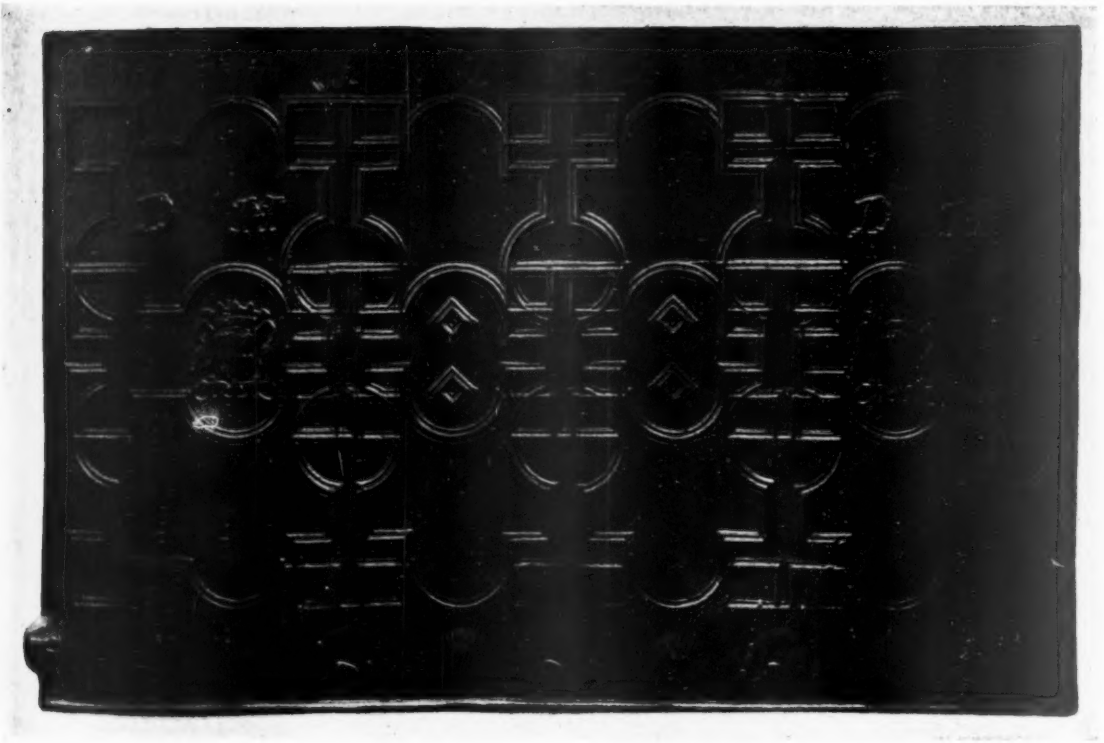


FIG. 16.—20, HANOVER SQUARE.

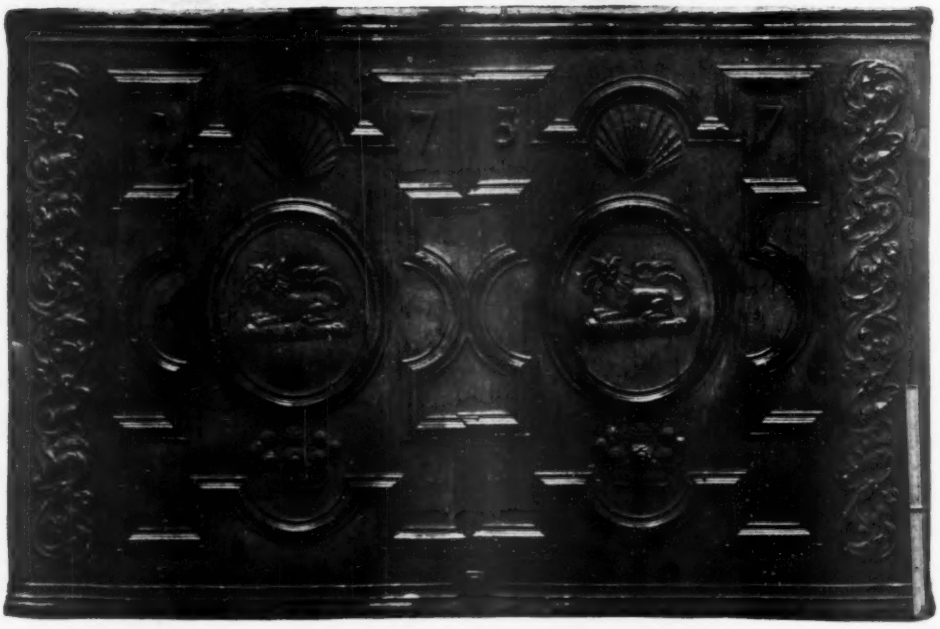


FIG. 17.—CHILD'S BANK, FLEET STREET.

FIG. 18.—QUEEN SQUARE, BLOOMSBURY.

horror of plain surfaces. It is an entertaining production, but one is grateful that it does not always happen.

At 20, Hanover Square, which houses those who are learned in everything from obstetrics to Irish folk songs, there is a tank in the area, visible from the doorway (Fig. 16). If my last example was a study in spotty ornament, this is a liberal education in the interlacing of ribs, almost Runic in complexity.

The tank of 1757 (Fig. 17) is another of the interesting series at Child's Bank, Fleet Street, and is a good example of the formalism of the later eighteenth-century work. The somewhat excessively-whiskered lions of the oval panels are amusing enough, and the strips of rather aimless ornament down the side lighten the general effect.

Mr. Max Clarke has at his house in Queen Square a good example (Fig. 18), which yet has some technical failings. The patterns seem to have been carelessly used, with the result that the alignment of the ribs is very irregular. The star ornaments are poor compared with those on the tank of Fig. 13, and the lettering is straggling and forlorn. The treatment of the coats of arms is rather more ambitious than successful.

Queen Square is not only full of lead cisterns, but the statue of Queen Charlotte (commonly known as the Queen Anne statue) is also of lead.

Near by, in Great Ormond Street, there is a cistern dated 1745, evidently made from the same patterns as the two best examples at Lincoln's Inn. The stone pedestal on which it stands is a modern addition, set up by Mr. Frederick Warre. This tank was illustrated in the *Builders' Journal* of March 25, 1905.

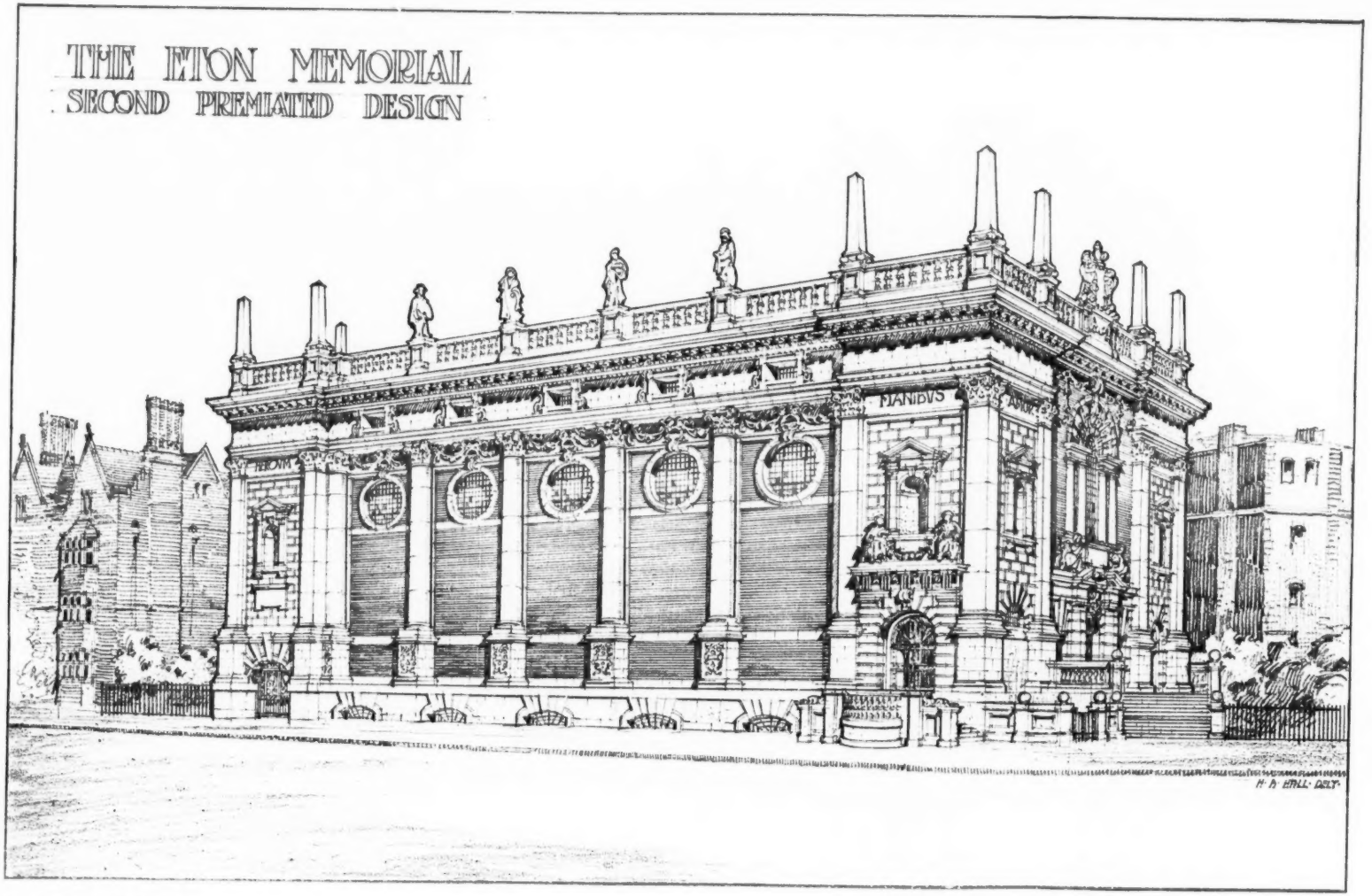
Pump-heads are less common than cisterns, but they are not very interesting. I show one of normal type (Fig. 19) which is rather early in date (for a pump-head). Others bear the stock cistern enrichments, such as shells and stars.

In my next article I shall deal with the ecclesiastical form of tank, the font.

LAWRENCE WEAVER, F.S.A.

FIG. 19.

I am indebted for kindly permission to reproduce photographs to the Lord Bolton, F.S.A. (Fig. 8), to Alfred Harris, Esq. (Figs. 1, 2 and 3), to G. Harry Wallis, Esq., Director of the Art Museum, Nottingham (Fig. 11), to C. King, Esq. (Fig. 10); and to the many owners of the cisterns illustrated, for allowing me to photograph their treasures.

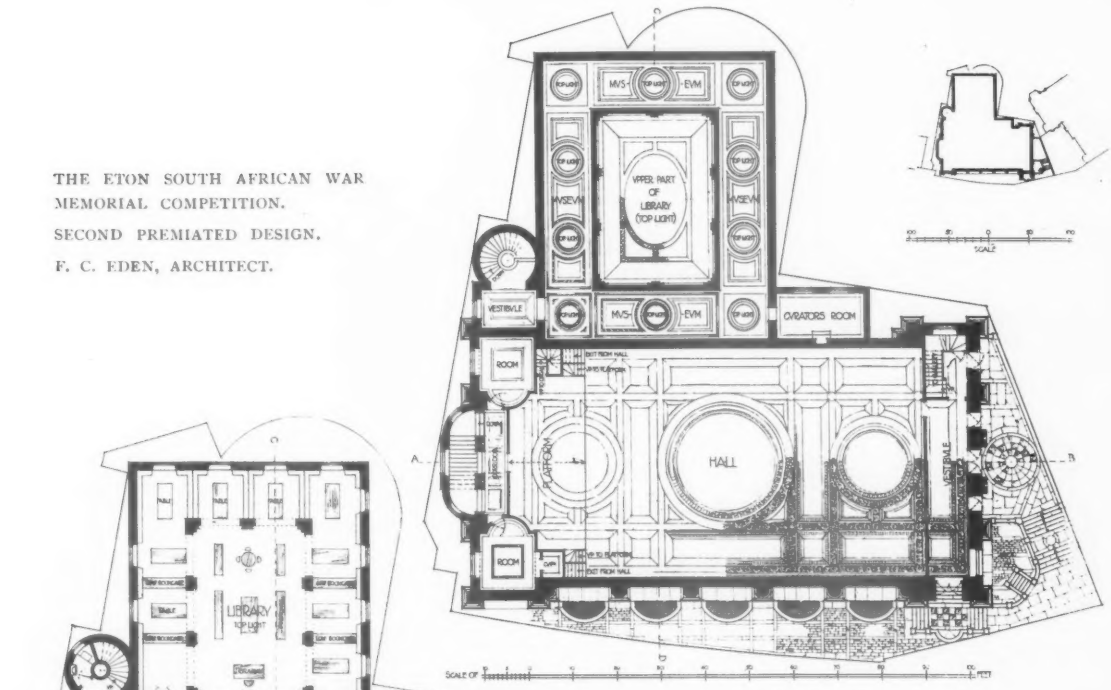


F. C. EDEN, ARCHITECT.

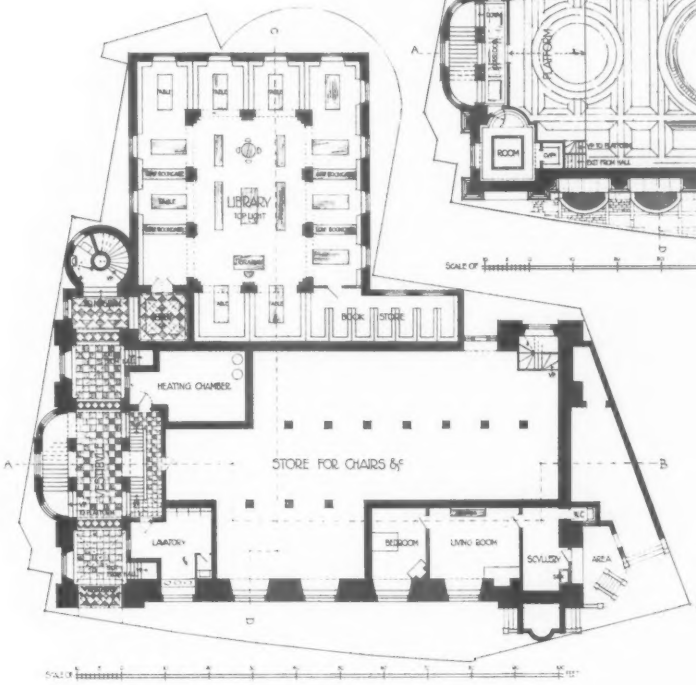
THE ETON SOUTH AFRICAN WAR MEMORIAL COMPETITION.

SECOND PREMIATED DESIGN.

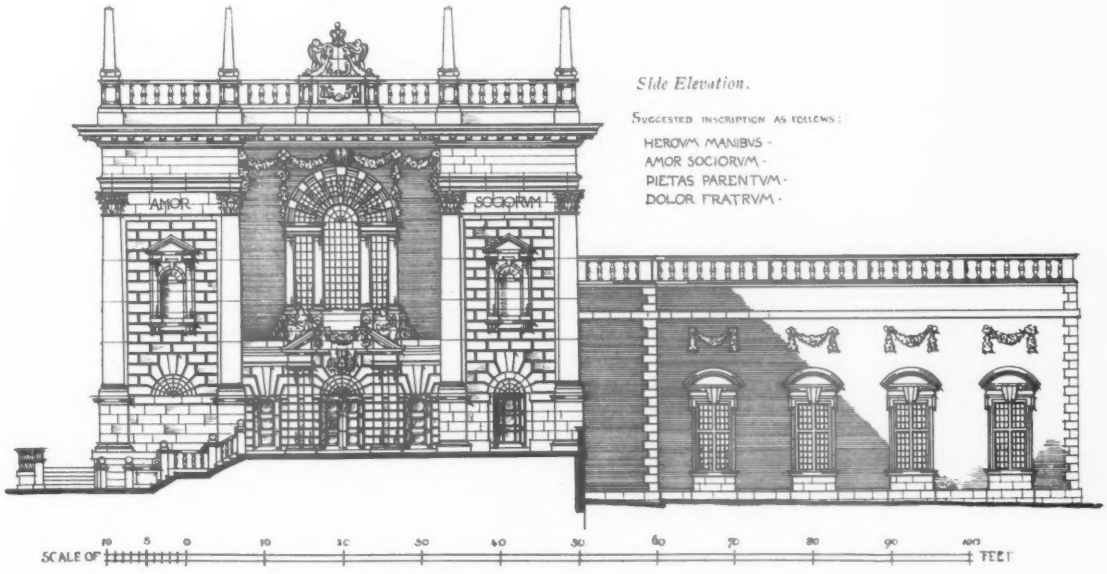
F. C. EDEN, ARCHITECT.



Principal Floor Plan.



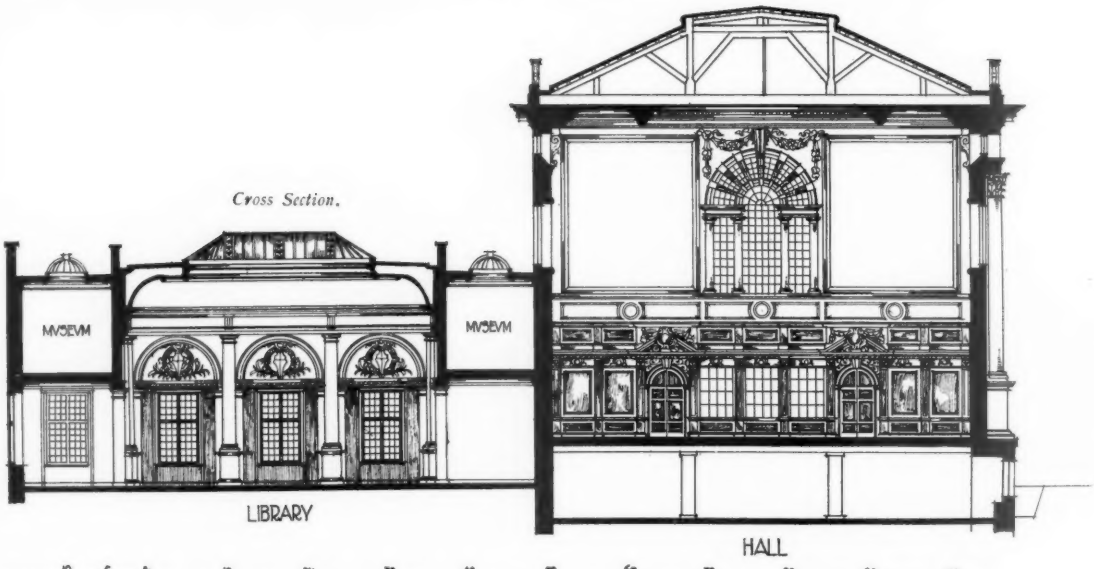
Basement Plan.



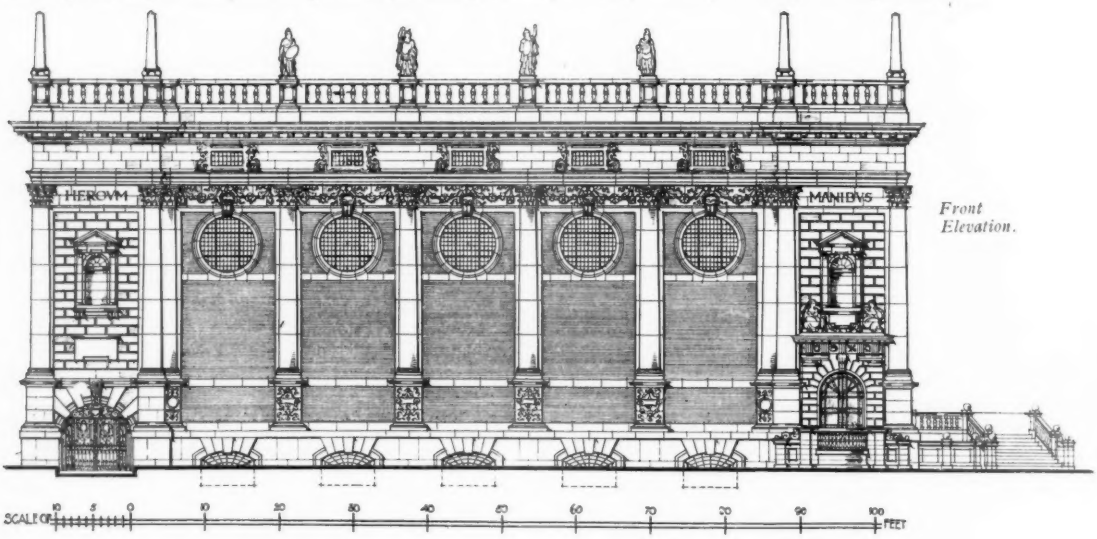
Side Elevation.

SUGGESTED INSCRIPTION AS FOLLOWS:

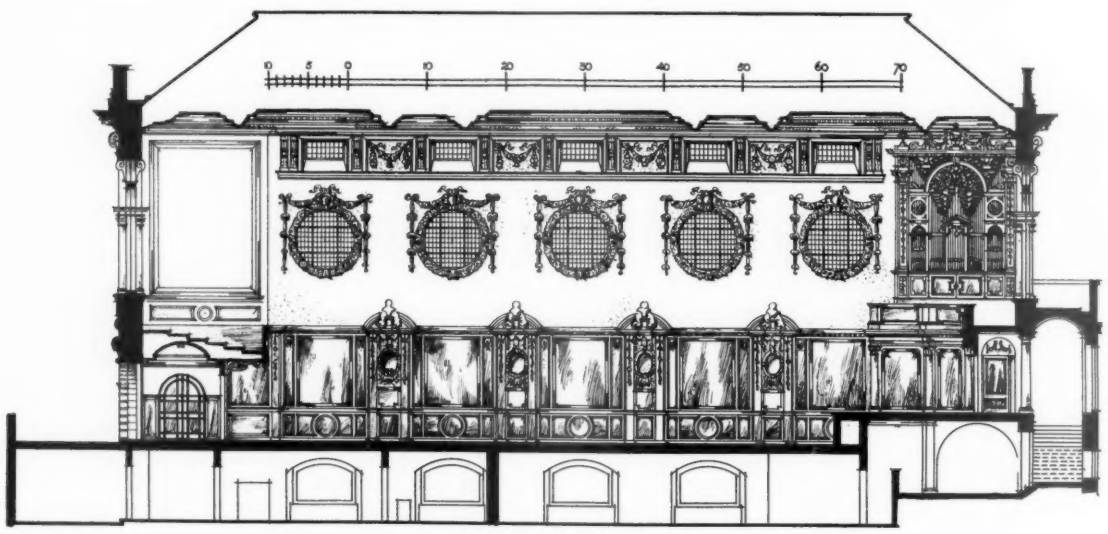
HEROVM MANIBVS -
AMOR SOCIORVM -
PIETAS PARENTVM -
DOLOR FRATRVM -



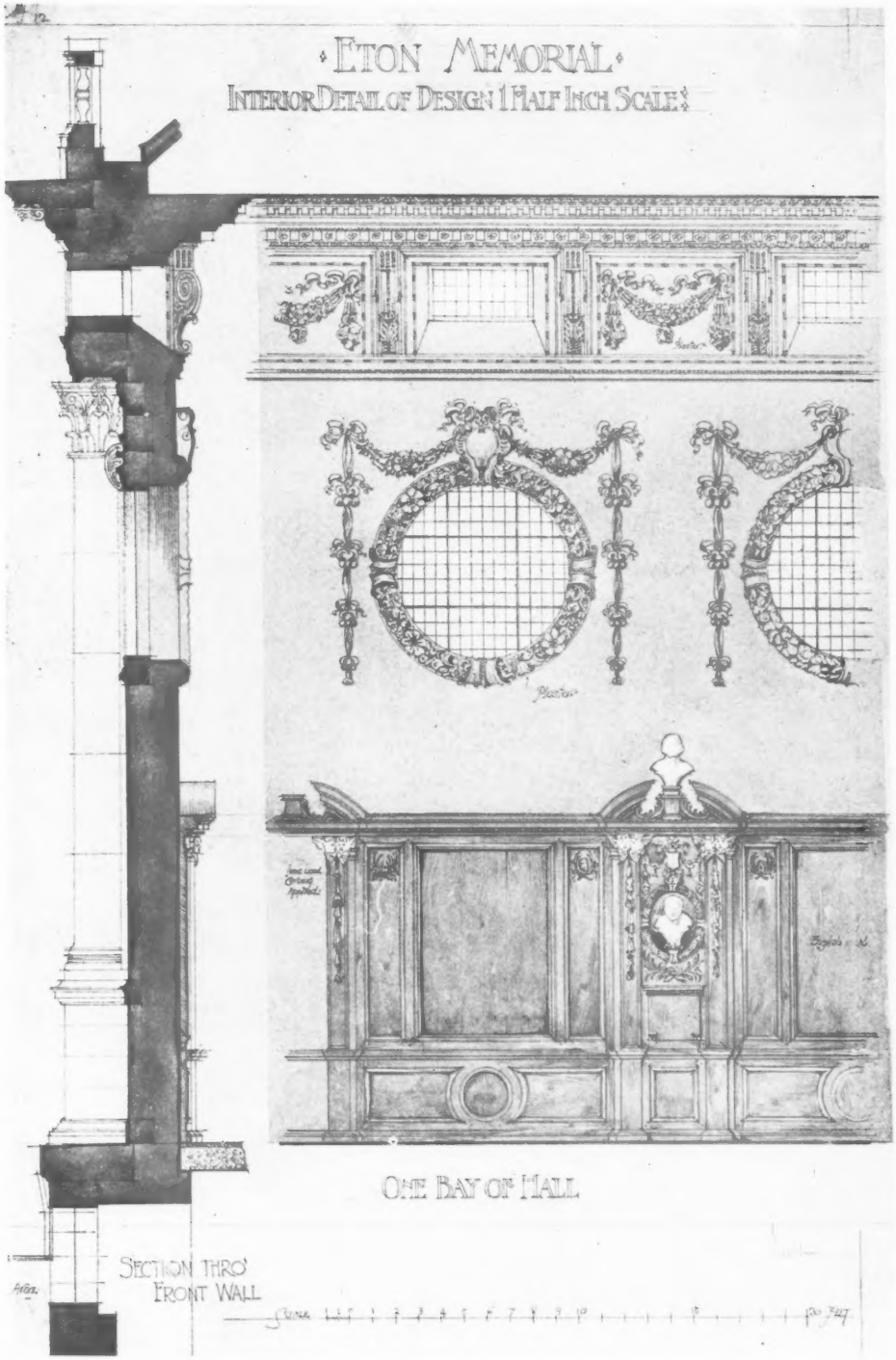
Cross Section.



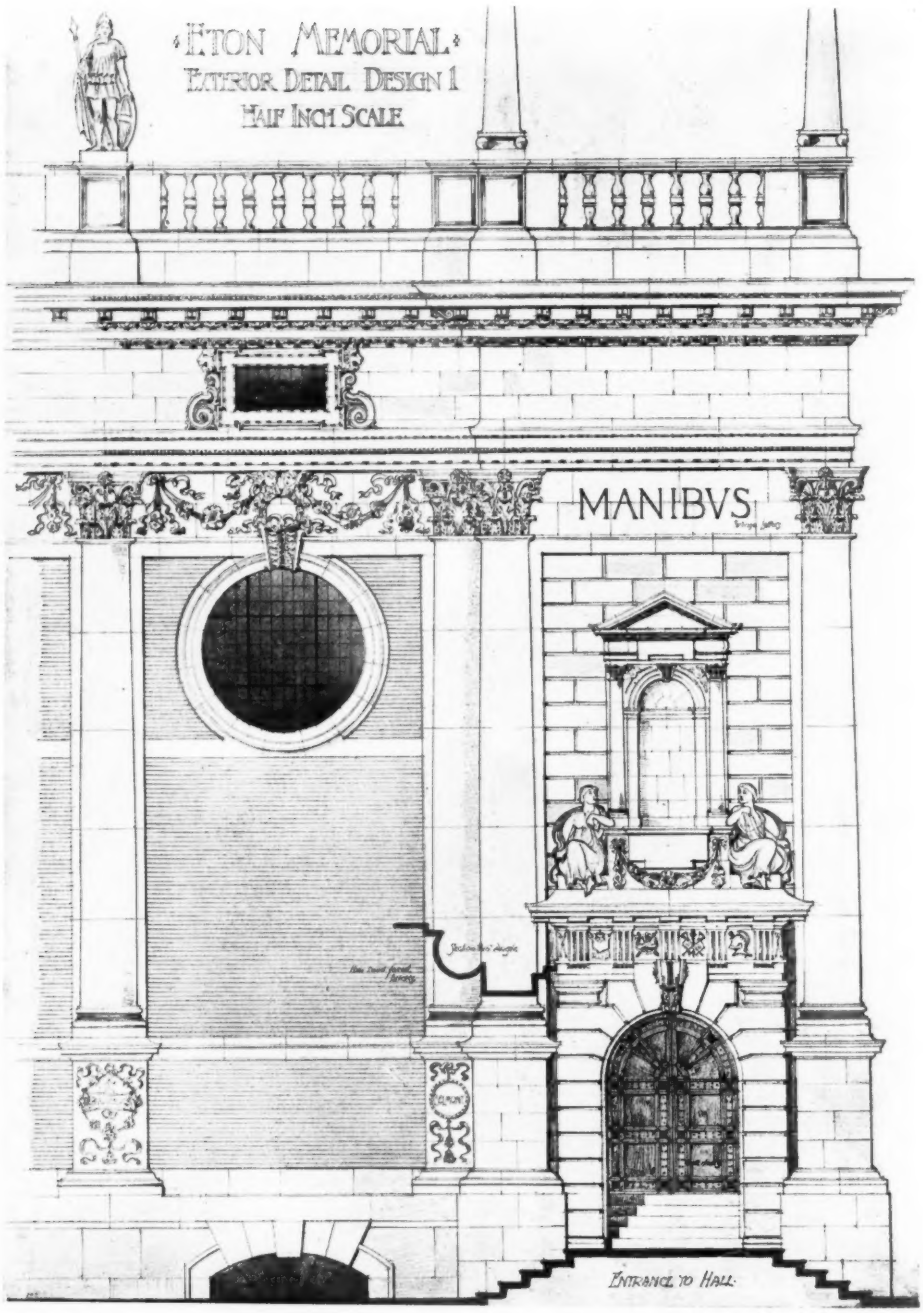
Front Elevation.



Longitudinal Section.



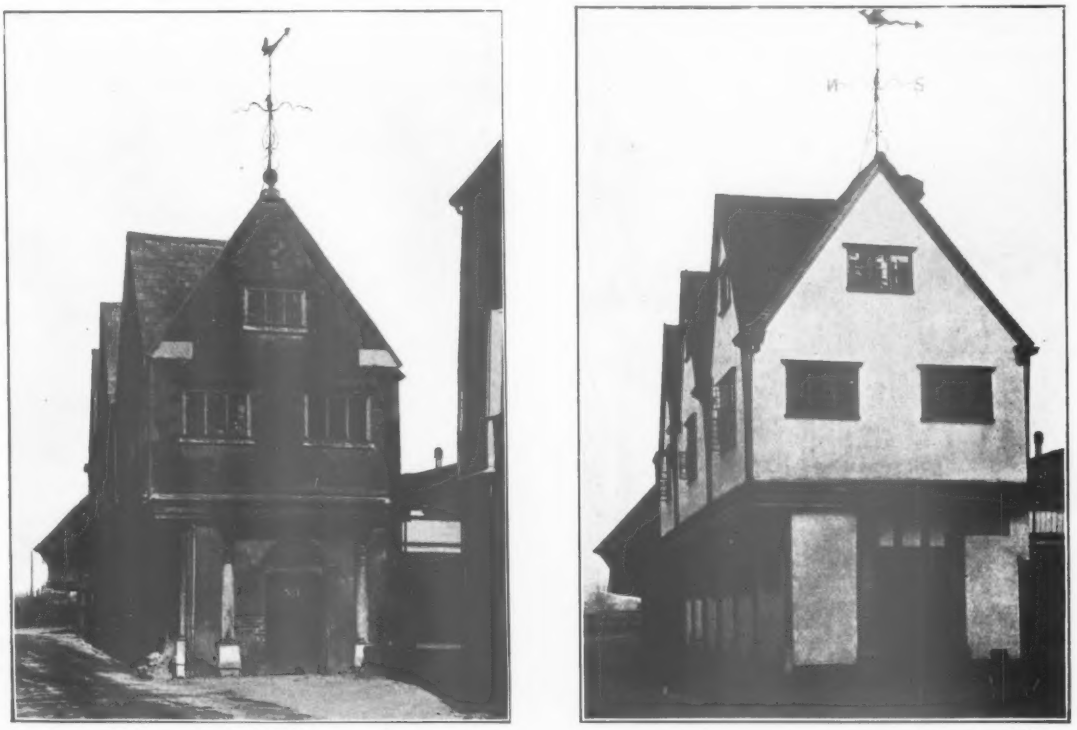
SECOND PREMIATED DESIGN. INTERIOR DETAIL.
F. C. EDEN, ARCHITECT.



SECOND PREMIATED DESIGN. DETAIL.
F. C. EDEN, ARCHITECT.

The Cloth Hall, Newbury.

LAST October the Cloth Hall at Newbury, in Berkshire, was opened, after repair, with some ceremony. In descriptions of the proceedings on this occasion the word "restoration" was conspicuous for its absence, yet certain very questionable "restorations" undoubtedly took place. The committee for, let us say, "repair," was guided by the local architectural taste, and what that was we can judge by the towers of the adjacent municipal buildings. In extenuation, it must be remembered, first, that the Cloth Hall was tumbling down; and secondly, that it had been "restored," in the fullest sense of that invidious term, in 1829, when a pointed doorway was inserted at the north end, and labels were put over the gable windows, while a very "Gothic quatrefoil" in plaster was inserted near the apex. All these and other improvements have now been removed, a few old features taken from drawings made early in the nineteenth century or resting on the tradition of the "oldest inhabitant" have been reinstated, and the Cloth Hall, no longer in danger of ruin, has been turned into a museum of antiquities and natural curiosities. Adjoining it on the east—that is, at the end furthest from the market-place—is a building to which I am anxious to call attention, and at the same time I do so with the greatest hesitation. It is, no doubt, very much dilapidated, and in need before winter of such repair as may protect it from the incursions of the weather. Also, it has very little of the structural ornament in latticed windows and carved pendants which attracted attention to its neighbour the Cloth Hall. It is locally called the Storehouse; it extends from near the eastern end of the hall some 60 ft. towards the canal wharf, and consists of a long, low gallery or balcony, with a wide roof corbelled out so as to overhang the balcony, which itself overhangs this part of the market-place. All is constructed of large timbers, carefully dovetailed and otherwise fitted together, of oak and pine. The design is evidently intended to suit the purposes of a great woollen market, the sellers with their wares being raised only a few feet above the buyers below. The only access from the ground to the gallery is by a massive double staircase in the centre, of very peculiar construction, and worthy, I venture to think, of both careful study and of preservation. The whole building, as well as a row of smaller stores which connects it with the Cloth Hall, is of early seventeenth-century work, possibly of the time of the celebrated "Jack of



Photos: J. W. Righton.

THE CLOTH HALL, NEWBURY. BEFORE AND AFTER RESTORATION.

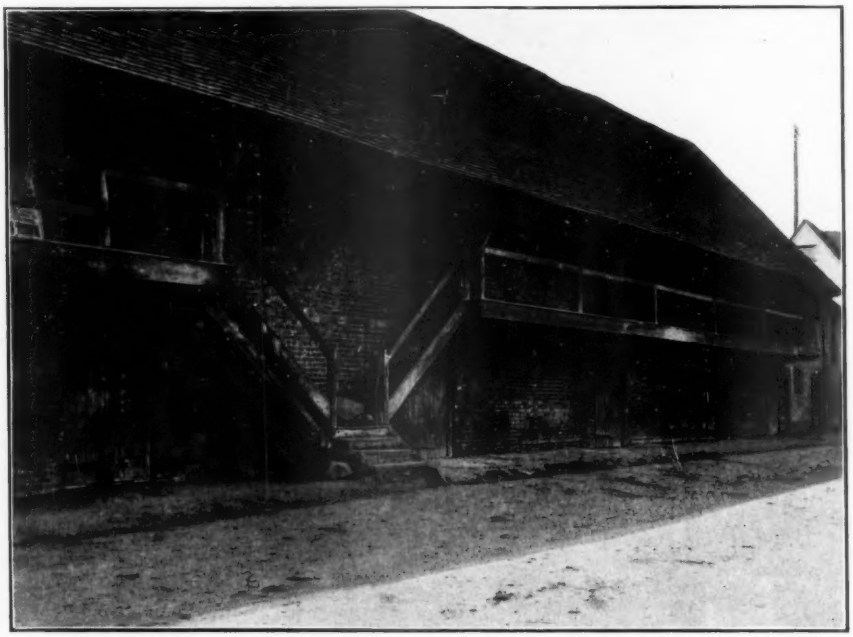


Photo: H. Favarger.

THE STOREHOUSE, NEWBURY.

Newbury," of whom the burghers of the ancient town are so proud. In this case it is older than the hall, and indeed, from its genuine if somewhat decayed condition, for it did not share in the destructive restorations of 1829, of very much greater interest. I do not recall anything like it in England, though I have seen something of the kind in Norway, and there are features among the architectural glories of Bruges and other cities of the Low Countries of which it may remind us. You will understand how much I hesitate in calling your attention to this curious building. Weather-tight is all I would wish to see it. Repair or any renewal of the features of the ancient construction will be to falsify it. Rather than see it "restored" I would be content to know that an architectural student had made careful measurements and drawings of the timbers, especially of the staircase. Some planks have already disappeared, and it is much to be feared that even a mild winter will injure the roof irretrievably. L.

Sewage Disposal Works for Isolated Dwellings.

I.—SOME PRINCIPLES OF TREATMENT.

With such a complex subject as the treatment of sewage it is difficult to get to grips in a single paragraph; but as the editor has requested me to try to do so, the attempt must be made and the reservations detailed after.

Natural Purification of Sewage.

The elimination naturally of the foul matters in sewage is accomplished by the action of micro-organisms and their products; certain organisms (anaërobes) liquefying the suspended solid matters in the absence of air, preparing the sewage for other organisms (aërobes) who eliminate the dissolved organic matters in the presence of abundant air. These processes are complicated by the existence of another large class of organisms (facultative anaërobes) distinct from the other two, which is capable of working in the absence or presence of air according to the material presented to it to work upon. The waste products of the organisms (enzymes) also assist in the work of

"breaking down" the polluting matters. These micro-organisms are housed naturally in the soil to a few feet below the surface, and consequently the land has been utilised for the purification of sewage for a very considerable period. As far as can be ascertained, the various classes of micro-organisms are promiscuously mixed in the soil, and the two operations in the purification of the sewage may proceed side by side, but because of this the rate of purification is slow. It is believed that the organisms that require air predominate at the surface of the soil or nearest the air, and the others, working in the absence of air, deeper down; but as those deep down are required for the first stage of purification (the elimination of the suspended solids), and those on the surface are required for the second stage (the elimination of the dissolved organic matter), this may explain the slowness of purification by the soil. Moreover, long experience of purification by the soil has shown that if crude sewage is turned on to the soil it gradually clogs the surface with the suspended solids, possibly because the anaërobic bacteria are not present there in sufficient numbers to deal quickly with it.

From these notes I exclude any consideration of the tub or earth closet system. The cottager with a good garden can always dispose of the waste matters from his establishment in the soil around him, with no discomfort to himself and considerable advantage to his garden. It is the method advocated by Dr. Vivian Poore and practised by him and many other people in rural districts. But the problem of large dwelling-places, housing several dozen or several hundred people, cannot be met on these lines. A single tub closet may be innocuous, but a range of six becomes, despite daily attention, a nuisance, and in summer an abomination.

Artificial Methods and Substitutes for Natural Purification and their Defects.

It may be objected that I restrict these notes to purification by bacteriological means; that I make no mention of the various chemical and other processes which have been devised from time to time for sewage treatment. Well, science has demonstrated beyond the possibility of dispute that the purification of sewage is in all cases due to the action of micro-organisms whether the treatment is carried out on the land, in water, or in artificial beds or tanks. Consequently the bacteriological action is not one of many methods of treatment, but the only treatment. Chemicals only operate so far as the first stage of treatment; that is to say, that by rapidly throwing down the suspended solids the clearer (supernatant) water containing the dissolved organic matter can be more speedily passed on to the nitrifying or second treatment beds. Thus the value of chemical treatment for very large flows is easily demonstrated. But with the supernatant water a certain proportion of suspended solids always escapes, and so the final effluents from chemical systems are nearly always subject to secondary decomposition. But for small domestic installations chemical and other systems may all be ruled out as being either too expensive or requiring too much attention.

Defects of the Soil in Natural Purification.

We can now take our consideration a step farther. Experience in land treatment has proved that certain soils of the lighter kind, having most interstitial space, are better for purification purposes than those of a heavy, close kind, having little or no interstitial space; and although no soil is, scientifically, useless for purification purposes, some soils are useless for the practical work of purifying sewage, as they introduce requirements of time, area (and consequently cost), with which it is impossible to comply. Even where the soil is practically suitable for purification, the difficulty of the surface-clogging still exists, and this can only be obviated by relieving the soil of the initial work of purification, viz., the elimination of the suspended solids.

The difficulties with the land in practical purification led to the devising of artificial substitutes for the soil as a housing medium for the micro-organisms. The efforts made in this direction have met with sufficient success to justify their adoption for practical purposes, though finality in detail has not yet been reached.

The Controversial Point.

It is in regard to these artificial housing places that a difficult and somewhat wearisome controversy has arisen. We have noted that there are two operations in sewage treatment: first, the liquefaction or reduction of the solid matters in simple suspension; and, secondly, the elimination of the dissolved organic matters; the latter constituting the more dangerous part of the pollution. We have noted also that naturally in the soil the first operation is effected by bacteria working under anaërobic conditions, and the second by organisms working under aërobic conditions. I use the word "conditions" advisedly, because the new class of facultative anaërobes, which may work either in the presence of air (aërobically) or its absence (anaërobically) according to the material presented to them, brings fresh factors into the question. As Sir Alexander Binnie remarked at the recent Public Health Congress, the more

one studies these bacteria the more one is struck by their wonderful adaptability to existing conditions. It seems as if Nature had provided agents capable of dealing with the polluting matter under any conditions, however unfavourable, and probably but for this wise provision the world would be uninhabited to-day.

Thus, in schemes aiming at the reproduction of the natural process, we should imagine that all three classes of bacteria had their part. But anaërobic action is mainly that phase of fermentation called putrefaction, and offensive gases and smells may be evolved by it. On this account anaërobic action has been very vigorously opposed in some quarters, and this opposition has led to attempts to carry out the whole of the purification solely under aërobic conditions.

Anaërobic plus Aërobic Treatment versus Aërobic Treatment only.

Whether sewage can or cannot be purified solely under aërobic conditions is the main controversial point in the treatment of sewage to-day. Whatever may be claimed by the partisans of one view or the other this question has never been authoritatively settled, and until bacteriologists can be dogmatic over it I do not see how there can be much progress. Mr. W. J. Dibdin is the great exponent of the aërobic theory; and, being one of the pioneer workers in this field of research, his opinions are entitled to respect. But his ideas are at variance with the most recent views of a number of eminent bacteriologists and experts, such as Dr. Rideal, Dr. Sims Woodhead, Professor Marshall Ward, and others; so that if the question was settled by the weight of evidence, the necessity of preliminary anaërobic treatment would be quickly established.

That the action in a contact bed dealing with crude sewage is wholly aërobic is gravely doubted by such authorities as Dr. Rideal, Dr. Sims Woodhead, and others. The advocates of preliminary anaërobic treatment do not claim to have entirely excluded the aërobes from the anaërobic tank; and, similarly, they do not believe that the anaërobes are entirely eliminated in the aërobic bed. They aim merely at accelerating the process of purification by the separation, as far as possible, of the two processes. Dr. Rideal goes farther; he attributes the failure of the contact bed in dealing with crude sewage to the fact that the necessary anaërobic process is hindered and retarded. And it may very truly be urged, that if Nature provides the anaërobes, they are a necessary factor in the purification process.

Moreover, it must be admitted that Mr. Dibdin has changed his methods if he has not receded from his views. The coarse coke contact beds tried at Leeds and elsewhere for crude sewage were admittedly a failure, quickly clogging up and becoming useless; so that any pretension that crude sewage can be treated on such contact beds alone has been abandoned. But since then Mr. Dibdin has abandoned the use of coke and such-like materials which are liable to "break down" or settle, and has patented a new form of coarse contact bed in which purpose-made tiles or pieces of slate are built up to form a sort of honeycomb to house the bacteria. Even with this new form of contact bed as used at Devizes there is a gradually increasing loss of capacity during use, and the deposit requires periodical "flushing-out" with a hose.

The Case for and against the Contact-Bed System.

Two facts are mainly relied on to prove that the action in these new Devizes beds is aërobic:—

1. That by rapidly filling the bed from the bottom thin films of air are imprisoned on the undersides of the slates, sufficient to aërate the sewage.
2. That no offensive odours are produced.

The first reason given seems to be a piece of assertion pure and simple; it would be extremely difficult to prove that any appreciable quantity of air is so retained. It is equivalent to saying that the pressure of a head of water is unable to drive out the air from a filling material honeycombed with holes. The retention of air, even if admitted, does not however prove that the action in the bed is wholly aërobic. As to the absence of odours, the statement must be regarded as comparative. You cannot have sewage without smell, but to most people fresh emulsified sewage is not usually abominably offensive.

The second reason brings us to a consideration of "putrefaction." On this point I may be allowed to quote Professor Ward's evidence before the Royal Commission. The action of the bacteria and their products was defined by him as follows:—

> I should say "fermentation" in the broad sense of the term; fermentations of various kinds leading to the destruction of the nitrogenous bodies, and in the end to the breaking down of these bodies into quite simple harmless constituents, like carbon dioxide, ammonia, and water, and indeed some of these, ammonia especially, being eventually further altered; and then fermentations of bodies like cellulose, of which we have of late come to know something, which would be broken down into partly gaseous and partly solid constituents, carbon dioxide and water in the end; and, in fact, the breaking down by fermentative processes to such constituents as could be used later on by plants.

Within the term "fermentation" Professor Ward includes putrefaction (evidenced by the production of evil-smelling gases) as "merely a particular case of fermentation." Questioned again on this point he affirmed that the processes "are similar processes." In answer to a further inquiry whether there were two kinds of fermentation, putrefactive or anaërobic and aërobic, Professor Ward answered:

Well, the attempt has been made to draw that distinction, but my opinion is that it cannot be held, and you will find that opinion expressed by most recent writers, such as Miqula and Lafai and other authorities; they say it breaks down. The attempt was made to uphold putrefaction as a particular process in which evil-smelling gases came off, and which was brought about by the action of anaërobic organisms; but neither of these characteristics is true. I mean, you may have anaërobic fermentation going on without putrefactive gases, and aërobic fermentations with them.

Thus the assertion that the absence of offensive odours is a proof of aërobic purification does not receive support from bacteriological authorities. Moreover, crude sewage can be treated on the soil, without any offensive odours, provided the sewage is not applied in such quantities as to make the ground "sewage-sick." So that the new contact bed accomplishes no more in this direction than has already been achieved by the soil.

A Theory regarding Contact Beds.

My contention with regard to this new contact bed is not that it is inefficient or does not produce good purification results, but that the action in it is not wholly aërobic. I advance a theory that contact beds are simply a reproduction of the natural soil on a magnified scale, and in the soil we know that anaërobic and aërobic processes are working side by side. If you continually turn crude sewage on to one patch of soil, the fine particles will speedily be clogged; if you turn crude sewage on to the coarser particles of a coke contact bed they will also be clogged, but not so speedily. Both will last longer if you give them periods of rest. In the new contact bed the same inevitable clogging is present; but the construction of the bed-filling renders it possible to get rid of it fairly easy.

Thus Mr. Dibdin's new contact bed may prove to be the happy solution of our difficulties. He may have devised an excellent substitute for the natural soil, in which, owing to the large amount of interstitial space, the inevitable clogging proceeds slowly, and can easily be removed when necessary without trouble or expense. But that the action in this new bed is wholly aërobic is a conclusion that must, in the light of present knowledge, be strongly resisted.

Necessity of Anaërobic Action.

There are, too, strong reasons for regarding anaërobic action as inevitable in the treatment of sewage. One of these is concerned with the question of cellulose; and on this point I quote some more of Professor Marshall Ward's evidence before the Royal Commission:—

The cellulose-destroying organisms have been isolated of late and found to be anaërobes. They carry on their work of destroying vegetable fibre, vegetable cell walls, dead leaves, and so forth, in the mud, in pools and in marshes, in ponds, etc. And it is owing to their action that quantities of marsh gas are given off at various times. And in late researches in Neva mud a cellulose-destroying organism has been isolated, which, provided it is cultivated in the absence of air, fixes itself upon pieces of paper, causes the fibres slowly to swell and dissolve, and, in fact, destroys the fibre, destroys cellulose, and there can be no doubt that substances like paper are destroyed in that manner in the soil or in domestic sewage. This occurs only in the depths, but there have been cases described where actions of this sort can go on nearer the supply of air—say, at the surface of a liquid—provided some other organisms can protect the anaërobic one from the action of oxygen.

Q. A large proportion of the sewage must consist of cellulose or allied forms; there must be a considerable quantity of material of that kind in the sewage?

A. I should think so .... Materials like paper and wood and any vegetable refuse would, of course, contain a great deal—I mean comminuted substances, like straw, parts of vegetables that have passed undigested through animals, and such-like bodies, would contain large quantities of cellulose.

Q. But did I understand you to say that all the cellulose-destroying organisms were always those which acted under anaërobic conditions?

A. Yes; I think I am right in saying they are all anaërobic.

Q. You do not know at present of organisms which can destroy cellulose, and especially which would destroy simple suspended articles of cellulose and the like, under aërobic conditions?

A. I can recall none. No; they are all anaërobic that have been worked out; all the cases that I am acquainted with concern anaërobic forms.

Q. Then might we infer from that that in the disposal of sewage it is most desirable that, at all events, a part of the process should be of an anaërobic kind?

A. Yes; otherwise I do not see how much of the solid matter would be got rid of.

In the case of small installations, there are also additional reasons for anaërobic action. The varying nature and composition of sewage furnishes

one reason. The sewage of towns differs in its character, strength, and quantity, not only from day to day but from hour to hour, and the same holds good with regard to purely domestic waste. One of the great virtues of anaërobic action lies in the liquefying of the sewage and the equalising of its strength. Thus the strong sewage of one hour is mixed with the weak sewage of another, and a more equal effluent is produced for subsequent aërobic treatment. In a town system the sewage usually has to travel a considerable distance, often several miles, before it reaches the outfall. During this passage through the sewers anaërobic action is going on, and the sewage arrives at the outfall in a more or less septicised and liquid condition. But in the case of small installations the distance traversed is quite inconsiderable, the outfall sewer is perhaps only a few hundred yards long, and the sewage arrives in a very fresh condition, the fœces and paper being little if at all broken. I was once asked to advise on a small double-contact bed system which was not working satisfactorily, the outfall plant was only some two hundred yards from the house. The outfall pipe at the first bed was choked with fœcal matter and paper. The gardener, who looked after the plant, told me that he had periodically to clear out this accumulation and bury it. I have also seen other plants where the sewage arrived in a more emulsified condition but where the bottom was similarly clogged up with the solid matters in suspension.

The Application of Anaërobic Conditions.

I have endeavoured to indicate on several grounds the inevitability of utilising anaërobic action for the reduction of the suspended solids, and the main consideration now left to us is the manner in which this action shall be applied. The combination of anaërobic and aërobic conditions in the ordinary coke contact bed has proved a failure, because of the clogging and the difficulty and expense of renewing the coke. Mr. Dibdin's new patent slate-waste beds at Devizes seem to promise well; but, even if the clogging difficulty is largely overcome, they do not remove the objection, already given as regards small installations, that the solid fœcal matters and paper are liable to choke the bottom of the bed before sufficient time has elapsed for digestion. Small contact-bed systems have, ere now, been provided with grit chambers, ostensibly to catch sand and other irreducible mineral matters, but in reality to intersect the solid fœcal matters, paper, etc. And if you have to periodically clean filth out of the grit-chamber, you might just as well do without any treatment works at all.

Generally speaking, for small installations an anaërobic tank will be required. I say generally speaking, because I can quite believe if the outfall drain is long enough the sewage of a small installation might be delivered sufficiently liquid and emulsified in condition to turn direct into a Dibdin patent contact bed, but these cases would be few and far between.

The tendency lately in regard to the anaërobic tank is to try to arrange a zonal or advancing treatment of the solids, so that the liquefied effluent is delivered to the aërobes in the best possible condition for nitrification. Finality here has not been reached, and in many cases there is a danger of the sewage being over-septicised, in which case it becomes exceedingly foul and intractable.

Subsequent Aërobic Treatment for Anaërobic Tank Effluent.

The filters and beds used for the subsequent aërobic treatment to eliminate the dissolved organic matter need only be briefly touched upon here. Coke contact beds have, for this, answered very fairly. They constitute one class of filter in the final treatment. In them the hydrolised sewage is "held-up" for a certain time. The other class of filters is that known as flow filters, this class including streaming filters and trickling filters. The streaming filter is always full, and the ingress and egress of the sewage is fixed at the same rate, so that the level never alters. In the trickling filter the sewage does not flood the beds, but is sprinkled or showered over the surface and trickles through. The sewage is sprayed either continuously or intermittently.

No Effluent Bacteriologically Safe.

A bacteriological examination of the most satisfactory effluent obtained by any process will reveal the presence of various organisms that must be regarded with grave suspicion, although chemically the effluent is irreproachable. It seems impossible to produce an effluent that, bacteriologically regarded, is safe to discharge into a potable water source. The idea of sterilising effluents by the aid of heat has, therefore, been suggested, and may possibly be further developed.

In a further paper I shall attempt to deal with some of the plant and apparatus which have been devised for small installations, together with some notes on their planning and laying out.

J. H. Elder-Duncan.