

No. I.]

Price £1. 4s.

[Dec. 1, 1826.]

DESCRIPTIONS AND DELINEATIONS

OF SOME OF THE

PUBLIC AND OTHER EDIFICES

AT AND IN THE VICINITY OF

MADRAS,

WITH

OTHER OBJECTS NEAR THAT PRESIDENCY.

By T. F. DE HAVILLAND,

LIEUTENANT-COLONEL OF MADRAS ENGINEERS.

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LETTER-PRESS.

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| 1. ACCOUNT OF ST. ANDREW'S CHURCH. | 2. ACCOUNT OF ST. ANDREW'S BRIDGE. |
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LONDON:

PUBLISHED BY KINGSBURY, PARBURY, AND ALLEN, LEADENHALL-STREET.

No. II.]

Price £1. 4s.

[April 1, 1827.

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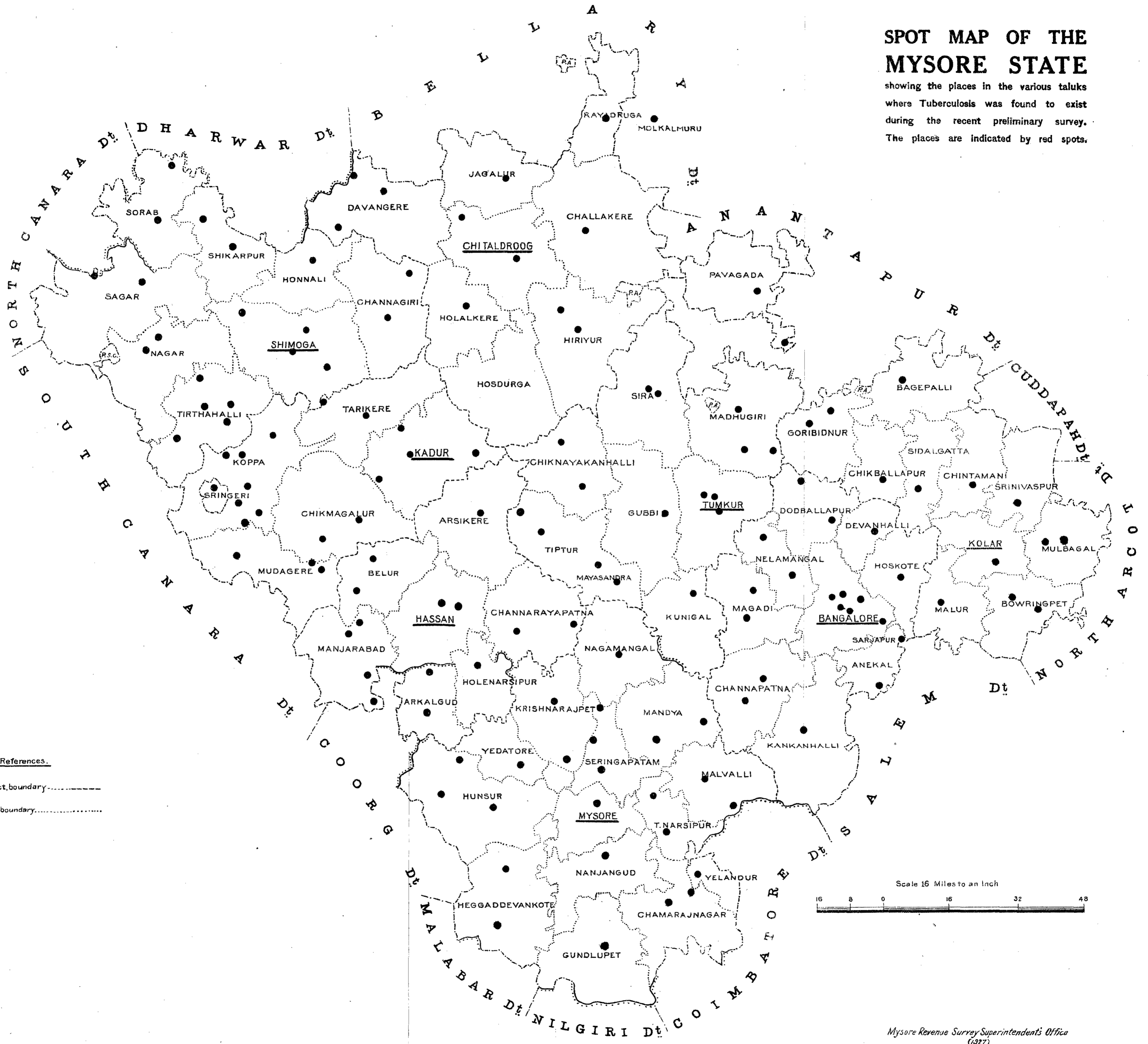
LETTER-PRESS.

1. CONTINUATION OF ST. ANDREW'S BRIDGE.
2. ACCOUNT OF THE ARMOGHAM SHOAL, ON THE COROMANDEL COAST.

LONDON:
PUBLISHED BY PARBURY, ALLEN, AND CO., LEADENHALL STREET.

SPOT MAP OF THE MYSORE STATE

showing the places in the various taluks where Tuberculosis was found to exist during the recent preliminary survey. The places are indicated by red spots.



References.

District boundary.....
 Taluk boundary.....

Mysore Revenue Survey Superintendent's Office
 (1927)

LITHO, GOVT. PRESS BANGALORE.

M.P.P.



Drawn and Printed by Maxwell Esq.

J. Gantz Pinx.

NORTH WEST VIEW OF ST. ANDREW'S CHURCH MADRAS

AN
ACCOUNT
OF
SAINT ANDREW'S CHURCH,
MADRAS.

Soon after the publication of the last Charter for the Honourable the East-India Company, in 1813, the members of the Scottish Church in India adopted measures to have *kirks* built at the different Presidencies, and accordingly, about the year 1816, the first was erected at Calcutta, which, generally speaking, is a handsome edifice.

Some difficulty arose, however, on the score of steeples, proposed to be added to these *kirks*, and it was understood that Doctor Middleton, the Bishop of Calcutta, had opposed it, as an unusual and unconstitutional measure, inadmissible *out* of Scotland; but Dr. Bryce, the head of the Scottish Church in India, persisting in support of his own establishment, carried the point, and the *kirk* steeple rose in proud majesty among those of the English Church.

Madras was the next presidency at which one was to be erected, and the Government there having lately built St. George's Church on Choultry Plain at the Company's expense, for the Church of England service, could not, with consistency, do less for that of the sister kingdom. The necessary orders were consequently given, for purchasing a piece of ground which should afford a fit site for it, and for preparing plans and estimates for a suitable edifice.

The situation selected was in some respects the most unfavourable that could have been chosen, especially as regarded the nature of the soil on which the structure was to be founded; it was also in an unpleasant neighbourhood, on the banks of the Chintadripettah river, which, for many months in the year, had little water in it, and that often stagnant and unwholesome: it was, moreover, near the noisy village of the same name, and its pagodas. But it had advantages which weighed in the opposite scale; it was not far from the boundaries of the Esplanades, and therefore convenient for any part of the garrison of Fort St. George which, if of that church, might be disposed to attend its service. Over

every other consideration, however, the apparent cheapness of the bargain (the prime cost of which was only 4,000 pagodas) prevailed.

The plot purchased contained six or seven acres of land, and on it stood the Old Freemasons' Lodge, built about thirty years before by Mr. Lucas of the medical establishment; who, though he might have been a very good *mason*, was certainly a wretched architect: but he was a busy man in his days, and spent a great part of his life in speculations; among other fancies, his mind was long bent on the discovery of a perpetual motion.

The ground, low and marshy, was frequently overflowed during the monsoons; but that vicinity was undergoing improvements by the erection of a bridge, since named St. Andrew's, and by the deepening and contracting of the bed of the river.

The old building on the ground served for the *kirk* and the minister's *manse* till the new one was completed, and was afterwards *removed*.

When the plans were called for, Lieutenant Grant, of Engineers, acting temporarily as Presidency Superintending Engineer, submitted one. The Elders of the kirk had determined on a *circular form*, and as great anxiety was manifested to have the work begun immediately, much feeling having been excited on the question of *steeple*s, and the Engineer himself wishing to begin the work before he should be superseded, recourse was had to the ready expedient of borrowing from another, and Gibbs' plan for a circular church, proposed for St. Martin's Lane in London, about seventy years ago, (but set aside for the present building on account of the great estimated expense) was resorted to. With a few alterations, a copy of this plan was submitted, on a somewhat reduced scale.

It was in like manner hastily approved. The Right Honourable Mr. Elliot, the then governor, being favourable to the object in view, found no fault with it. But another question then arose between the Bishop and the Scottish Ministers, as to the competency of the latter to marry and baptize in their *kirks*. This question seemed to be of such vital importance, that the building of Saint Andrew's at Madras was postponed, until an answer should be received to the reference made by Dr. Bryce to the Mother-church on that subject.

The ensuing year, 1817, a favourable reply having been received to this reference, and more time and attention bestowed on the plan, it was found objectionable in many particulars, more especially in the nature of the proposed roof, which would have been difficult of execution, much more expensive than anticipated, and not sufficiently strong or durable for an edifice of that description.

The chief engineer, Colonel Caldwell, reported officially upon it: he was of opinion that the roof intended would never answer, and recommended that the dome should be covered with lead or copper; but such a covering, at Madras, would have rendered the church scarcely sufferable from heat; besides, that it would have been very difficult, if possible,

to have secured the wood-work from the white ants, as has been evinced in St. George's Church on Choultry Plain, whose organ has narrowly escaped being completely reduced to dust by that persevering and destructive insect.

The plan was further objectionable as to the doors and windows, which were too small, and not suitably disposed for the local temperature; while the manner in which the vestry and other rooms were to be attached to the body of the church was both inconvenient and unsightly.

A want of taste was also thought to pervade the architectural proportions and combinations; but above all, the foundations not having been planned with a knowledge of the site which the building was to occupy, were very insufficient for the security of any edifice in that soil.

The estimate, which had been prepared with equal haste, amounted to 34,000 pagodas; exclusively of the lead or copper with which the dome must have been covered, and of many other *items* omitted.

Meanwhile, the author of these remarks had been called to the Presidency to take charge of the Superintending Engineer's department, and after communicating with the Minister and Elders, he reformed the plan, and submitted it with all its details for their approbation, which was obtained in the most flattering and unqualified terms, and subsequently confirmed by the Government.

The circular form was retained, and the dimensions originally proposed generally adhered to; but in other respects the plan was entirely new in design and construction. The main object was, strength and permanency combined with lightness and neatness. Above all, the total abstraction of timber-work in the roof was desirable: first, because, in the vicissitudes of that climate, even the best-seasoned wood soon perishes; and secondly, that it never can be completely secured against the depredations of the white ants. On these grounds it was resolved to dome and arch the building with masonry, if it could be safely contrived without making it heavy, or taking away from the elegance of the design. Such an undertaking was of no small difficulty without incurring very great expense, and was even by many considered impracticable.

The edifice may be thus described. The body of the church is a circle eighty-one feet and a half diameter in the clear, with a rectangular compartment east and west of it, and a portico extending beyond the latter to the westward. Over the circular part is a dome, covering as it were the *nave* of the church, with an *annular* arch round it over what may be termed the *aisles*.

This dome is fifty-one feet and a half in diameter, interior measurement, borne on sixteen columns, disposed at unequal distances; thus, the whole circumference of the *soffit* of the

entablature is divided into sixty-four parts, *five* of which are given to the two inter-columniations through which the main passage leads, from the principal entrance westward to the pulpit and sacramental room; *two* parts to the next inter-columniations on each side; and *three* parts to each of the ten others; which, with the sixteen diameters of the columns themselves, each equal to *one* part, make up the sixty-four parts of the circumference taken in the centre of the entablature.

The architrave and frieze, which stand on the sixteen columns, are of stone, laid in the manner of a *straight arch* perfectly horizontal; but the cornice above is of brick; and on it rests the dome, the *equilibrium* of which is preserved by the *lateral* pressure of the annular arch round it resting on the outer walls of the building.

Of the sixteen columns above-mentioned, the four bearing the principal inter-columniations are of granite; the remainder are of the same kind of stone as the architrave and frieze, and of what is at Madras termed the *iron-stone*: an indifferent sort of material, apparently composed of clay and *scoria of iron* more or less honey-combed, but which by experiment has been found to be of a consistency sufficient to resist a pressure, *three* times as great as bricks would bear, without being crushed; and it is calculated that if these stones were well selected and laid, the columns might support *seven* times as much weight as is actually laid on them.

The capitals of these columns are all of granite to secure the volutes, which are ponderous, from breaking off by their own weight or by accident; and on each capital stands another block of granite, against which the *straight arch* of the entablature presses and is supported. The *voussoirs* are about three feet high, the whole breadth of the entablature, and one foot thick.

The dome is so constructed as to relieve the entablature by means of arcades, wrought into it and resting on the columns; while at the same time it is, as it were, but a frame-work of brick, running upwards from the columns also towards the crown, where these *ribs* are terminated and united together by a circular arch of the same description. This frame-work is then filled in with masonry formed of *cones* of pottery, such as are used in *Syrian roofs*.

The purpose of this mode of construction was; first, to relieve the entablature between the columns; and secondly, as already remarked, to obtain as light a structure as possible (which was of moment in so unfavourable a soil), consistently with strength and durability.

With a view to render the equilibrium of the whole still more perfect, the arcade, built into the dome as above described, is carried outwardly, above the terrace of the annular arch, to the exterior limit of the upper diameter of the columns, where it rises perpendicularly to the height of the balustrade which surrounds the building, and where it terminates into a *cordon*, from which two steps retreating unite it to the exterior curve of the dome;

these steps themselves standing on a small *scheme annular* arch, which tends also to lighten the edifice. This combination at once resists the lateral pressure of the dome, and stabilitates the columns on which it rests.

The interior form of the dome is a segment of a sphere, fifty-one feet and a half in diameter, and twenty-four feet high, including the entablature, making the whole height under the key from the pavement about fifty-four feet. In the interior of the dome, above the entablature of the order, stands in relief a balustrade, through which is seen, as it were, the azure sky, the canopy of heaven; represented by the stucco of the dome coloured with *lapis lazuli*. This appearance gives to the whole an awful grandeur, which could not have been expected in so small an edifice.

The balustrade, however, rising against the curve of the dome, and not being quite perpendicular, appears, as seen in the drawing of the interior of St. Andrew's, in discordance with the strict rules of architecture; but when viewed from beneath the dome, it does not offend the eye as might be supposed: and its height having been diminished to assist the perspective, the defect is rendered less obvious. Similar anomalies, however, may be traced in the works of some of the best masters of the art: in St. Paul's Cathedral, for instance, that *chef-d'œuvre* of the *great Wren* and of British architecture, the pilasters in the interior of the cone supporting the dome, if examined in the drawings, will be found to have a similar defect, arising from their convergence; but the defect does not offend the observer below, while it in fact adds to the grandeur of the scene, by giving the appearance of greater loftiness to the cone.

This may be a fit place to remark, that when the entablature above described was placed on the capitals of the columns, a rod of iron, one inch in diameter, was carried round in a groove under the soffit, which passing between the blocks of stone and the capitals, formed a complete ring; it was then supported by iron Y's, in the foot of which was an eye to receive it, the two tops of the Y's running into the arcades of the dome above-mentioned. These Y's descending through the entablature grasped the ring in the middle of each intercolumniation and kept it in its position. No great resistance was expected from this ring, and the object of it was chiefly to observe if any movement should take place in any part of the circle from an imperfect equilibration in the dome and annular arch, and to keep the whole together in its place whilst the scaffolding was removing. But no movement whatsoever was perceived, the ring suffered no more strain than when applied, and might easily have been removed; but as no inconvenience from it was anticipated it was allowed to remain, and the groove was stuccoed over.

Subsequently, and after the church had been completely finished, the columns were carefully examined, but no *horizontal* fissure or crack was perceived in their whole height:

proof that the equilibrium was well established, and that no movement had actually taken place in the entablature supporting the dome and annular arch.

The annular arch, it may be here stated, was also chiefly composed of *pottery cones* like the dome, the springs of it only being of brick.

The order within is the Composite, the whole height thirty-five feet, of which three feet six inches are taken up by low circular pedestals the height of the pew rails; the entablature is five feet four inches, and the column, including base and capital, twenty-six feet two inches. The pedestal is made circular for convenience, as it is not seen; and the base, standing immediately above the pews, leaves the whole column exposed to view. The diameter of the columns is two feet seven inches and seven-eighths, and diminishes to the top only one-eighth; but the shaft is *fluted*, and *rudented plain* one-third of the height, to give it gracefulness and lightness.

Corresponding with the columns, and in a line with them drawn from the centre, are single pilasters against the wall of the edifice, *projecting* one-fourth of a diameter, *fluted* and *rudented* one-third, but straight without diminishing at top, such diminishing being of bad taste, even when the pilasters stand near the columns. Between the pilasters arcades are shewn of the same depth as the pilasters, in each of which is a circular-head door and an oblong attic window above it. The arcade is terminated by an *archivolt* resting on an *impost*, and keyed with a *console* bearing the architrave from which the annular arch springs.

The frieze of the entablature which supports the dome is formed of projecting *fascies* wreathed; and the *soffit* of the *straight arch* or entablature is pannelled, and enriched with foliage between the columns: other parts of the entablature are also lightly ornamented.

In the *annular arch-way* or *aisle*, the architrave of the order is alone preserved; from which the arch springs; a lighter and better effect is thus obtained for a small span, while by the lateral pressure of the arch placed in this manner, a better counterpoise to that of the dome is obtained: above the architrave is a neat Etruscan border.

The thickness of the dome at the crown is only nine inches, whence it gradually increases to nearly twice that dimension at the cornice. Over the *Syrian cones* already mentioned, three courses of flat tiles are carefully laid, and on them the stucco is applied.

Without arrogating to himself any particular merit in the edifice, the engineer may, he believes, safely say that it is the only building extant, or at least generally known, in the world, wherein a dome of masonry of those dimensions is supported on a colonnade of that height, the entablature of which is a *straight arch*, without beam or lintel. Many larger domes exist, doubtless, but they are supported on solid walls or strong arcades; and if any there be resting on colonnades, it is where the intercolumniations are small, and by means of strong beams or massive stone lintels cramped together, and not acting as *voussoirs* against each other. In

the present case, the span of the largest intercolumniation or *straight arch* is sixteen feet from the centre of the columns supporting them. But the unfavourableness of the soil rendered the undertaking by much the more difficult, since any deficiency of equilibrium in the several parts could not be indifferently made up by excess of solidity, without running the risk of partial and unequal *settlements*, which would have rent the building in every direction.

. On the same principle, the walls of this edifice were made as slender as consistent with security; and it will be found that few buildings of a solid construction, like St. Andrew's Church, stand on so small a surface of supporting points as it does, compared with the whole area of the edifice. The adoption of arcades and pilasters within, and of pilasters without, led powerfully to this desired object.

The doors generally are fifteen feet high by six in breadth; and the attics oblong, corresponding in breadth with the doors, and four feet in height; but the eastern window is twenty-four feet by nine feet two inches. None of the doors and windows are glazed: they are *venetianed* to admit light and air; and the attics are panelled and turn on horizontal pivots.

The eastern rectangular compartment contains a long room, into which the body of the church opens through a lofty arch (as seen in the drawing of the interior) immediately behind the pulpit, which exhibits a grand appearance, scarcely to have been looked for in so limited a construction. This room is forty-eight feet by twenty, and is intended for the administration of the Lord's Supper when it may not be convenient to use the *nave* for that purpose, as is most commonly the practice in the Scottish Church. It is flat-domed, with *Syrian cones* in three compartments, supported on eight columns of the Composite order, with pilasters behind them, surmounted by an entablature, in which, to render the stile less heavy, the *frieze* has been omitted. Above this entablature angular *pendentives* spring to support the oval and circular domes. The whole height of this order is twenty-one feet and a half, but without pedestals; and the entire height, from the ceiling to the pavement, is twenty-nine feet and a half.

Above the middle part of this apartment is erected a small room, behind the eastern pediment (domed also), for the elders to keep their records, plate, &c. and to hold their meetings. The whole construction of this compartment is not incurious, inasmuch as no timber is employed in it, and even very little iron.

On each side of the arch leading to the room below from the body of the church, and in the thickness of the wall, is a spiral staircase of masonry, leading up to the record-room and to the terrace above the annular arch, which forms a pleasant walk; the light is introduced into these staircases by small apertures between the pairs of exterior pilasters, which are scarcely perceptible to the observer.

The rectangular compartment to the westward corresponds in exterior form and dimensions to the other; it contains the base of the tower and steeple twenty-four feet square (in which is the vestibule, fourteen feet in diameter), with a room on each side twenty-two feet and a half by twelve. These side rooms, through which there are other entrances into the church, are intended to hold staircases to the galleries, whenever it may be deemed necessary to erect them for additional accommodation. One of these staircases is already constructed, and leads to the tower and steeple; nor would it be attended with much difficulty to establish galleries, and an organ-loft opposite the pulpit, although, when St. Andrew's was built, they were both expressly forbidden. Such galleries should be supported on iron standards free from the columns.

The effect of a good instrument in this church would be admirable, and few apartments could be better suited to the solemn and lengthened notes of an oratorio or other sacred music.

When this temple was first opened for divine service a considerable echo affected the voice of the minister, so as to render it rather indistinct to the distant parts of the congregation; but much of this inconvenience was attributable to the advancing age of its minister, that venerable and most amiable *single-hearted* man, the Reverend Dr. Allan, D.D. and M.D. Alas! he did not live long to perform the divine offices of his calling in that edifice: he had himself laid the *corner* stone of it, and daily watched its growth to completion, as an anxious father would have done that of a favourite child, to maturity. This echo, however, which was the result of the circular form adopted in the building, was more remarkable from the newness of the stucco, which for a considerable time continued to retain some degree of moisture, a condition which, it is well known, from the pores being filled, favours the reverberative tendency of the surface; but it would gradually lose that tendency as the masonry and stucco exsiccated. Any echo proceeding from the concavity of the dome could not interfere, from the centre of reflection being far above the congregation, and therefore the inconvenience must proceed from the circular shape of the walls chiefly, and as they are much broken into arcades, pilasters, doors, and windows, it will not long be sensible.

The steeple stands on the tower which is raised over the vestibule to a level with the crown of the dome, and rises above it $111\frac{1}{2}$ feet, divided into three stories, a spire, ball, and weather-cock; giving to the whole an elevation of $131\frac{1}{2}$ feet above the entablatures, and of $166\frac{1}{2}$ feet above the pavement of the church. The first story is square, with Venetian doors in recess, covered by pediments on projecting columns of the modern Ionic order. The second is octagonal, with columns at the angles of the Composite order, disengaged about two-thirds of a diameter; and the third is circular, with eight Corinthian columns projecting two-thirds of a diameter, as in the second story; and the spire, on an octagonal base, is fluted: the whole gradually tapering into a pyramid, whose height to its base, is as 14 to 3 nearly, offering

a pleasing object to the eye of the observer. The weathercock, which is of copper, is made to turn on a *red-wood* spindle, to neutralize as much as possible the fatal effects of thunderstorms.

The steeple, as above described, is taller by eleven feet and a half than that of St. Martin's Church in London, which has lately been brought into view by the prolongation of Pall-Mall and the street in front of the King's Mews, estimating that steeple to rise about one hundred and twenty feet above the entablatures of the building.

On the 8th May, 1820, the steeple was completed, and on the 11th, only three days after, was exposed to imminent danger in a most violent storm while the whole of the scaffolding was still about it, opposing a surface to the raging elements three or four times the area of the steeple itself. The wind blew with the greatest violence for thirty hours, chiefly from the north-east, during which period, sixteen inches of rain fell at Madras; and the scaffolding, which was framed of heavy spars and purlings, was blown against it; but the steeple resisted the whole storm unhurt; and fortunately for Dr. Allan, who was in the *manse* below, and could not have ventured without doors, none of the timbers detached themselves. No measures could be taken for his relief till the storm subsided, although much anxiety was entertained for his safety, the wind blowing exactly in the direction of the *manse* in a most tremendous manner. This memorable storm continued for the whole time with the same unbated violence across the Peninsula, and was felt at a considerable distance at sea.

To the westward of the compartment containing the steeple, stands the portico, of the modern Ionic order, on a colonnade *doubled* in its depth, surmounted by a pediment along the whole front, in the *tympanum* of which the sacred name *JEHOVAH* appears in Hebrew characters of gold in a triangle, emanating rays of glory; while in the frieze below stands the name of the edifice and the date of its erection. There are three doors under the portico. The middle one, supported by pilasters and an entablature, leads through the vestibule directly to the body of the church; the others, through the side rooms, to the circular passage on either side. The reason for doubling this colonnade was the better to support the roof of the portico, which is entirely of masonry on the same principles as the dome, with *straight-arch* entablatures in lieu of beams or lintels. This double colonnade suited with the rest of the exterior architecture, consisting of columns and pilasters *in pairs* of the same order, also gives a sufficient depth for the stone steps leading up to the portico to be under cover, so that the carriages may draw up to them conveniently: a most desirable arrangement in low latitudes. The whole length of the portico is fifty-seven feet; the breadth, out and out, eighteen feet and a half, and eleven feet within the columns.

A few iron bonds and Y's were used to prevent any movement in the work while the centerings of the portico were removing; but when done, there appeared no stress on them

whatsoever. Blocks of granite on the capitals unite the pairs, and serve as abutments for the straight arches.

The use of pediments in terraced buildings, where the pitch roof is not continued from them with the same slope, is in itself an anomaly, since pediments in their origin were in fact the gable-ends of such roofs. They are, however, in very common use without any reference to the roof, especially in India, where terraces are preferred; and with more or less good effect, as the buildings bearing them are more or less lofty. But an obvious defect in these *vain* structures consists in their extending only to the *edge* of the upper diameter of the column *interiorly*; while exteriorly, the cornice projecting a diameter or more beyond the column, seems to make the pediments totter, and to be in danger of falling forward at the slightest blast; that, at least, is the impression which prevails when they are seen in profile. To avoid this awkwardness in the present case, the pediment is made to extend over the double colonnade, and besides that to project as much *inwardly* as the cornice does *outwardly*.

The advantages of this arrangement is not confined to the mere appearance, but is turned to essential use; for the pediment being arched and bearing on the columns only, tends to stabilitate the colonnade without dwelling heavily on the intermediate entablatures, having but a very thin wall in front for the *tympanum*. The sections of this pediment will render these details obvious; and it will be seen that the doubling of the colonnade of the portico has no bad effect in the view taken of it in any direction.

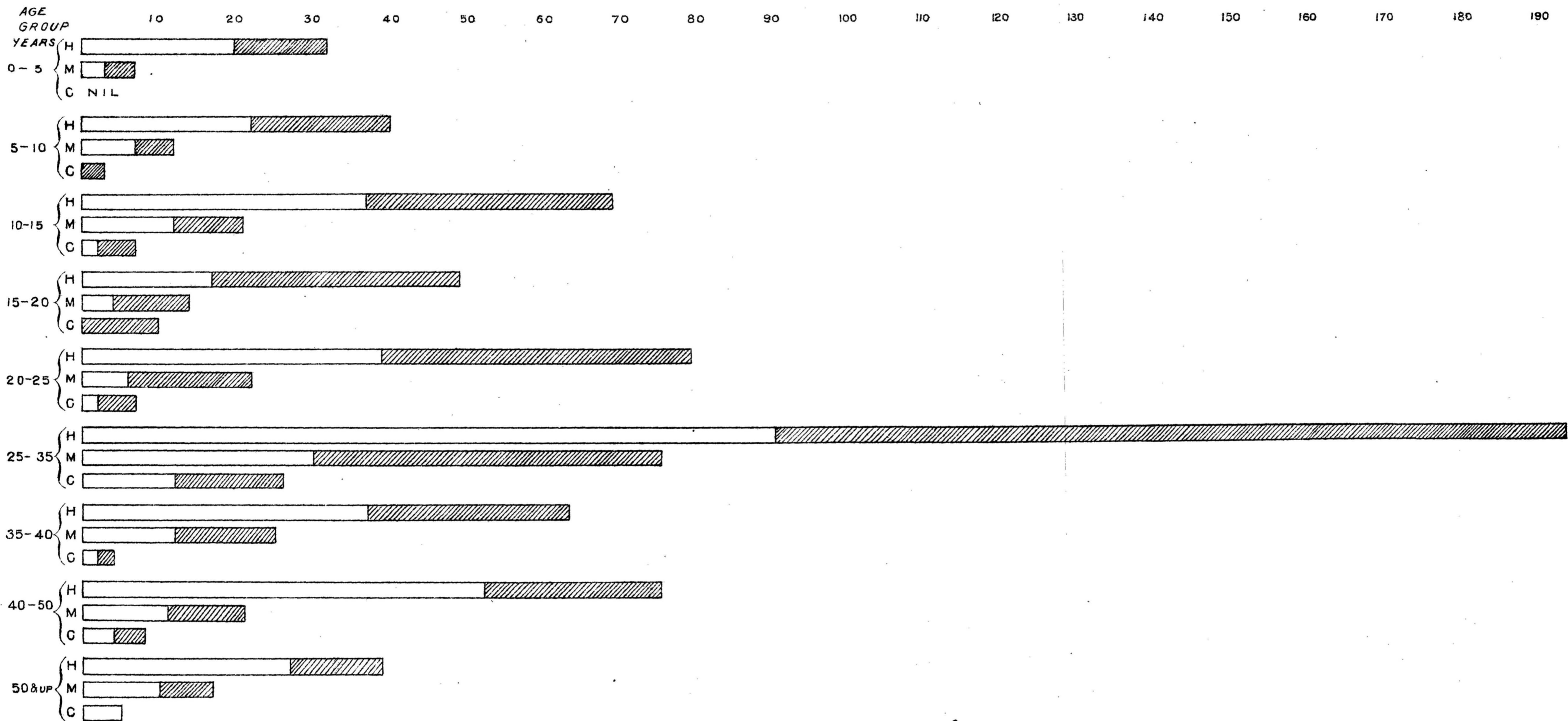
The basement of the building is four feet high, and serves as a plinth to the order (which has no pedestal) all around the edifice, running *flush* throughout, as well as the entablature, without breaks. This gives the appearance of neatness and of additional strength to the edifice.

The eastern elevation, wherein the large window into the sacramental-room is conspicuous, has pilasters to correspond with the columns of the portico, which are thus disposed of; the middle inter-columniation occupies *four* diameters in the clear; those on each side, *three*; and these are bounded by pairs of columns or pilasters separated by half a diameter. In the pediment to the eastward are wrought the Company's arms in relief with Parker's cement, with the motto in gold letters in the frieze beneath. The elliptic shield of the arms serves for a window to the record-room above.

The exterior order, like the interior, is thirty-five feet high; the diameters are three feet two inches and an eighth, being *one-eleventh* of the whole height, or *one-ninth* of the column itself; the entablature two diameters. The pilasters run up without decreasing, but the columns diminish one-eighth; they are both *fluted*, and *rudented one-third* up.

The north, and south elevations of this church will not be found wanting in neatness and

*DISTRIBUTION OF TUBERCULOSIS IN MYSORE DURING 1926,
ACCORDING TO SEX AND COMMUNITY IN EACH AGE GROUP.*



H=HINDOO
M=MUSSALMAN
C=CHRISTIAN

*BARRED PORTION = FEMALES
UN-BARRED PORTION = MALES*

chasteness. The columns and pilasters are disposed in pairs, and give the appearance of solidity which becomes such a temple. The circular part of the outline of the plan on each side is cut off to form a *fronton* corresponding with the ends of the octangular compartments; and as this cutting off takes away from the strength of the walls where the lateral pressure of the dome and annular arch is considerable, two pairs of columns are advanced in front of the pilasters, forming a small porch over the side entrances into the church, at which the steps are also constructed under cover. These columns are well connected with the pilasters and walls by blocks of stone and masonry, which, with the *finishing* or *amortissement*, and a *sarcophagus* above, form a compact resisting body.

In these elevations of the church is shewn how the circular part of the building is connected with the rectangular compartments on each side by means of a *bent* pilaster. This expedient seemed to be the best for the occasion, although *bent* and *inserted* pilasters and columns should, as much as possible, be avoided, as defective in taste and elegance; but they are to be met with in many buildings, and occur frequently in the Cathedral of St. Paul's already referred to.

The balustrade round the building is of the same height as the entablature, and serves to screen the arcades of the dome above, and to make the dome itself as little conspicuous as possible, so as not to take away from the loftiness of the steeple, which is the principal object. The entablature, without being loaded with decorations, is not altogether plain: its frieze is filled with an Etruscan border, and some of its members are foliated. The capitals of all the columns in and out are of stone, so that the volutes are in no danger of giving way, as occurred at the Madras banqueting-room, when it became necessary to remove them all, and to change the style of the order altogether.

The ratio which the whole area of the church bears to that of its walls and columns, is as 6.658 to 1; and that of the interior area of the body of the church to the section of the sixteen columns supporting the whole roof, as 5.973 to 1. The former ratio is nearly the same as Rondelet finds in the church of Saint Sulpice at Paris, but greater than that of St. Paul's in London, which is as 6 to 1; and the latter is within a small fraction as great as that of St. Joseph at Palermo, the lightest building mentioned in Mr. Rondelet's Tables. The area of the ground which St. Andrew's Church covers is 10,193 feet.

The stucco with which the walls are incrustrated inside and out is put on with the greatest care; the columns especially, which actually resemble beautiful parian marble in whiteness and in polish. The Madras stucco or *chunam* is renowned for its superiority over every other, and this edifice offers a fine specimen of its elegance and beauty.

The pews and pulpit are of mahogany: the former erected on curves, concentric to the latter; light, airy and convenient, with a *shaped* back and arms to each sitting. The

pulpit is a neat specimen of the gothic order. There is only one reading-desk for the precentor, the minister performing the whole service in the pulpit. Even baptism is there administered, and for this purpose a silver basin or font is attached to the pulpit on the minister's right hand, the parties coming to the baptism standing below it on the platform.

The floor of the interior is laid with marble tessellated, slightly veined, and the portico and all the steps with granite.

There remains still to be described the foundations. It has already been remarked, that the soil was most unfavourable, as indeed it is throughout the vicinity of Madras. The practice which has obtained from time immemorial in this part of India to secure edifices in such cases is a simple and a most efficacious one, worthy the notice of architects in general: it is that of substituting *wells* for the pile-work used in Europe.

In the present instance, the whole area of the edifice, excepting a circle in the middle of about thirty feet diameter, was sunk as deep as it could with convenience, and until the water and the mud became difficult to controul. This was at about the depth of fourteen feet below the surface of the soil; it was then levelled and the wells formed and founded on that surface. These wells were of two kinds, of *brick* and of *pottery*, the former about four feet in diameter in the clear, the latter three feet.

The process of sinking these wells is as follows. If of brick, the bricks are made purposely for them, and of a shape to fit each other in their breadth in circular layers, like the voussoirs of an arch, of the usual thickness, and about seven inches long: a little longer as the diameter of the well increases. Before these bricks are laid, a ring of wicker-work, of the diameter of the intended wall and as broad as the bricks are long, is placed on the surface, and on it the bricks are carefully laid in horizontal layers, with a little clay mortar, very liquid, between them. A cylindrical wall is thus raised to a convenient height; or if known, as high above the surface as it may be required to sink the wells below it. The cylinder thus formed is then firmly bound together outwardly with hay or straw ropes or twists, wound round it from the bottom to the top: this done, the well-sinker gets into the cylinder with a basket, and with his hands chiefly when the mud is soft, sometimes with a *mammotty*,* a large short-handled hoe, and other fit tools, he excavates the soil from the bottom, and fills the basket, which is then haled up by other workmen on scaffolding above, and handed out of the way. In this operation great care must be taken to excavate *evenly* all round under the wicker ring, that the cylinder may preserve its perpendicularity. The process is thus continued until the cylinder disappears beneath the soil, or until the

* From *mum-vutty*, earth digger.

bottom is found to be of sufficient consistency for the object in view. If the cylinder be not long enough to reach to such a soil, it is raised again and bound round as before, and the well-sinker continues his work till the object, a good soil or rock, is attained. The well is then filled with brick-bats, sand, shingle, small stones, or any other substances which will neither *dissolve* nor alter their volume in water, and will admit of being rammed down to a solid consistency.

The wells having been placed as near to each other as practicable, the interstices between them are very limited; but these interstices are also to be filled up and rammed down with the same kind of materials as the wells themselves. The whole space is then levelled to an uniform surface, perfectly firm and impenetrable, on which the masonry of the foundations is established.

The pottery wells are fitted up and sunk like the others, but the cylinders are formed of *baked* rings, formed in frames two to three inches thick and five or six in height, *in lieu* of bricks. These, however, are seldom used for wells much more than three feet; while, on the contrary, wells even from twelve to fifteen feet in diameter, are often sunk with brick in the way described above, and to a very great depth.

The *well-sinkers* are a distinct set of people, of the agricultural or labouring class, in Lower India. They intermarry among themselves only, not even, it is said, with the *tank-diggers*, whose avocations and labours are of so similar a nature. They travel about the country in small companies or families, with tents or sheds, in search of employment; but in the vicinity of Madras, where their labours are constantly in request, they have had, for the last forty years, a settled place of habitation, and reside there in huts and small houses. They are very hard-working people, but not provident though well paid while employed. They are given to drinking, perhaps more than other classes of labourers, from their practice of taking spirits while sinking the wells, in order to sustain them in their great exertions, and to preserve them against the effects of cold and wet.

While sinking the wells they are almost always immersed in water, having no more clothing on than decency requires; and though the water gains on them they continue their work by diving beneath it, remaining below a considerable time at each immersion. The practice of allowing the water to rise over the men is to save the expense of baling, which would be considerable, and also to obviate a greater evil, which would accrue if *baling* were attempted; for the water, forcing itself through the interstices of the bricks, would wash away the mortar and derange the cylinder, which would then fall in. In pottery wells, however, it may be and it is often done: there being less space in these, the sinker is more embarrassed, and would find it difficult to come to the surface for breath if the water were deep. As the exertion of working under water is very great, they relieve each other very frequently, the

one employed in drawing up the basket taking the place of his fellow below. The women and children do not assist in this part of the work, but they receive and remove the soil from the man who raises it out of the well.

All wells for water are sunk in the same manner wherever the nature of the soil admits of it. The clay mortar, in these cases especially, is laid very thin. The dimensions of water-wells are suited to the purposes for which they are required, and to their depth. Sometimes the wells are made to diminish in stages as they are sunk, and in this manner many wells have been carried to the depth of fifty feet. When required for foundations, the diameters are regulated by the nature of the walls or revatments they are intended to support.

In the plans annexed, it will be observed that the larger wells of brick are disposed of under the more essential parts of the building, and that they are supported by the smaller of pottery. On the same plan is shewn in dotted lines the outline of the foundations as laid on the top of the wells, which foundations diminish regularly upwards to the dimensions at the basement shewn in the other plan. In order to stabilitate the edifice and to bind every part firmly together, all the foundations are connected by vaults, from a half to a whole brick thick, upon a rise of three or three and a quarter feet: that is to say, the vaults spring at the ground level, and rise to receive the pavement at the top of the basement, the spandrils being filled up with broken brickbats and lime mortar, called in India *jully*.

Thus the whole area of the church comprises a series of vaults, which, besides strengthening the edifice, might at any time, if expedient or necessary, be converted into catacombs. Under the tower and steeple the large brick wells alone are used; and as it was expected that the greatly exceeding weight of that part of the building over the rest would cause its masonry to *settle* more than the rest, the further precaution was taken of having inverted arches under the rooms on each side of the tower, so that the weight of their outer walls should in some degree become a counterpoise to the tower.

The wells are sunk about nine feet, the foundations being raised about thirteen and a quarter feet above that, and the basement four feet more, make the whole depth below the pavement about twenty-six and a quarter feet. But even at that depth the soil attained was still of the nature of a *quicksand*, and to appearance not very solid: but it was a *sand*, a substance that would not dissolve or alter its volume.

The ground, when opened for foundations, proved to be as follows: First, a crust of vegetable and made soil, scarcely eighteen inches deep, below which was a foot or two of alluvious earth and sand; immediately under this, and at about the level of the sea at high water, commenced a stratum of black soapy salt mud, evidently a marine alluvion deposited there for ages, in which were many oyster-shells, some found single, others still joined together, but all perfectly flattened, and so far decomposed as to be easily crumbled to dust.

This stratum continued for eight or nine feet, when the mud became gradually mixed with quartz sand. Hitherto this mud had been found very soft and wet, but much water had not gathered in the trough; and although the workmen stood half-leg deep in it while working, there was not much difficulty in effecting the excavation: but as the sand increased so did the water, and it soon became necessary to establish and sink the wells as before described. As the sinking advanced the soil was examined; and after proceeding six or seven feet deeper, it was found to contain so large a proportion of sand, that the mud with it barely filled up its interstices, so that, even when washed clear of it, its bulk remained undiminished. The wells were, however, sunk two or three feet more; and as this kind of medium continued, it was determined to stop there, although, as before remarked, it was even then little better than a *quicksand*: but the whole area being *uniformly* the same, no apprehension was entertained of the result, as each part would be sustained *in equilibrio* with the other.

All edifices of importance along the Coromandel Coast, where the soil of the nature described prevails, are founded in this manner; and generally, wherever it can conveniently be effected, and where *welling* is neglected, the buildings very soon crack into fissures in every direction; for besides the *impression* which it necessarily makes in the mud, the rain during the wet season getting beneath the upper-stratum of clay and vegetable mould, through the fissures into which the hot weather has rent it, dissolves the salt, and offers a less resisting *medium* to the walls, an effect which becomes more visible every year. Almost the whole of Fort St. George is seated on wells in this manner; but those which are used under the sea face are built with lime mortar; a precaution very necessary, wherever the action of moving waters is to be apprehended, as under bridges, quays, piers, &c.

These foundations have been found, when judiciously secured, to answer perfectly well, and St. Andrew's Church stands firmly on its bed of wells. It may however be observed, that the great excess of weight in the tower and steeple over the remainder of the building has occasioned a slight fissure on both sides; but not a more considerable one than may be discovered in all edifices where the inequality of pressure is so remarkable.

It has before been stated, that in May 1820, when the steeple was just finished, a most violent and lasting storm occurred, which caused some anxiety for the safety of the edifice: but before that it had been exposed to a former one, which happened on the 24th October 1818. At this time the walls were raised up to the entablature, but the sacramental-room only was yet covered in: the dome of this apartment was just finished, and the centerings were not yet removed. The storm lasted no more than a few hours, but with the most raging violence: wind and rain, with vivid lightning and thunder. The velocity of the former was

computed to have been at least ninety-four miles per hour during its height; and the rain, although it was of comparatively short duration, amounted to a depth of five inches, and inundated the vicinity of Madras.

After it was over St. Andrew's Church was examined. No damage or mischief at first appeared to have been sustained; but, on a closer inspection, a crack was observed across the building, between the sacramental-room and the porticos on the north and south faces, obliquely from near the room on the south side to the portico on the north. During the storm the centerings of the sacramental-room had still remained, and though they were heavy, and supported on temporary brick pillars, their weight could not *alone* have been the cause of this accident, since the fissure observed was at a considerable distance from them, and that the whole weight, with the centerings, must have been as nothing almost, compared with that of the steeple; and hence there was every reason to believe that the edifice had been struck during the storm by a thunderbolt. It was, however, determined to prosecute the work, and the crack, which, though scarcely perceptible, could be traced from the top of the wall to the bottom on both sides, and through the foundations for the columns within, has not since suffered any change. Such cracks, however, in another construction might have proved fatal: they would have served as a gallery for the white ants up to the roof, which, if it had been of timber, they might soon have destroyed.

It is surprising that the expedient of *welling* for foundations has not been generally adopted in England, where, especially along the banks of the Thames and other oozy rivers, their use would be so expeditious, economical, and effectual. Cast iron zones might with good effect be employed, with *rebates* to fit on each other. In the new London Bridge, now erecting, they would have answered uncommonly well; and being of iron, it would not be necessary to keep the water in them while sinking, so that as many might be kept going as a steam-engine would keep clear of water, and the men in them work nearly dry. Their own weight and the sharpness of their edge would take them down easily, as fast as the soil could be removed from them with windlasses or cranes, &c., worked by the same engine. When sunk they might be filled with materials, rammed down with sufficient lime to consolidate in the course of time; so that if ever the iron zones should become corroded, the materials would remain a solid mass of masonry. Assuming, even, the supposition that the iron would corrode sooner than the wooden piles would rot, which may be a question, this mode of founding seems preferable to that of piling, generally used in England.

The long room of the Custom-House might, in like manner, have been secured against the fatal accident which has levelled it to the ground, and which will cost the nation so many pounds to repair; for this *welling* would have been peculiarly well adapted to those founda-

tions, wherein it has been stated that *old walls* were found which interrupted the piling, and prevented the piles being sufficiently driven. These, or any other obstacles, would have been easily removed, and the wells sunk as deep as necessary.

In the Tunnel now constructing under the Thames they might be most advantageously employed, in the event of the soil becoming unfavourable, or if there should be the least danger of the masonry sinking or settling. In short, in every situation they would be useful, and particularly so in a confined space, where the driving of piles would be very inconvenient.

The *first stone* of St. Andrews was laid under the north-west angle of the steeple, on the 6th April 1818, by the Reverend Doctor John Allen, D. D. and M. D., who then named the edifice, and blessed and consecrated it for divine worship, according to the rites of the Church of Scotland. The ceremony was simple, without procession or pageantry. Every thing having been prepared and a platform laid, the Minister, supported by the four Elders, came to the spot, accompanied by a numerous and respectable assemblage of the congregation. Under the stone was deposited specimens of the several coins of the British and Madras currency, and a brass plate, containing the following inscription on one side, and the same rendered into Latin on the other.

By the Grace of Almighty God,
in the Reign of GEORGE III, Father of his Country,
and during the Regency of GEORGE his Son,
the First Stone of this Edifice,
appertaining to the Church of Scotland,
was laid,
in the presence of
Robert Fullerton, David Hill, Kirkby Dalrymple,
and William M'Taggart, Esquires,
the Elders of the Church of Scotland at this Presidency,
by John Allan, D. D. and M. D.,
their Minister and Moderator,
on the 6th April 1818 :
The Right Honourable Hugh Elliot being Governor ;
Major Thomas Fiott de Havilland, Architect.

This inscription was also written on parchment, with other translations of it in the Tamul and Gentoo languages; the parchment likewise contained the relative value of the coins at the currency of the day, and with the coins themselves, was inclosed in a bottle hermetically sealed, for which a cavity had been prepared in a block of granite underneath; to be covered by the plate, and then by the foundation stone, after the intervening surface had been endued with mortar by the Minister. A silver trowel had been prepared for the

occasion, and the foundation stone suspended to a small tackle over the site, by means of which the minister unassisted performed the whole operation of laying the stone.

The prayer offered up to the Almighty on the occasion, by that worthy and truly amiable man the minister, was highly appropriate, and was delivered so impressively as to reach the hearts and feelings of all those who were present. It is inserted here, a tribute to his memory, whose great characteristics were meekness and singleness of heart. His one desire and constant prayer, poor man, was to see this edifice completed, and to perform the service of his God in it ere he died. The Almighty vouchsafed his prayer; but, alas! he did not grace the pulpit long; he was soon called away to better climes! It was a remarkable circumstance, that the great bell which was put up in the tower was tolled for the first time at the funeral of this good man.

THE PRAYER.

“ Almighty and ever gracious God! we, thy humble and dependant beings, desire to
 “ approach the footstool of thy throne to celebrate thy unsearchable perfections, to
 “ acknowledge thy righteous administration, and to express our thankfulness to Thee for our
 “ privileges as members of society and as Christians. We adore Thee, the one only living
 “ God, the lord of hosts, with whom is everlasting strength; the creator and ruler of the
 “ universe, the heavens declare thy glory, the hosts of the firmament proclaim thy praises!

“ Amidst such astonishing displays of infinite power, wisdom, and goodness, who would
 “ not stand in awe of thy majesty, ascribe unto Thee, the kingdom, the power, and the
 “ glory, in whom all possible perfections supremely reside. We adore that infinite
 “ understanding which devised the extensive plan of the universe; we revere that Almighty
 “ power which raised the stupendous fabric; we venerate that unerring wisdom, which
 “ establishes the laws by which the order of its numberless systems is invariably
 “ maintained; we contemplate with delight, that uncircumscribed benevolence, which
 “ peopled the heavens, the earth, and the elements with animated beings, and made
 “ provision for their support and enjoyment. The eyes of all wait upon thee, and thou
 “ givest them their food in due season.

“ While the works of creation celebrate thy goodness, and are subservient to thy will,
 “ forbid that we, the subjects of thy moral government, should remain silent, ungrateful,
 “ and disobedient. Let us never forget the distinguished rank which thou hast assigned
 “ us among thy works, and that to whom so much is given, of them much also will be
 “ required. We thank Thee for our national privileges and blessings; truly *the lines have*
 “ *fallen to us in pleasant places*, and we are a highly favoured people. Under thy divine

“ protection we enjoy every security for the exercise of our religion, the safety of our
 “ lives, the possession of our property, and the establishment of our freedom and
 “ independence.

“ While we thank Thee for our privileges, civil and religious, we pray for thy blessing on
 “ these establishments where our lot is now cast. Inspire the Governors of them with wisdom
 “ to rule in thy fear, and to pursue such measures as may tend to thy glory, and the
 “ happiness of all under their authority. Surround, we beseech thee, with thy special
 “ favour, the Governor of this Presidency, and prosper his administration. Be gracious
 “ to all who sit in council with him. Bless all their endeavours to know and to promote
 “ the interests of this establishment. Enable all who have any public duty to discharge
 “ under government, to be faithful to Thee, and to the trust that is reposed in them.

“ Now, O God, we implore thy countenance and favour, in behalf of this distant corner
 “ of thy vineyard. Consecrate a people in this place for Thyself: bless the occasion of
 “ our present meeting; condescend to assist and encourage thy servant who has the
 “ superintendence of the edifice about to be erected; establish Thou the work of his
 “ hands; prosper his undertaking; protect the builders, and in thine own good time
 “ perfect the structure. Except Thou, O God, dost build the house, the builders will
 “ labour in vain: except Thou takest charge of the flock of thy pasture, the watchman's
 “ care of them will prove fruitless. Our authorities may plant, and we, thy servants, may
 “ water; but to thee, O God, we look for the blessing, and to give the increase.

“ We pray for the whole Christian world; for the spread of gospel light among all
 “ nations; for the churches of Christ, distinguished by whatever name; for our national
 “ churches; for these distant branches of them; for thy servants in the ministry, and for
 “ the whole body of Christians in communion with them.

“ May the name of the Lord be hallowed in every Christian land, and the power of
 “ godliness prevail. Build up, we beseech Thee, Christians in their most holy faith, upon
 “ the foundation of the Apostles and Prophets, Jesus Christ being the chief corner stone,
 “ on whom the whole moral building fitly framed together groweth into an holy temple,
 “ for an habitation of God through the Spirit.

“ Now unto Him who is able to do for us far above what we can either ask or think; unto
 “ God only wise, be ascribed all honour, power, and glory, through Jesus Christ, world
 “ without end. Amen.”

The congregation departed with hearts warmed by the piety of their excellent pastor, fervently praying for the success of the undertaking.

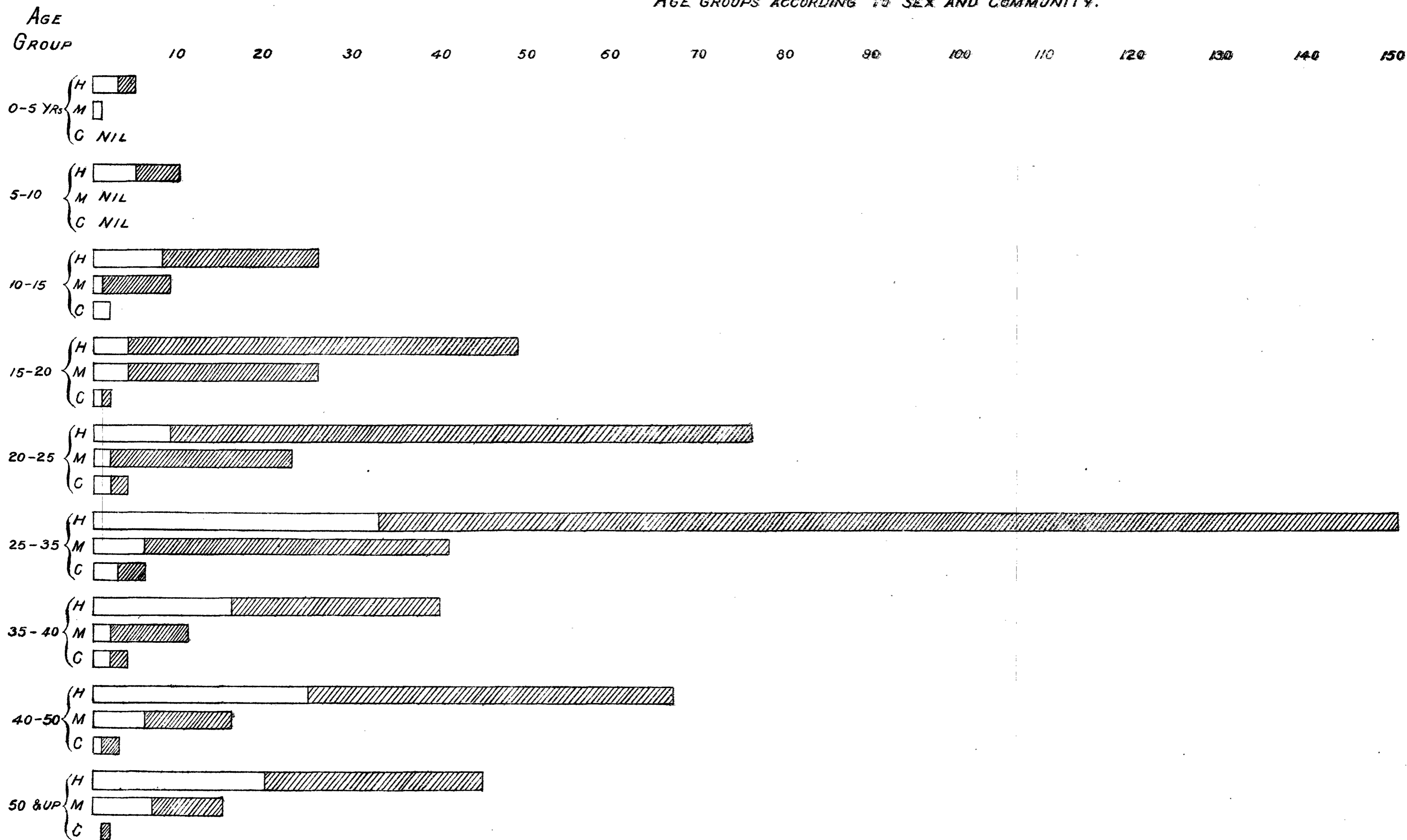
It may be here remarked, that the bells for the church were also ordered at Madras; but there was no foundry established there for large works, except that at the powder-mills.

When the casting of the bells was suggested, no doubt was entertained of the head *founder* of that establishment being allowed to give his assistance in the undertaking. When, however, application was made to the Military Board, under whose orders the Powder-manufactory is placed, it was not found convenient to *spare him*. The church is a *civil* work, the powder belongs to the military department, and the Military Board, perhaps, considered it an improper interference with their authority, although the application went to them through the Government.

The project was nevertheless persevered in, the Government not counter-ordering them; and after some trials in a temporary foundry erected for the purpose, and an experienced founder having returned from Bengal, a handsome bell was cast, four feet in diameter (the largest ever cast at Madras), and two smaller ones: but from the foundry being only a temporary one, and the founder not having all the requisite means conveniently at hand, the *tips* of some of the *ears* of the great bell remained defective, and although they were yet abundantly strong to bear the weight of the bell, and much more, it was thought more prudent to perforate the crown and to fix in it a *wrought-iron* preventer staple, which was accordingly done, without in the least affecting its tone, which, in the presence of the Governor, was, on being completed, tried and found to be a most excellent one. It was then put up and generally approved; the first time it was tolled was, as already stated, at the funeral of the worthy pastor.

Not a word was said against this ill-fated bell till the engineer had left Madras, when, through some unworthy intrigue which need not here be detailed, the bell was cried down, and the Military Board was induced to order an inquiry. For this inquiry it appears, from the reports of the day, that the founder of the powder-mill establishment, *without* whose services it had been cast, was selected, and it is not surprising that *he* should report upon it unfavourably, when a great jealousy existed between him and the founder employed. The bell was then ordered to be sold for the account of Government. But it was not sold *in statu quo* to the best bidder, the most customary mode of proceeding, it was first brought to the Arsenal, and there *broken up*, involving, of course, additional expense. *Dead men tell no tales!* Had it not been thus broken up, it might yet be proved that this bell was perfectly good and unobjectionable, notwithstanding the inserted staple; an assertion the author of these remarks feels called upon to make in justification of his character, which, although only impeached in so trifling a matter as this bell, and under circumstances which he could not controul, he will not allow to pass unnoticed. He will further observe, that the insertion of staples in the crown of bells is by no means an uncommon expedient, when it is apprehended that the *cast* ears may not be sufficiently strong. One of the largest of the beautiful bells of St. Mary's Church, at Taunton, may be mentioned as an instance where it has been resorted to; this bell is entirely supported by such means, the cast

DEATHS FROM TUBERCULOSIS DURING 1926 IN THE DIFFERENT,
AGE GROUPS ACCORDING TO SEX AND COMMUNITY.



H=HINDOOS
M=MUSSALMANS
C=CHRISTIANS

THE BARRED PORTION REPRESENTS FEMALES
THE UN-BARRED PORTION REPRESENTS MALES

AN
ACCOUNT
OF
SAINT ANDREW'S BRIDGE,
MADRAS.

THIS edifice is situated near St. Andrew's Church, over the river Coo-um, and it was erected in the year 1817, by the same engineer as that church.

The Coo-um is a small river, which disembogues into the sea immediately to the southward of Fort St. George at Madras, and except during the monsoon holds very little water. At that season, or during the prevalence of storms, the water rises in it very high; and from the flatness of the country around Madras causes an extensive inundation, united by another small river from the northward, until, its bar being broken or cut, a rapid discharge takes place. This bar, which except on those occasions remains shut by the never-ceasing action of the surf, frequently requires the greatest efforts of some hundreds of men to open, by digging through the sand, and much mischief is often done in the neighbourhood before a passage, for the accumulated waters to run through, can be effected. Once open, the force of the water is such that it may be observed to change the colour of the sea to a considerable distance from the shore.

Before the river reaches its bar, it meanders round the village of *Chintadrapetta*, which stands on a small elevation, and which village was about thirty-two years ago completely insulated by the giving way of a dam above it. Great inconvenience was experienced at Madras from the communications being interrupted in every direction by these waters from the want of bridges: the first of those now existing in that neighbourhood was erected in 1755, since which, at different epochs, several others have been added; but the greatest nuisance which arose from the state and condition of these rivers was the effluvia and miasma which exhaled from them. The Coo-um, especially, had no defined bed, as it flowed round Chintadrapettah, but covered an extensive waste, which when the waters retired became the repository of every description of filth and dirt, and besides that was in every part dug up into holes, from which sand or soil was taken by any or every person that chose. These holes when overflowed became dangerous, and in some places there were quicksands which it was difficult to avoid; and as one of the principal avenues, the Poonamallee road,



Drawn and Engraved by Maxwell Esq.

VIEW OF ST ANDREW'S BRIDGE MADRAS.

led through that village to Fort St. George, a bridge there seemed to be most urgently called for.

Petitions from the inhabitants had frequently been presented to Government for a bridge to be there erected; and at length, in 1816, one of them was entertained, and referred to the Military Board and to the Road Committee for their report. Both departments supporting the request of the inhabitants, strongly urged the Government to accede to their prayer, and to the cost being charged to the town assessment and to the funds proceeding from lotteries: there was some difference of opinion as to the site for its erection, whether it should be on the west side of the high road to the Fort, or on the north side, to connect the village of *Vepery* with it; but it was decided in favour of the former.

The plans submitted with the petition had been prepared without any the least consideration of the localities in a scientific point of view; and it was a matter of surprise, as they had been submitted with the petitions to the report of the Chief Engineer and the Quarter-Master General, that their inadequateness had not elicited any remarks from those officers.

These plans, which had been prepared by a native master-mason, were for wooden bridges on brick piers, of the same construction as those which had been before erected on the same river above that site, but extended over the whole flat to the westward, instead of being limited to a sufficient length; and then again to be continued on the east side over the new branch which had been cut by the giving way of a dam; so that, in lieu of a water-way of one hundred and eighty-seven feet and a half, which the bridge above contained, it was now proposed to have an aggregate water-way of three hundred and twenty-five feet, and to leave the waste *in statu quo*, to the annoyance of the neighbourhood; without *considering*, at the same time, that these bridges would soon rot and go to ruin, as those erected only a few years before were fast doing. When the plans were referred to the report of the superintending engineer, the author of this publication, he pointed out the inexpediency and inadequacy of the project altogether. He did this, however, with all the deference which was due to the opinions of the Military Board: and as the order of the day was economy, he did not *then venture* to suggest a *permanent* bridge of masonry, but satisfied himself with recommending that the bed of the river should be deepened and narrowed, so as to recover part of the waste, and to maintain a certain depth of water in it at all seasons. Afterwards, however, when the subject was further discussed, general opinion began to favour a permanent edifice, and he then proposed a bridge, consisting of a centre arch fifty feet span, one on each side forty-eight feet, and two small arches at the abutments to relieve them from the pressure of the larger arches. The height to be given to the centre arch was twelve feet and a half only, to render the access over the bridge convenient. The road was to be a segment of a circle of 2,100 feet radius from the middle of the lateral arches to the middle

of the other, and thence to the abutments a tangent to that arch. The breadth of the roadway was also to diverge from the middle of the bridge towards each abutment, to be thirty feet wide at the former part, and about thirty-four at the latter; the plan of the parapets on each side being traced from a radius of 3,150 feet. The edifice was to be chiefly of brick masonry, but the piers to be lined with iron-stone to guard against corrosion, and the outer face of the bridge, or at least of the head of the arches, to be in granite. The estimate for this bridge was only 9,070 pagodas (about £3,628), while that submitted for the wooden bridges first proposed, which were to be only twenty-five feet wide, amounted to nearly 8,770 pagodas (or £3,510). This proposition was then referred to the Military Board, who reported most favourably upon it; though they anticipated that it would not be accomplished at the estimated expense, as the Committee of the Board considered it "an undertaking of great enterprize and extent;" but they recommended that the whole of the arch-work should be in *iron-stone* rather than in brick, as the same committee thought that the proposed arches were cast upon a *scheme* which demanded a harder material than the bricks procurable at Madras; and finally, the estimates sanctioned were as follows:

For the erection of the bridge.....	Pagodas 11,022 37 20
For repairing the dam.....	690 0 0
For deepening the river bed.....	4,600 0 0
	Total £6,285, or Pagodas 15,712 37 20

On the 1st March 1817 the excavation was commenced, and on the 30th April following, the *foundation stone* was placed in the centre of the eastern abutment. Wells had previously been sunk to secure the edifice, of the same description and in the manner detailed in the account of St. Andrew's Church; but more difficulty attended the operation, as the water flowed in with much more rapidity, notwithstanding the precautions that were taken to keep the work free.

The following inscription was placed beneath the foundation-stone, with translations in the Latin and the Tamul Languages.

" By the Blessing of God Almighty,
in the Reign of GEORGE III.
the Father of his Country,
the first stone of this Bridge
was laid on the 30th day of April,
in the year of our Lord 1817:
the Right Honourable HUGH ELLIOT
being Governor of Madras,
and Major THOMAS FIOTT DE HAVILLAND Architect.
Which may God prosper."

The Free-Masons were *desirous* of being employed in this operation; but the Governor *declined* their services, and directed that the stone should be laid without ceremony or *eclat*, which was done accordingly.

The three principal arches are elliptic, drawn from *five centres*, and composed of five segments; the longest radius of the middle arch being forty-six feet and a quarter, the two next, twenty feet and one-eighth, and the shortest seven feet. This delineation formed a beautiful curve, and the arches being bell-mouthed appeared remarkably light and neat. One-seventh of the span was given to the piers, and one-twentieth to the length of the key-stone, the voussoirs lengthening a little towards the spandrils.

It has already been remarked, that the iron stone used in this edifice offers no more than about three times the resistance that brick would, and therefore the same stone may be considered as not exceeding the *sixth* or *seventh* part of the strength of good granite: nevertheless two feet and a half was deemed a sufficient depth for the key-stone of such an arch, fifty feet span on a radius of forty-six feet and a quarter, and the event has fully proved that judgment to be a correct one.

Brick arches were afterwards turned over the piers and spandrils, to lighten the edifice, but they do not appear outwardly.

In this work the expedient of mixing the mortar in a mill was *first* adopted at Madras, and being found to answer, the system has since been pursued in most works of magnitude, *in lieu* of beating it in troughs with small hand *pillons* or stampers by women and children, in the Indian manner. Some other experiments were also tried on the lime used, which is made of cockle-shells found in quarries inland some distance from the sea, in various parts of the coast. These shells are brought to Madras by sea and canal carriage, and there calcined and used for most purposes. In this edifice, when slaked, one part *in bulk* with *one and a half* part of pounded brick and tile, and *one* part of quartz sand, was employed. The specific gravity of the shells before calcination was found to be 2.96, water being 1.

To ascertain whether any advantage is derived from the use of *jagghery* (coarse sugar) in mortar, so prevalent throughout India, small pillars were carefully built with mortar mixed up, some with sugared water, and some with lime-water, and allowed to set for nearly a month, when it was found that the tenacity of the former was about seventy-four pounds per superficial foot, while that of the latter was about eighty-one pounds on the same area. Several experiments had before been made, and have since been repeated to the same effect; and there is no reason to believe that, in the end, any advantage is derived to the mortar by the use of saccharine matter. The mortar, from the *gluten* or *gum* the sugar contains, appears more plastic with it, and the masons find it *works* better; but, in reality, it is an

useless expense in the first instance, and is probably prejudicial to the final endurance of the cement; first, because there is a considerable quantity of gummy and earthy matter which may not combine so well; and secondly, because, as it is found that quick-lime is with difficulty slaked in sugared water, when this is used many particles of lime may remain unslaked, or may be slaked *so late* as to disturb the crystallization after it has commenced; the use therefore of this ingredient was discontinued in this edifice, and the disuse of it generally has since been recommended for large and extensive works.

On the 15th of September the arches on each side of the middle one were closed, inserting the key-stones with great care and precaution, to prevent as much as possible any after sinking; to which end, also, the mortar was laid very liquid, and as *thinly* in the joints as possible.

During the night of the 18th and the whole day of the 19th the rain fell incessantly, the centerings of the middle unfinished arch were secured against accident; on the 23d at night it again rained most violently, and the freshes came down three or four feet deep from the northward and eastward.

The middle arch was shut in on the 29th of September; the next and the following days the operation of gradually loosing and removing the centres was prosecuted, keeping the crowns well supported to the last. By the 10th of October all the centerings were removed, and the arches over the piers and spandrils commenced. Heavy rain fell on the 15th and 16th, the water rose about five feet above the spring of the arches, but no mischief was done. The spandril arches were completed on the 23d of October, from which time it continued raining for a week. On the 1st November there were seven feet of water above the springs, although the bars of the river had been kept open; the water ran through the bridge at the rate of about ninety-eight inches per second. On the 26th of October, within six months from the laying of the foundation stone, the bridge was open to foot passengers.

It continued to rain very heavily for days together during the whole of November, and on the 26th there was about seven feet and a half water above the springs under the bridges, running, however, at the rate of only forty-six inches per hour. This variation of velocity arose from the state in which the bar happened to be at the moments of trial, and the time of the tide.

The whole vicinity of Madras was overflowed, and the roads about greatly damaged, the water not having been known so high for many years, and the rough stones which were collecting to pave the bed of the river under the bridge, were thrown in below it, lest the newly moved sand and soil round the foundations should be carried away to a depth that might injure the edifice.

The *movements* of the arches in settling were narrowly noticed, and very few fissures were observed in the extrados. A precaution had, however, been taken in turning the arches, at about half way from the spring to the crown, to introduce on each side a bar of iron along the whole layer, fixed with lead into the *head* granite voussoirs, which precaution was doubtless of considerable advantage, under the circumstance of the very bad weather experienced; but these fissures all disappeared again except those at the *haunch* or spandril, which remained, and were about three-sixteenths of an inch wide. These were carefully *grouted* in, and in all the arches, appeared at the sixth or seventh voussoir from the spring.

After the centres had been removed and the parapets were built, the fall of the crowns was accurately measured, and were found to be from two, to two and a-half inches in the three arches. In forming the centres a greater fall had been expected; four inches and three-quarters had been allowed in the middle one, and four in the two others. Since then very little movement has been observable, so that the probability is that the crowns now still stand *somewhat* higher than was intended.

It is useful to remark, as it regards the theory of arches derived from practice, that when the heavy rains first came down before the middle arch was closed, the centering giving way a little, the *incomplete* half arches opened transversely on each side between the *ninth* and *tenth* voussoir from the springs at the extrados, which fissures were about a quarter of an inch wide the whole length of the course. These fissures were carefully covered, and nothing allowed to be put into them; and when the arch was afterwards left to its own operation, they were closed and found *transferred* to the joint between the *sixth* and *seventh* voussoir. Had an experiment not been desirable, it had been better to have *grouted* them as soon as observed; but the object of the experiment was to ascertain at which joint, in arches of the construction described above, the *separation* takes place after the centering has been removed, since there must necessarily be a tendency to such separation in all *semi-circular* and *semi-elliptic* arches, from the circumstance of the mortar in the joints being *compressed* by the pressure of the voussoirs, disposed by their gravity to fall perpendicularly to the ground; a separation which must occur somewhere between the key and the abutment, and nearer the latter as the arch thickens towards it, or is loaded above; thus marking what part of the arch may be considered to act laterally against the abutment; namely, that between the key and the joint of separation; the rest, adhering to the abutment, tending to *stabilitate* it. In these arches, then, it appeared to be about the *seventh* joint from the abutment or pier.

The bridge having soon been rendered passable, and completed early in 1818, gave great satisfaction, and a very favourable report of it was made by the Military Board to Government.

ST. ANDREW'S BRIDGE.

The actual cost of the bridge, as originally planned, was	£4,194	or Pagodas	10,486
That of the dam.....	274	685
	<hr/>		<hr/>
Together	£4,468	11,171
	<hr/>		<hr/>
Which was less than the estimate by....	£183	458
	<hr/>		<hr/>

But the arches over the spandrils, the iron bars in the main arches, the rough pavement under the bridge, and the establishing of lamps on it afterwards authorized, came to £368 or Pagodas 920

The excavation of the river was, however, considerably extended, and a large tank or reservoir near it filled up; all which, including the raising of the ground gained from the river, levelling and inclosing it with a railing, and making the new roads to the bridge, &c., amounted to about £3,200 or Pagodas 8,000 so that the whole of this improvement, the greatest effected in the vicinity of Madras for many years, cost only £8,036. 8s. or Pagodas 20,091.

This bridge, which was at first denominated *Chintadrapettah*, from the adjoining village, was after the building of the Kirk, ordered by Government to be called St. Andrew's Bridge.

In progress of time the annual freshes of the river will tend gradually to refill the river bed; but as the alluvial sand will, as it accumulates, be employed to raise its banks and the environs, a state of things will at length be obtained when this channel will assume a permanent form, and the inundations, now so frequent and inconvenient, and sometimes destructive, cease to occur. Until this *desideratum* is obtained, every opportunity offered by seasons of drought, and by a want of work for the poor in times of famine and scarcity, should be seized to this effect; and the Government would ultimately gain by it, if it ordered these alluvions to be taken up and spread from time to time over the esplanades of the Fort and Black Town.

AN
A C C O U N T
OF THE
ARMOGHAM SHOAL AND BLACKWOOD'S HARBOUR,
ON THE
C O R O M A N D E L C O A S T,
NEAR
M A D R A S.

THIS extensive shoal on the Coast of Coromandel has long remained unnoticed, although known to Europeans, as well as to the natives of that part of India. It is recorded in the East-India Directories, and the loss of many ships upon it has testified its existence for centuries past; but its extent and peculiarity of situation, with all the circumstances about it, were still to be determined, when Admiral the Hon. Sir Henry Blackwood commanded the East-India squadron in 1821-2. A few years only anterior to that epoch, Mr. Puget, the Commissioner of the Royal Navy, whose station and residence was at Madras, had, it appears, recommended to the Lords of the Admiralty to make Trincomallee the Navy-depôt and the Admiral's station in the East; without, probably, sufficiently considering all the disadvantages which such an arrangement would involve. Above all, perhaps, the insalubrity of the climate, and its utter bereavement, generally speaking, of the comforts of life, of supplies and provisions of almost every kind, were to be apprehended; chiefly resulting from an ungenial soil, and a consequent scarcity of population, greater than in other parts of the island; although, from the almost proverbial beauty of the harbour and its environs, its vast capacity and convenience in many respects, it was acknowledged to be one of the finest in the world; having a good and well-defended entrance, and a great depth and smoothness of water, also equally unrivalled: but it had long been admitted, that these advantages, and its central position in the Indian seas and the British possessions in Asia, could not coun-

terbalance the paramount objections to it in other respects, which had hitherto been deemed insuperable; but the Commissioner conceived, no doubt, that he had other good reasons on which to ground his proposition. Madras, however, had long been the Admiral's station for a great part of the year, and the principal naval stores and the hospital were also established there; yet, for two months in the year, the Navy could have little or no communication with the shore without running great risks, and the officers and crews of his Majesty's ships could at no time visit the place in their own boats. The Admiral himself, whenever he landed, was obliged, at the back of the never-ceasing surf, to quit his own proud barge, at some hazard of his life, and to step into one of the most inconvenient conveyances possible, a *massulah boat*; to be then swept, with almost terrific velocity, through the repeated surges, in considerable danger of being swamped; ultimately, to be bumped on shore like an abandoned boat or a wreck; and then to scramble out, on men's shoulders or otherwise, at the watched moment of a retreating wave. Madras might also, in Mr. Puget's mind, have another *local* disadvantage: it was under the sway of a Company's Governor; and that circumstance might be considered, as derogatory to the reverence and high respect so justly due and allowed to the British Navy. With such an impression, if it did actually exist, the Commissioner naturally sighed for a land under the immediate rule of His Majesty's Government; concluding in his own mind, that no inconvenience, known or to be anticipated, should compete with that object, and that with the wealth and resources to be placed at his disposal, he might, he flattered himself, smooth away every difficulty.

Accordingly, as soon as he received his instructions from the Admiralty, he proceeded to break up the naval establishment at Madras. So anxious was he to leave that *inhospitable shore*, that the stores were removed, and the Crown property at Madras assigned over to the Honourable Company, before the new port and buildings were ready for this important transfer.

No time was lost in entering into contracts for the erection of suitable edifices. Among these, the Commissioner's and other houses stood foremost; and then a spacious Hospital was founded, with suitable houses and apartments for the Governor, the Surgeons of the establishment, &c. &c.

These, and other measures, were in considerable progress, when Sir H. Blackwood assumed the command of the squadron; but he stood appalled, when he learned and saw the effects of the climate on all who were, and had been there, either as residents or temporarily employed. Several surgeons had already followed each other to the grave, which, by reason of the great numbers of every description of persons on the sick list, was the more to be lamented. He also, to his great surprise, observed that even the artificers and

most of the materials employed on the new and extensive buildings were brought, at an enormous expense, from afar—from the coast of Coromandel, and even chiefly from Madras itself; that the difficulty of procuring people increased daily, as those first come thither died or suffered from the climate; and that latterly it became almost impossible to replace those who died or left the place sick. The contractor himself fell a sacrifice to his enterprize, and a victim to the well-known *Trincomallee fever*. The Admiral further perceived, that, situated in an unprofitable country, and very distant from Colombo, the seat of the Ceylon Government, Trincomallee had little chance of being made a comfortable station, or the Navy of being well and readily supplied in all its different departments. Even the mutton, so essential an article of consumption in the Navy and Army, was to be brought from the continent; and in constant succession, for the sheep began to fall away immediately on their landing, and soon became unfit for food if long kept.

Struck with these great inconveniences and other vital objections to the place as a Depôt and a station for the Admiral, with the Naval-yard, Arsenal, Hospital, Magazine, &c. for the India squadron; Sir Henry Blackwood lost no time, it seems, in representing the case back to the proper authorities; and as the establishments at Madras had been hastily broken up, he, after removing the stores and men where he best could stow and accommodate them, looked about for a fit place of shelter within the limits of his command, which might be more central than Bombay, and more convenient than the *new harbour* in the Hoogly or Calcutta river, to which the ships of his Majesty's Navy might have easy access from all quarters, and ride safely at a good anchorage the whole year round: advantages which even Bombay, on the west coast, did not entirely possess, and much less the *new harbour* in the Hoogly; the entrance of this latter port being dangerous, intricate, and tedious, while the shallowness of the river does not admit of ships of the line going up within many miles of Calcutta.

Under these circumstances, the Admiral turned his views to the *Armogham Shoal*, as likely to afford an extensive shelter between it and the shore, and to be in other respects an eligible spot from its vicinity to Madras, its central position between the Company's presidencies and the range of his command. He, therefore, applied to the Supreme Government in Bengal to have a survey of it accurately taken, which was instantly acquiesced in, and the service confided to the execution of Captain Maxfield, of the Company's Marine Establishment, and Assistant Marine Surveyor General; an officer of considerable merit, then commanding the *Nearchus*, and afterwards the *Meriton* cruiser.

Sir Henry Blackwood, desirous at the same time of ascertaining the nature of the shore at Armogham, of the country thence to Madras, and of the means of communication from one place to the other, applied to the Madras Government for a professional officer to make

a land survey and report of the interior between the two places, which, connected with Captain Maxfield's chart, would render the information on that subject complete; and the Acting Chief Engineer and Inspector-general of Civil estimates* was requested to carry into effect his Excellency's wishes.

When these services were nearly accomplished, Sir Henry Blackwood went up in the flag ship, the *Leander*, to satisfy himself, by personal inspection, of the advantages of this station; and Captain Maxfield having piloted her through the southern passage, the *Leander* anchored within the shoal, and remained there three or four days. His Excellency was pleased with the *local*, and was convinced that, if established as an anchorage, the advantages to be derived from the position of that shoal would be incalculable. To the station taken up by the *Leander* Captain Maxfield gave the name of "*Blackwood's Harbour*."

That gentleman accompanied his report (dated 20th June 1822) by a *stasimetrical* survey of the *Armogham Shoal* and reef of Point Poondy, with the anchorage and soundings between the *former*, the shore, and the *latter*, representing it as the only place on the Coromandel coast which offers any the least protection to ships during an easterly gale.

This survey was taken with great care, and the chart of it contained all the accuracy desirable to make it an useful document. Captain Maxfield, during his stay there, procured much valuable information from the natives in the neighbourhood; and, among other matters of importance, he states from their report, that during the north-east *monsoon* or stormy season, the sea breaks very high on the shallow ridge of the shoal, rendering the harbour within it comparatively *smooth*, the swell and surf there being then even less than during the southern *monsoon*, and the prevalence of the *land winds*. That the surf is at no time dangerous, even for the boats used at that place, which are so small and slight, that they would be unsafe at Madras even in common weather; but that within the *Armogham* the communication with the shore in these skiffs is quite secure, and may generally be kept up in boats of any description. This was amply confirmed by the boats of the *Meriton*, which landed daily on that beach without the least danger or inconvenience, from the 22d May to the 15th June, three or four days only excepted.

Captain Maxfield also obtained from native residents, at *Condoor*, who were well acquainted with the nature and effects of the surf at Madras, that it was equally violent to the northward and southward within a few miles of the shoal, but that under its influence it was always found thus moderate.

That able officer attributes this state of things to the shelter of the shoal, and to the sudden change in the direction of the coast at Point Poondy, which, from *Pulicat* to that

* Major de Havilland.

point runs N. b. E. one-quarter east, and thence to *Armogham* N. N. W.; from which last place the coast resumes its original direction out of the influence of the shoal, when the surf is again equally as violent and as high as to the southward of Poondy Point. He then concludes, from his local observations and from the information he had received, that of the many ships of every description which have from time to time been lost on that extensive bank, three-fourths at least might have rode safely at the anchorage within it, if it had been known; and that, if any had been driven and wrecked on shore, the crews might all have been saved! A matter of no small importance; for he justly remarks, that the chance of saving the crews, on that coast, generally, is almost as hopeless as that of the vessels riding out the gale in safety.

Captain Maxfield next notices the entrance of the harbour at Point Poondy, in latitude $13^{\circ} 46' 45''$, distant from the Madras Roads only about forty-two miles; much nearer than the *new harbour* in the *Hoogly* is to Calcutta; while the back-water to Madras through the Pulicat Lake, would afford a more expeditious, convenient, and safe communication, than the river Hooghly offers between Saugur and Calcutta; where the rapidity of the tide, and other local causes, render the navigation of that river precarious and perilous; and he expresses his most sanguine hope, that if the occupation of Blackwood's Harbour should ever take place, those accidents which, from their frequency, have become *familiar*, although in themselves appalling, will no more occur; and that the communication with Madras will then be as secure, at *all seasons*, as with any other parts of his Majesty's eastern dominions.

In order to show, that while he was surveying Blackwood's Harbour, and that he daily landed there in his ship's boats, the surf at Madras was breaking with tremendous force, he mentions, that while he lay in the roads, at the latter place, for a few days, immediately prior to his proceeding on this service (and when he had gone to take on board the Inspector-general), the surf was so high, that the *bar-boat*, attached to the ship, was torn to pieces in attempting to come off, and that two persons were drowned in that catastrophe.

Captain Maxfield laid down buoys to mark the extremities of the Poondy reef and Armogham shoal, which, so long as they endure, will enable ships to pass in and out of the harbour with safety, even in the north-east *monsoon*, when the current sets to the south-west, and when a ship, getting in with the land, may find it difficult to weather the shoal.

The Admiral, on receiving this report from the Marine Surveyor, lost no time in bringing it to the notice of the Supreme Government, and in recommending a measure which, in the course of his conversations with that officer and Major de Havilland, had been suggested as essential to crown the information required on this interesting subject, namely, to have a

vessel of considerable burden, well found in anchors and cables, to lay in Blackwood's Harbour from the ensuing 10th of October to the 1st of January following, in the charge and under the command of an active and vigilant officer, who should notice the effects of the *monsoon* on the harbour and the shore, with zeal and attention, and *weather out* the season at all *hazards*. The Admiral's letter was dated 1st July 1822, and addressed to the Most Noble the Marquis Hastings.

He confirmed from his own observation, while riding there in his flag ship, "during the force of the south-west *monsoon*," "the correct and modest view" Captain Maxfield had taken of the advantages likely to result from an occupation of the *harbour* (a designation it already deserved from the protection afforded it by the *Armogham Shoal*), and recommended its merits to be taken into early consideration; deeming it, as a "seaman and naval officer," a matter of the utmost consequence to the mercantile interests of the country, in peace or war, "on a coast which from Hooghly to Ceylon possesses no shelter for shipping;" dwelling on the great *demurrage*, risk, and other inconveniences incurred at Madras, where the communication with the shore is so frequently interrupted, and at one season entirely discontinued: while in Blackwood's Harbour no such disadvantages would obtain, even in the stormy months, during which, he repeated, as reported by the natives, the water is actually *most* smooth and the place *most* secure. The Admiral proposed that an old ship, from six to seven hundred tons burden, should be hired, and that Captain Maxfield himself, whom his Excellency considered an officer of merit, should be placed in charge of it on the station.

Sir H. Blackwood was likewise to request of his successor to send a ship there from his squadron, as often, and for as long as he might be able to spare one, between October and January. He also recommended to the consideration of the Governor General the establishment of a *light* on Point Poondy, and of a beacon on the shallowest point of the bank.

It was understood that the Government had acquiesced in the expediency of sending a vessel to winter there, but some delay occurred to prevent its being effected that year. Meanwhile, Sir H. Blackwood having been relieved, returned to Europe. Some effort was made the ensuing year to attain this object; but it was done in a lukewarm manner, it seems, and the vessel did not remain there the whole of the season.

Major de Havilland's report had not yet reached the Admiral, when he wrote to the Governor General on the subject, so anxious was he to have the ship stationed at the anchorage the ensuing season which was then fast approaching: but he received it before he quitted India, and made use of it *when* he wrote to the authorities at home on the subject; which he *immediately* did, as understood from himself, and with considerable expectation that it would be taken up *there*, and that measures would be soon adopted from England, to establish that anchorage.

This important object, however, has since been allowed to flee to the *offing* of consideration, and seems now to have got *clear out of sight*; although its accomplishment is so desirable, and so perfectly feasible. But it seems to be the fate of *British* India, scarcely ever to be favoured by British ingenuity! It has often been said, that in India there is no *British public*: and this, in truth, is verified by the little interest which is taken in any object of *public* advantage or utility. The fact is, that when any project or work of magnitude is to be undertaken, the Government must necessarily do it, or it cannot be effected; and the Governors generally know too well the disposition of their Honourable Masters to economy, ever to enter into or sanction any disbursement they can avoid, unless they may reasonably contemplate a *quick return*; and the Proprietors generally, whose dividends of five and a quarter per cent. always stand first and foremost in their view, when any case is brought to their consideration, are too much attached to the *present*, which is *theirs*, readily to sanction any outlay for the benefit of the *future*, which may *not* be *theirs*, or which may not *directly* tend to increase, or at least to establish, those dividends.

This feeling is so prevalent in England, that with whatever anxiety and interest a project may be brought forward, it is met with comparative apathy; and it is feared that the authorities at home, generally, perhaps also from press of other business, are too frequently satisfied with what the forms of office simply require of them, that is, to have a *syllabus* of the proposition submitted to them, not always to be read or considered except by a few more curious than the rest; and who sometimes do so to make themselves masters of the objections, without attending much to the arguments in favour of the proposition, in case it should be ever brought into notice.

Such dispositions, however, are not attributable to a want of zeal for the good of the country in those Authorities; they proceed out of the nature of the British possessions in India, and out of the extraordinary dominion and rule set over them. There is, as just observed, no *British public* in India; and the *public* at home takes too little interest in any question of India, and are too distant, in *space* and *time*, from the localities, ever to contemplate with any degree of warmth the eventual result.

This state of things must account for the perfect indifference with which any improvement, especially at the presidency of Madras, is regarded, its concerns seeming to attract even less notice than those of its sister establishments! What, it may be asked, can be urged stronger than this fact in support of the allegation, that in nearly two centuries the Company have possessed that *port*, or rather open roadstead, not one attempt has been made to improve or facilitate the communication with the shipping! Not a *jetty* or a *wharf*; not a *quay* or a *pier*; not even a *crane* has been erected there! Nor does this proceed from any impracticability in the measure: in the course of the last half century, several proposi-

tions for wharfs and jetties have been submitted to the Authorities at home and abroad, but, one after another, they have all been *rejected or neglected*; and Madras, to this day, remains with no other means of communication than the *massulah boat*; the same, or at least of the same description, as that in which Mr. Francis Day may have landed when he first visited the fishing villages on its sands and dreary beach to found the factory there. Of these boats, it is true, that four or five are honoured with the high-sounding title of *accommodation boats* for passengers; it would however be difficult to say in what consists their convenience or commodiousness above the rest besides being a little larger, and having an awning which, at the moment of landing, is sloped down to ward off the spray or a portion of it. But, on the other hand, floating higher above the water, they are less manageable in a gale or a high surf; and although the crew is increased more than in proportion, many people prefer trusting themselves in the *unaccommodating* boats in bad weather, and generally effect their passage over the surf with greater safety and expedition, at an expense of about as many *pence*, as shillings are charged for an almost fictitious *accommodation*.

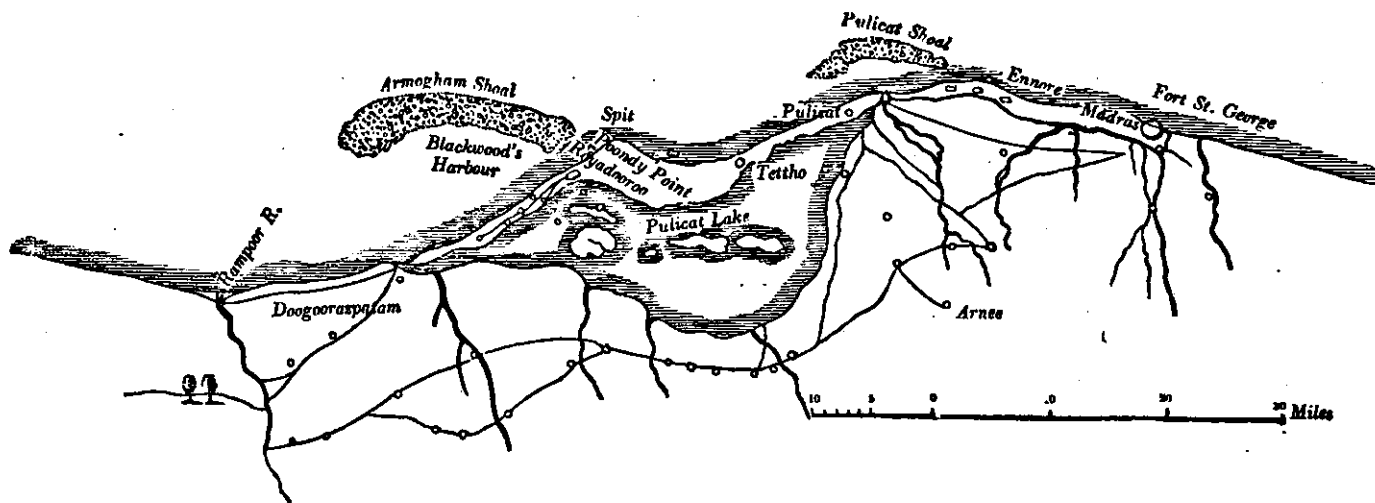
But to return to the objects of the present account, the Armogham shoal and Blackwood harbour. The Acting Chief Engineer, in his report, corroborated the information given by Captain Maxfield, as to the fitness of that site for an anchorage, from information which he had obtained from various other sources besides the natives. He then entered fully on the question of an inland communication with Madras through the Pulicat lake, and threw out some observations on the eventual construction of a work on the shallow part of the shoal; and in a map of the coast from Madras to Doogoorazpatam, he furnished every topographical information necessary to convey to the Authorities a clear view of the importance of this great object.

It appears manifest from the natural formation of the coast in these parts, and the constant operation of the periodical currents up and down, that the Pulicat lake, like the Chilka lake, near Ganjam, and many others in other parts of the world, has at one time been an indentment of the coast or small bay, however distant that epoch may be; in front of which, in the revolution of succeeding ages, the sea has thrown up an embankment, in the same manner as it does a *bar* across the mouth of a river, on every coast which is surf-beaten, and laved by constant currents. Of this action, which is quite natural, the main effect is to *straighten* the coast, the current not readily deviating from its direct course; whence, while on the one hand it avoids sudden bays or inlets, and at length shuts them up, on the other it strikes on every projection or headland, and in process of time wears it away in part, or wholly removes it, if it be not of a nature to resist such operation, from its consisting of rock or hard impenetrable soil. In such latter case, the headland then, which may not be altogether worn away, stands more or less sharp and conspicuous, in the inverse ratio of its

extent on the line of coast ; and if it remain a mere *point*, the land on each side, being of a softer or more corrodible nature, is hollowed into cavities by the current, which is *contracted* at its passage round the resisting point, and necessarily accelerated ; acting with additional force on the yielding shore just *beyond* it ; and hence it is, that the greatest of these cavities is always that which is *beyond* the point *from* the current ; and whenever the current changes to the opposite quarter, such cavity is partially filled up, while that on the other side of the point is again hollowed. This effect is observable all along the Coromandel coast where such points present themselves. It is particularly remarkable at Mahabalipooram, thirty miles to the southward of Madras, where a Hindoo temple stands on a rock projecting from the sandy beach ; on each side of which the shore is periodically worn away, as the currents change with the season, in the manner above described.

It will be seen in the annexed map, and more clearly still in the sketch here introduced

Sketch of the Coromandel Coast, from Madras to Doogoorazpatam.



of the outline of the coast and lake, that Poondy is one of those points which has resisted the current ; and it must be equally obvious to every person who has visited that part of the country, that the line of the coast from *Pulicat* to *Tetthoo*, and again from *Royadooroo* to *Doogoorazpatam* (each part about fifteen miles in length), has been formed by the continued action of the current and of the surf ; admitting, at the same time, the probability of a pre-existing island between *Tetthoo* and *Royadooroo*, which has thus been united to the general line of the coast, and which the very name *Tetthoo*, of the southernmost villages on it, seems to indicate ; but, if there had not been some resisting obstacle at or immediately below the surface at Poondy Point, though it has generally the appearance of sand, it is evident that the whole line from Pulicat to Doogooraz, about forty-five English miles, would, by the constant operation of the causes mentioned, and in the course of time, have been reduced to a much straighter line ; accordingly, a large *spit* is found at that point, projecting from the land about two miles into the sea, and gradually shallowing up to the shore, on which the

sea constantly breaks. What the foundation or body of this spit may be is not known; but it is probably of stiff *clay*, as there is no indication of rock immediately in the neighbourhood, and it may be concluded that the body of the *Armogham* shoal is of the same substance also. These two form banks, between which the sea has found or cut a passage; the outward bank or shoal has then gradually been extended and enlarged, by the deposit of the materials worn away from the shore to the southward of the spit, while the fact of these banks being founded on strata of resisting materials, fixed and immoveable, is confirmed by the local traditions, and the number of ships which have been lost on it out of the memory of man. It is therefore evident, that a breakwater might be constructed on the shallow part of the shoal with safety, where the water lies from fifteen to twenty feet in depth, and on which it now very frequently breaks even in fine weather. Such a work would make Blackwood's Harbour a most secure and comfortable haven, easy of access in all seasons, as professionally testified by the naval officers above-mentioned; with excellent holding ground and a sufficient depth of water. Such a work would also render the landing still more safe and convenient to ships' boats, and facilitate the erection of jetties, wharfs, &c. in due course.

The construction of a breakwater, a work of such vast magnitude, as the term would imply when connected with the ocean, strikes every one with an idea, that the expense attending it must necessarily be enormous, if not ruinous. The one, however, now contemplated, would not be very costly, if carried on with judgment, founded on the experience had of the one across the Plymouth Sound, and other works of a similar nature. The length need not be determined at the onset: it might be continued until the shelter required was obtained: the breadth or *thickness* of the work would also be left to the operation of the waves upon it, and the *height* or depth would be so regulated, that the upper surface would be just above the summits of the highest waves known, that nothing but sprays should fly over it.

If the accounts given by Mr. Granville to the public, in 1825, of the Plymouth breakwater be correct, all the dimensions then were determined beforehand; and hence it is that, in respect to breadth or thickness, it has grown into an endless mass of stones beyond all bounds of reason, and at an unheard-of expense, while in other particulars it still remains incomplete, and even insecure. The section of the breakwater annexed to the publication has a base of upwards of four hundred feet, a summit of fifty feet, by an average height of about sixty-two feet; but in the "summary of intended dimensions," they are stated to be: base, three hundred and sixty feet; summit, forty-eight feet; and height, forty-two only. In the drawn section, this last dimension is the height of the work under low-water mark spring tides, only; but, be the dimensions what they may, three hundred and sixty on forty-

two, or four hundred on sixty-two, it is very certain that a much more contracted mass than that would have answered the purpose fully as well, and have saved a prodigious expenditure of materials, and consequently of money, if it had been raised to a sufficient height.

It appears that *buoys* were placed to mark off the outline or perimeter of the intended work, within which the stones were thrown promiscuously, leaving them to find their own base. Here seems to have been the first error: there should have been only a *single* line marked out, drawn so as to stand a little in *front* of the middle of the proposed work; and on this line the stones should constantly have been cast, beginning at some convenient spot about the centre of the length, and making the stone vessels to lie as close to each other as possible, and to continue throwing in the same place until the stones stood as high above the highest spring tide as they could conveniently be placed out of those vessels. In this manner the stones would really have taken their own bearing; but casting them "promiscuously" on so extended a breadth of surface, as the plan of this great work, where the depth of the water prevented their being seen, and when the station of the buoys might still change with the tide, although they were at double *moorings*, necessarily subjected the progress to great irregularities; and by endeavouring, as the mass gradually rose from the bottom, to give the sides of it the *intended slope*, the stones, instead of being left to their own impulse, were thus extended to limits, doubtless, very frequently infringed upon, and then unavoidably rolled further off, gradually, than the demarcation proposed. This view of the case seems confirmed by the circumstance mentioned in the account alluded to; that the dimensions originally suggested for the section were two hundred and ten feet base, thirty feet summit, and forty height; which dimensions, as now observed, have, by the same account, since been greatly exceeded, especially in the base. But the want of a sufficient height has been the great, the capital fault; and however the surface stones may now be wrought, wedged in, or cramped, it will not be secure till there be a superstructure, at the same time that the slopes have been so unnecessarily extended.

Now, with every deference that is due to the able engineer who planned that work, it is argued, that if the stones had been cast on one and the same line as proposed above, the slopes obtained by their natural bearing (left entirely to their own gravity and the impulse of the waves) would have been different from what they actually are, or are represented to be: *that* towards the ocean would have proved the *steepest*, the reverse of *what* was proposed; besides that, both these *slopes*, the exterior one especially, instead of being *rectilineal*, as shewn in the section (and as it has probably been executed, so far as it lay in the power of man to do so), would have been *curved*, *contracting* downward or becoming *more steep* as the depth of water *increased*.

When, in 1817, the mean height of the water was found, during a storm, to have risen six

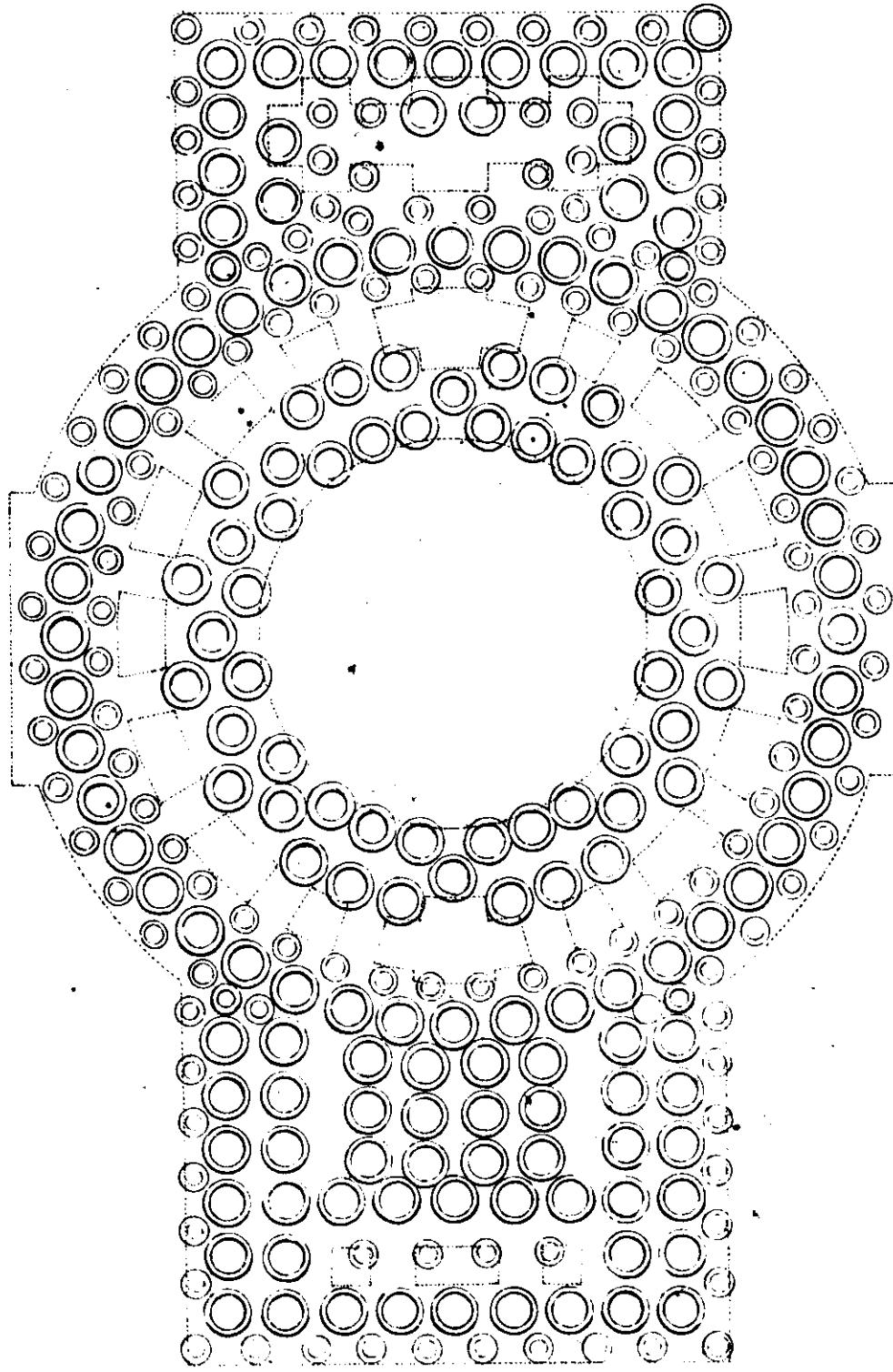
feet above the summit of the work, so as to disturb the *surface stones*, where the work had been completed and carefully finished for a space of two hundred feet or so, if the error had then been admitted, and the work raised only *those six feet more*, that addition only might have gone a great way towards protecting it in the higher rise of 1824, which, it seems, exceeded the former by twenty-six inches, and which tore off the surface again, but to a much greater extent; and yet, as if by a sort of infatuation, this error, as palpable and obvious as noon-day, is obstinately persevered in! And notwithstanding these two awful visitations, ordained as it were by Providence for our instruction and good, we have the mortification to hear of more of the public money being squandered away, in replacing the stones in their former unstable position; with great additional costs for squaring, smoothing, wedging and cramping; and for bringing granite all the way from Dartmoor, to be substituted, in some places, for the limestone.

It cannot for a moment be allowed, that these damages were the result of the *slopes* being too *rapid*; for it does not appear that any of the stones were carried down on the *weather* side of the work by the re-action of the surges: on the contrary, a large portion of those stones which formed the upper surface were transported to the *lee side*, and there deposited in accumulated heaps, along the *upper* edge of the *inner* slope, without, however, any of them rolling downwards to any great distance; none of them, it is believed, beyond *low-water* mark. Nor is the mischief to be attributed to the *breaking* or *dashing* of the sea upon the work merely; no breakers that can be imagined could alone *start* such stones out of their places and fling them afar off, as has with deference been explained to the Lords of the Admiralty; the *operation* of the element which disturbed them was of a very different nature; for it is clear, and must have appeared so to any person who visited the work after the last storm, and contemplated with attention the melancholy effects of that calamitous day, that the stones which were removed to the inner slope were not *dragged* or *flung* thither by main force, as that principle would require; but that they had actually been *lifted* out of their *sockets*, and *floated* along by degrees, until sheltered from the buoyancy of the waves, which alone could move them.

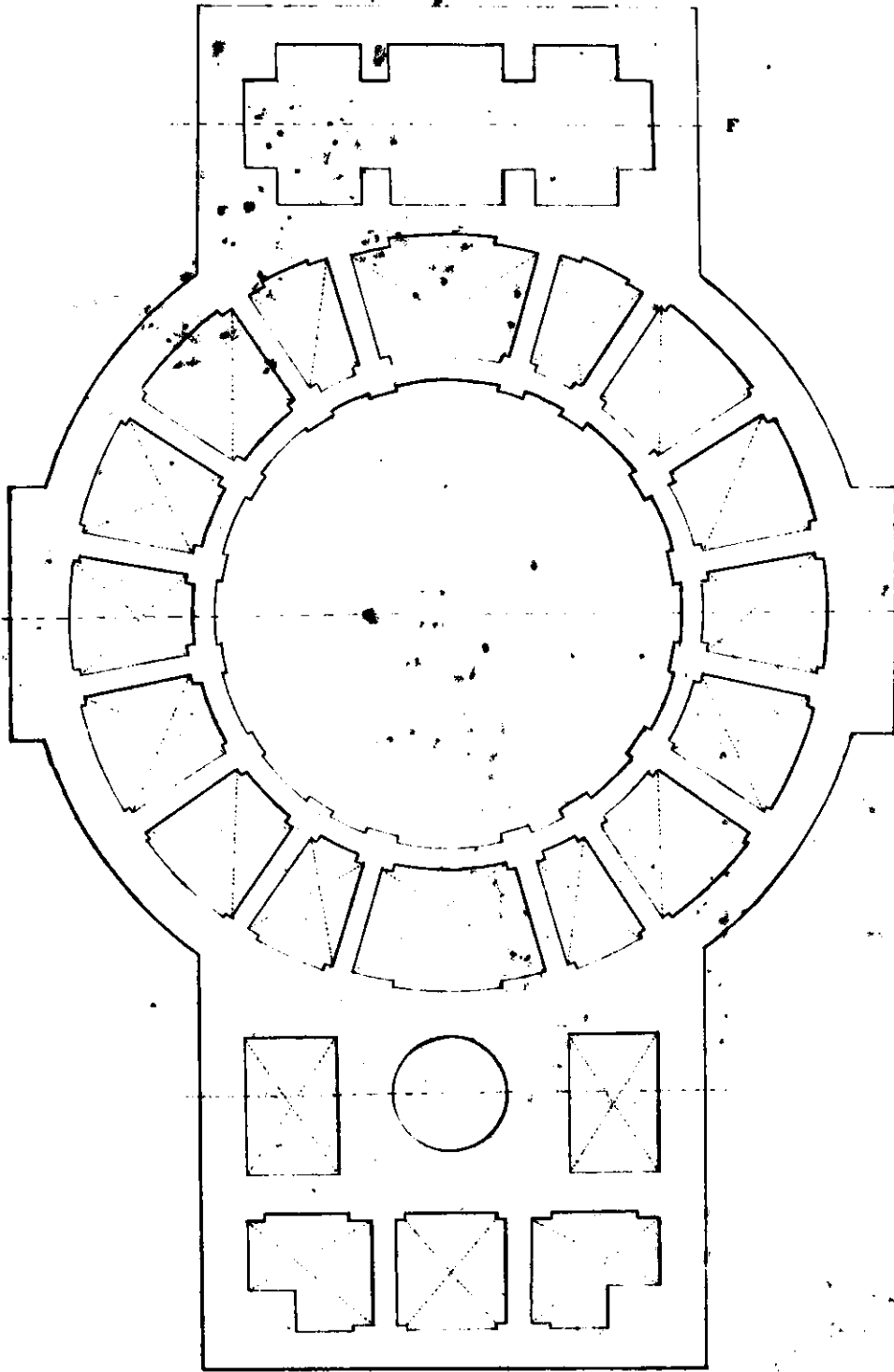
To comprehend this operation, be it kept in mind that in 1817 and 1824 the sea rose to a mean level of several feet above the summit of this breakwater: in the last instance, to eight feet two inches. Now for the sake of argument, let it be assumed, that when the body of the sea was at that height, the *summit* of each wave was *eight* feet more above that height, and the *trough* as many feet below it; it follows, that as each billow arrived successively at the breakwater, its *preceding* trough just uncovered the surface of the work, leaving it exposed to the *increased* buoyancy of the approaching wave, as it *subsided* with accelerated movement to *rise* again under the stones with reciprocal velocity, as through an inverted

ST ANDREWS CHURCH

PLAN OF THE WELLS UNDER THE FOUNDATION

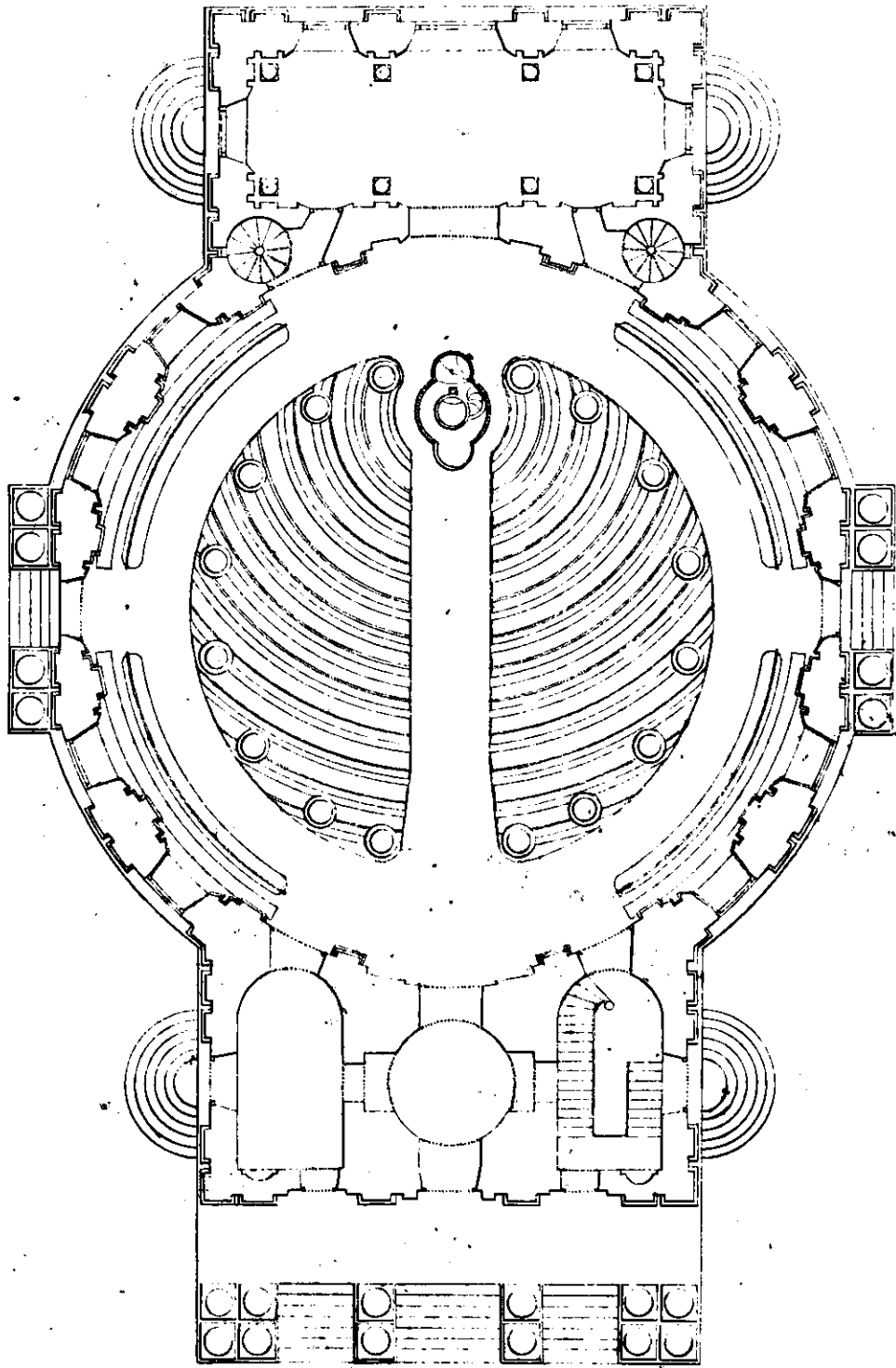


PLAN of the upper part of the FOUNDATIONS of the
SCOTCH KIRK at the Basement.

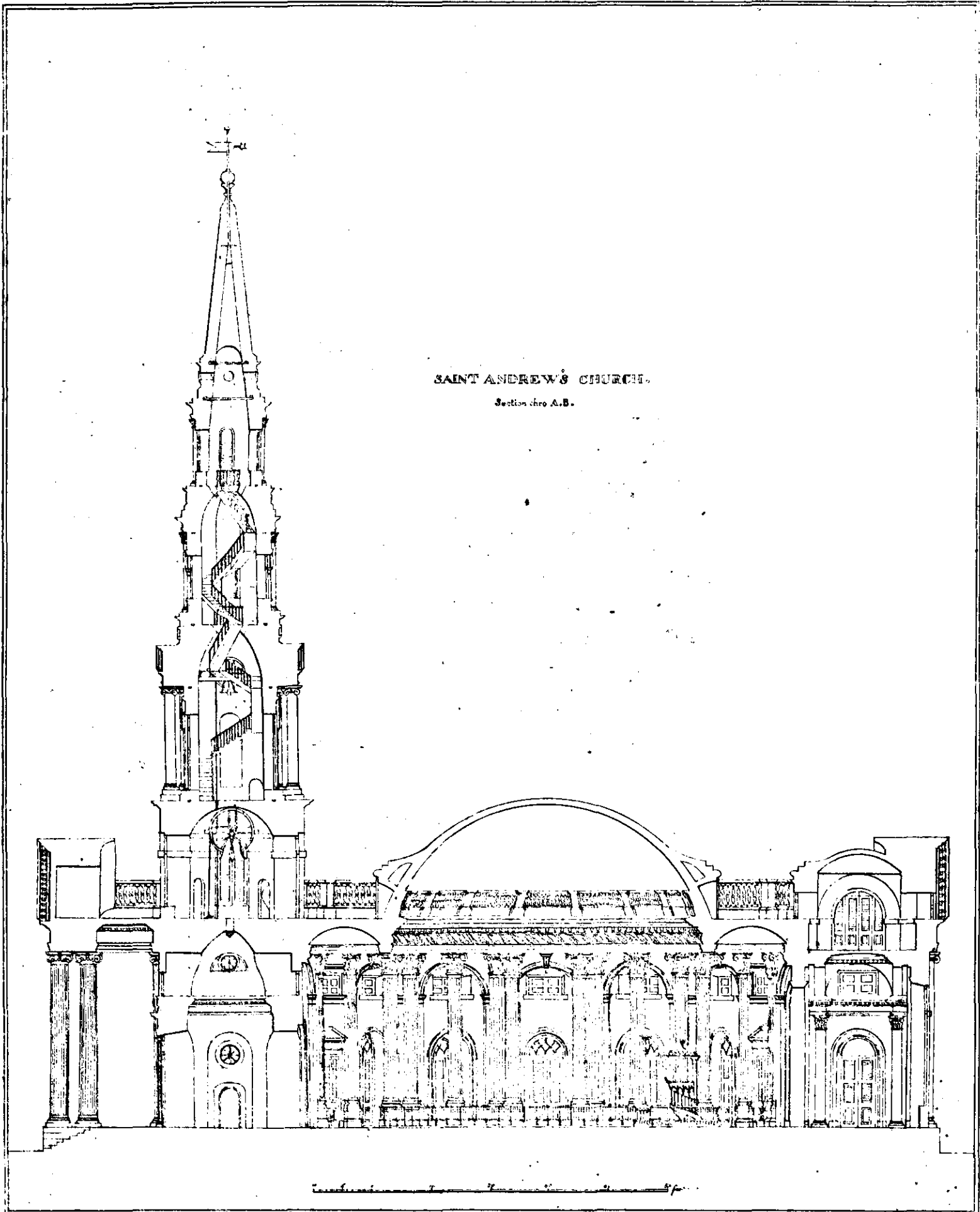


10 feet

GROUND PLAN OF (THE SCOTCH KIEK) SAINT ANDREW'S CHURCH
AT MADRAS.



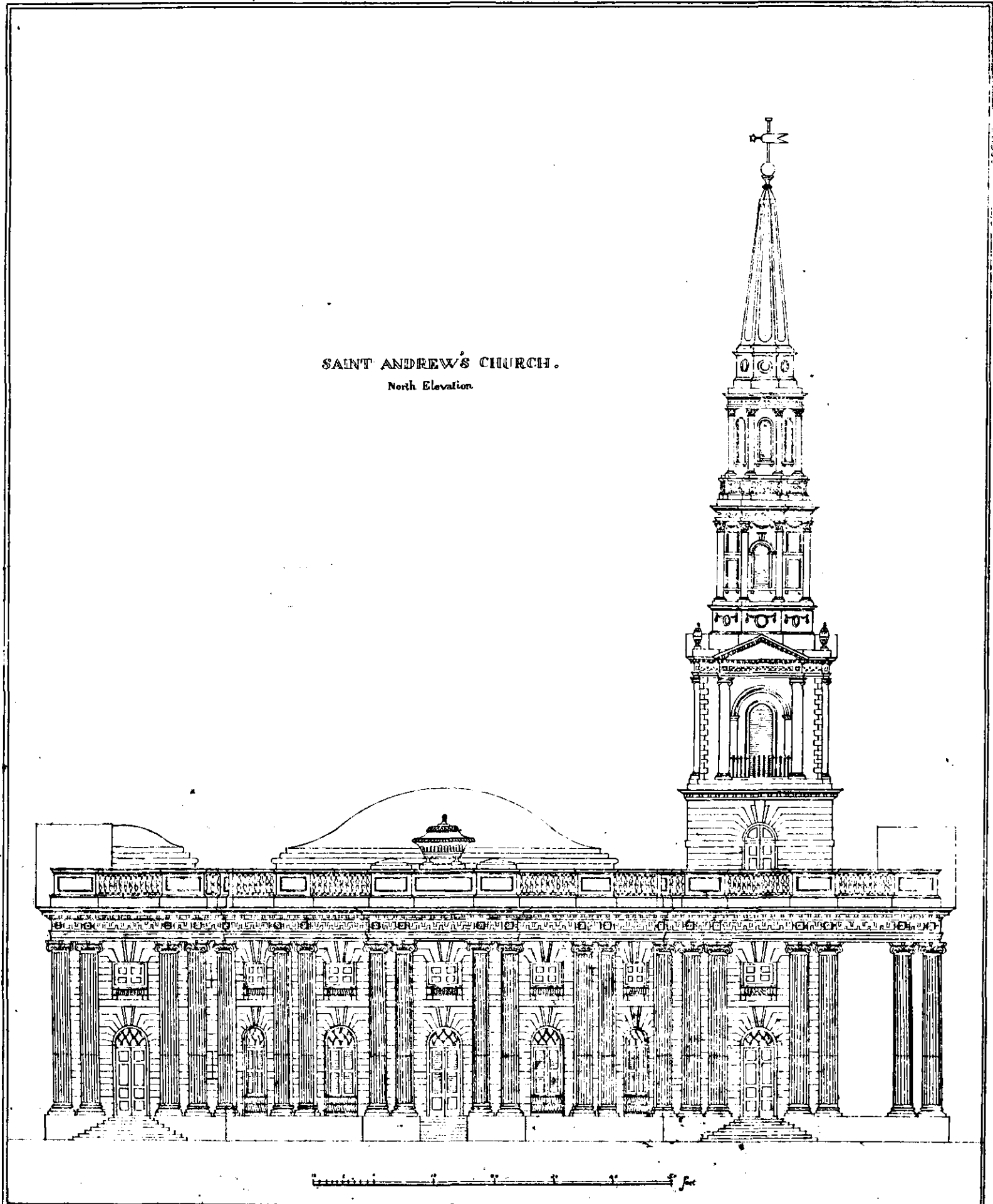
Scale 1/4" = 1' 0"



SAINT ANDREW'S CHURCH.

Section thro A.B.

SAINT ANDREW'S CHURCH.
North Elevation.

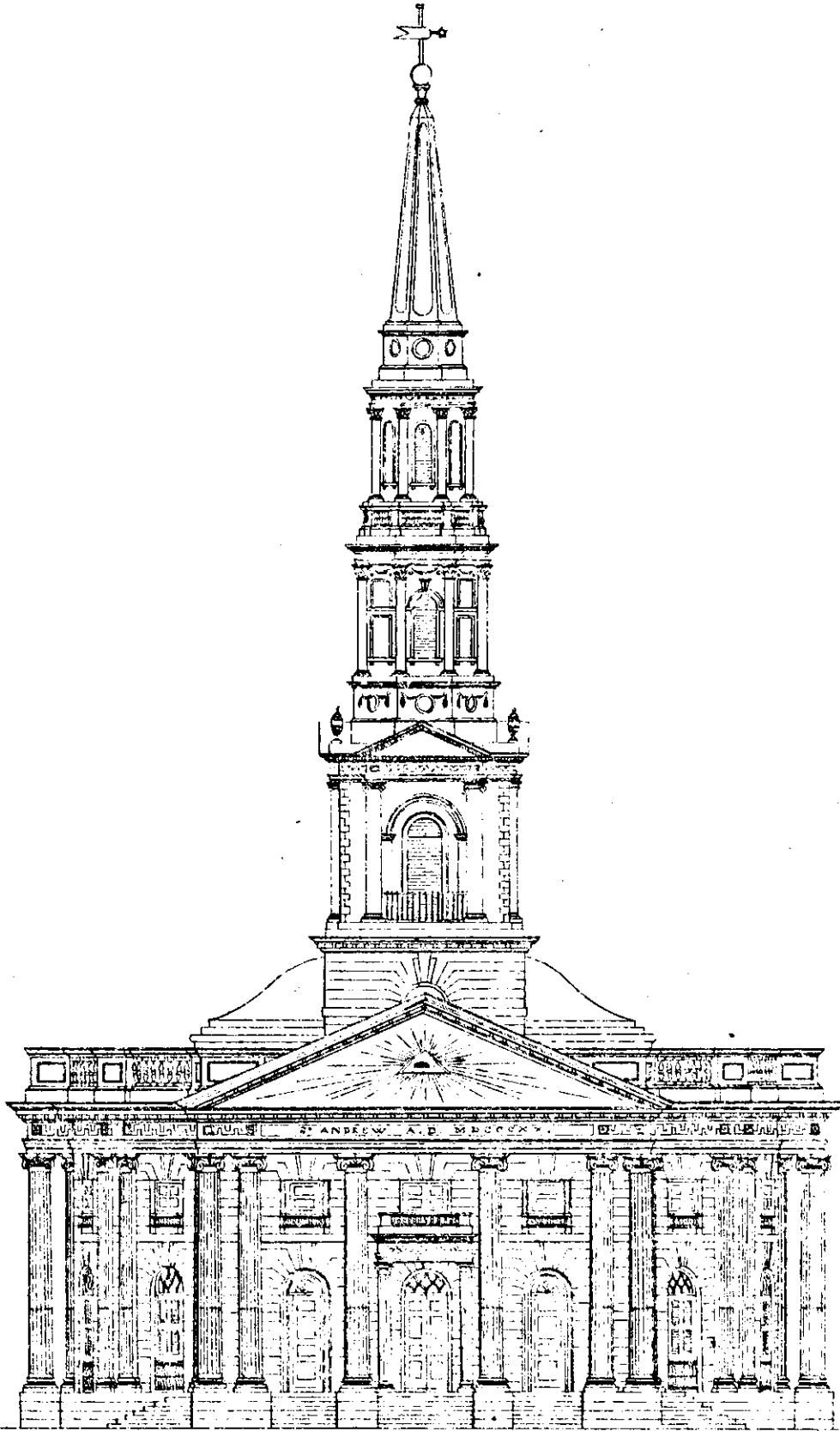


From the Original by L. Col de Havilland.

Drawn and Printed by Maswell, Esq.

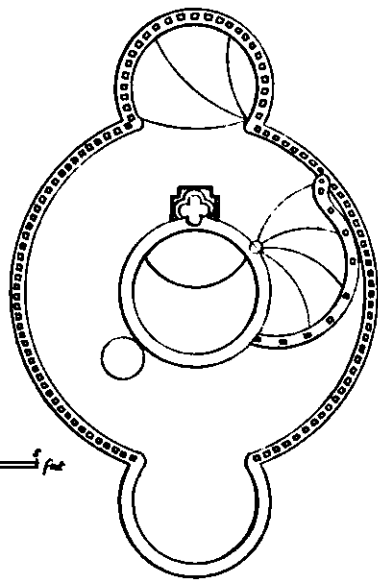
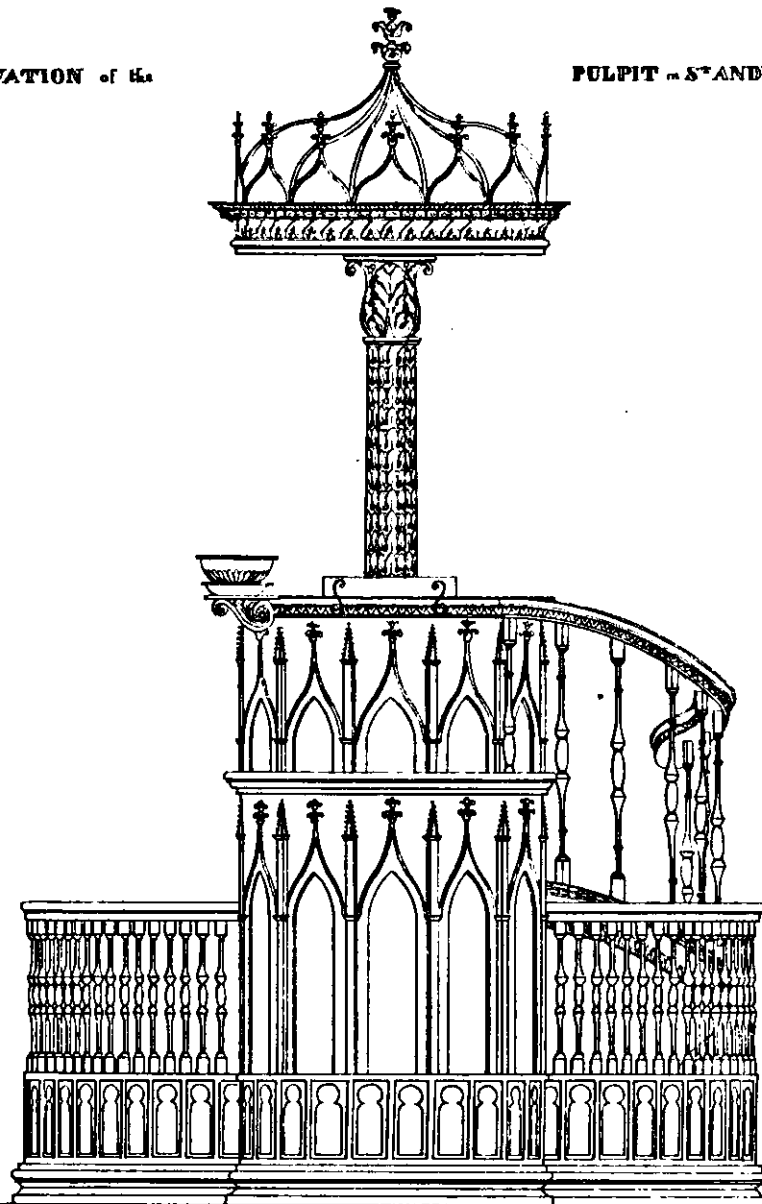
SAINT ANDREWS CHURCH.

West Elevation



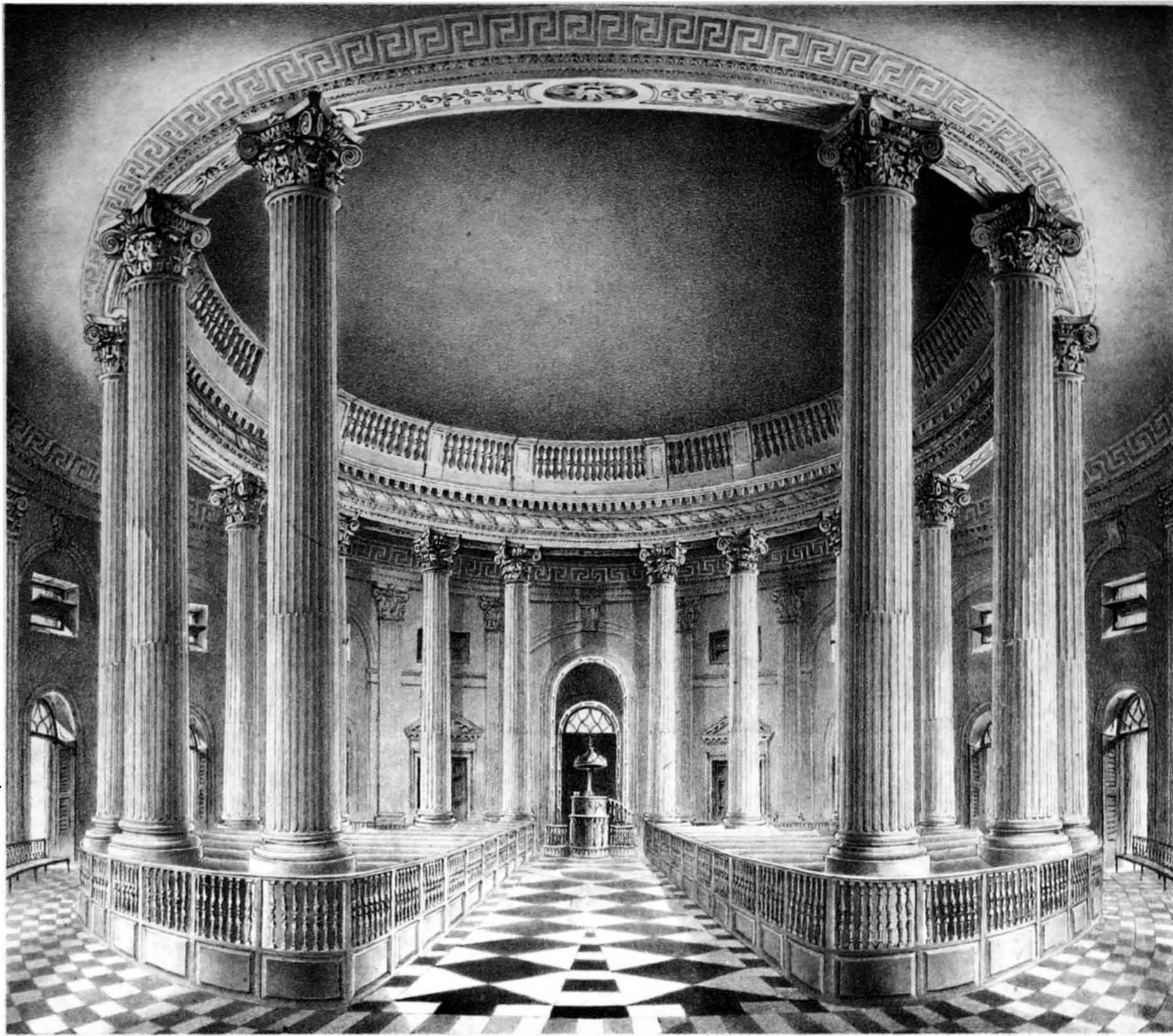
PLAN and ELEVATION of the

FULPIT in S^t ANDREW'S CHURCH.



Elevation. 0 1 2 3 4 5 6 feet

Plan. 0 1 2 3 4 5 6 feet



W. G. Smith, Esq.

Drawn and Printed by Birrell, Esq.

VIEW OF THE INTERIOR OF ST ANDREW'S CHURCH MADRAS.

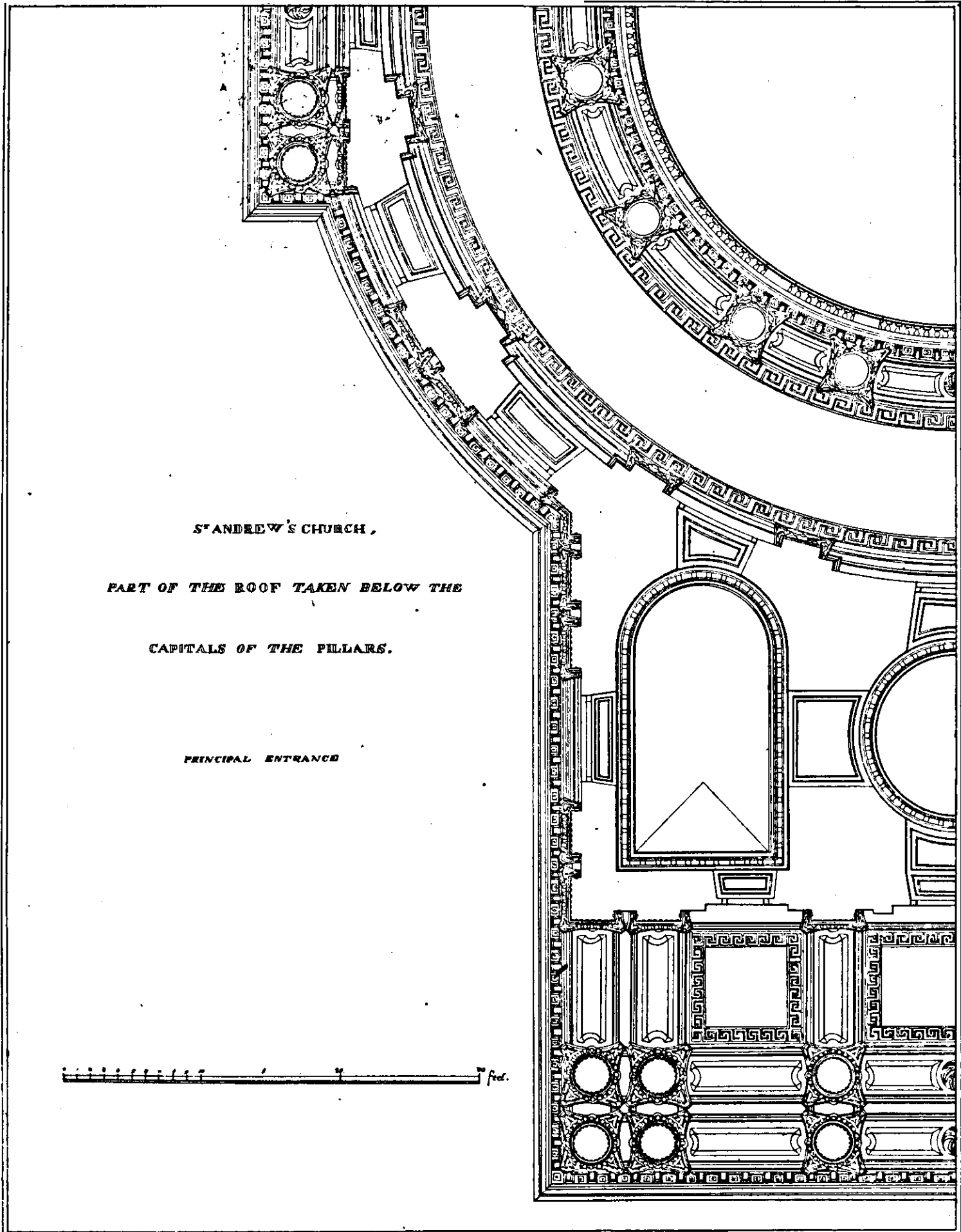


MAP
 of the COAST from
MADRAS to DOOGORAZPATAM,
 with the
Pulicat & Armogham Shoals,
 and
Blackwoods Harbour,
PULICAT LAKE & BACK WATERS.

By Lieut. Colonel de Havilland of Madras Engineers.

REFERENCES
 to Blackwoods Harbour
 A.A. Site of the proposed Beacons
 B. d. Light House
 C. C. Buys Established

Statute Miles.
 1 2 3 4 5



ST ANDREW'S CHURCH,

PART OF THE ROOF TAKEN BELOW THE

CAPITALS OF THE PILLARS.

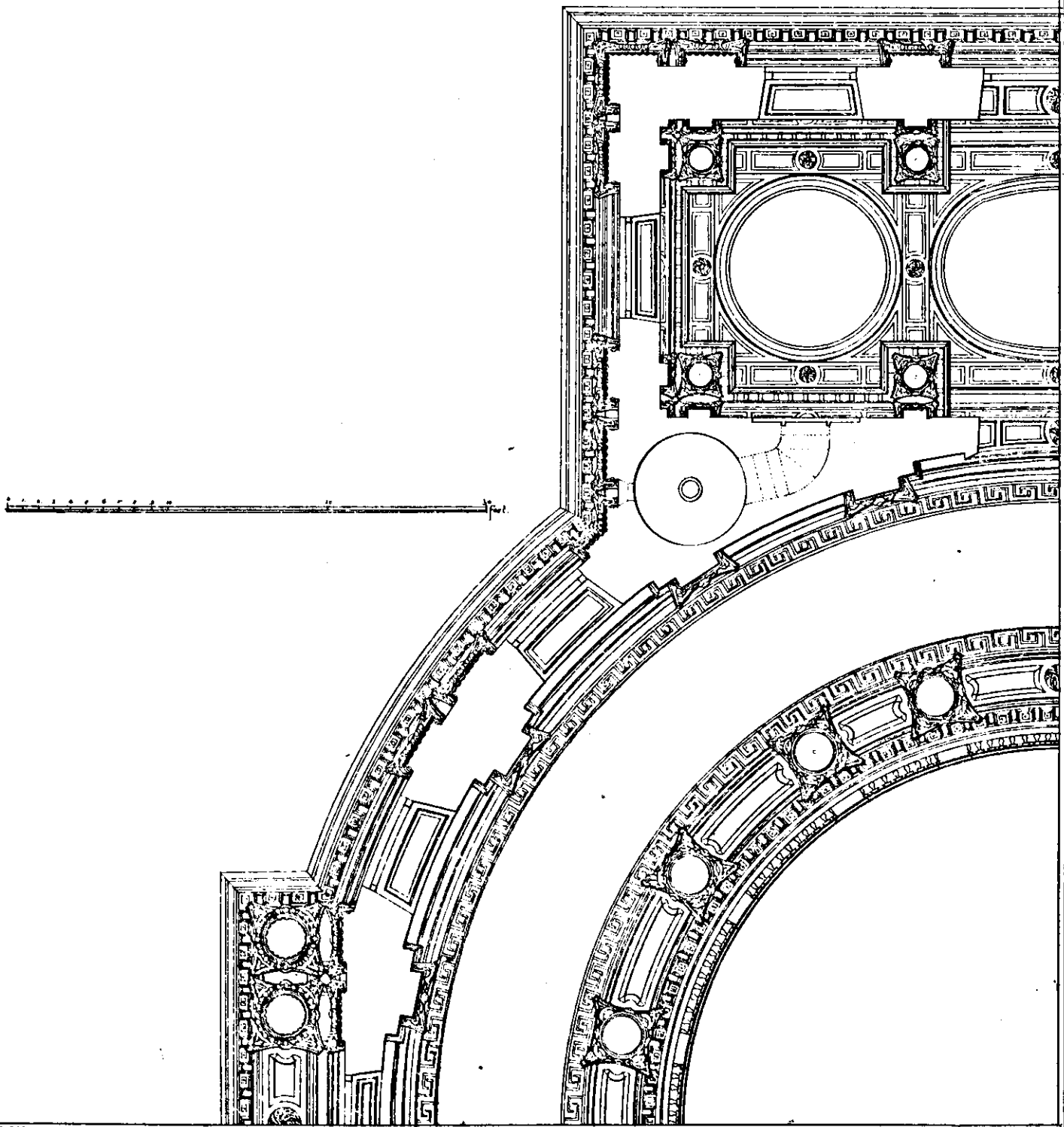
PRINCIPAL ENTRANCE

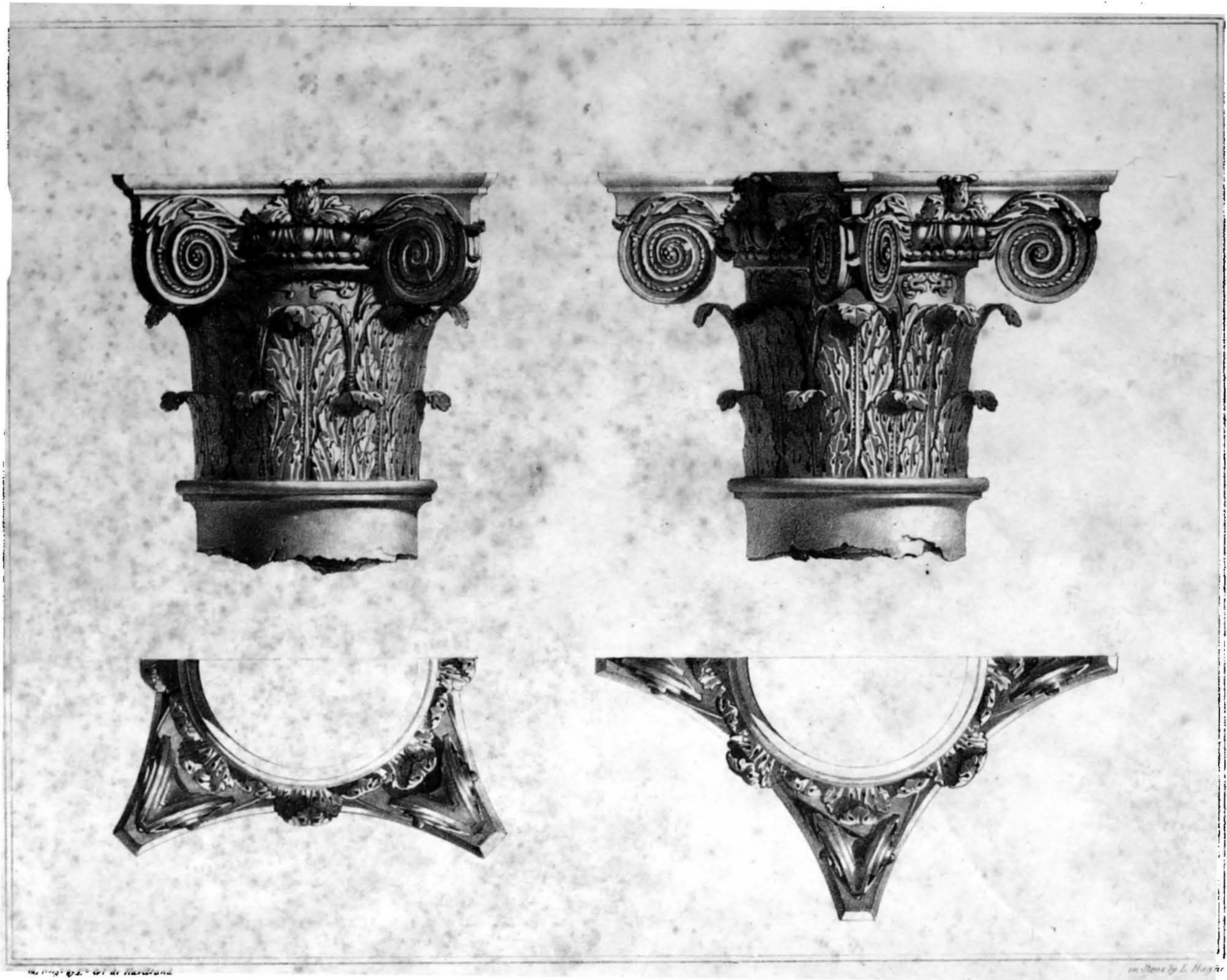
feet.

STANDREW'S CHURCH,

PART OF THE ROOF TAKEN BELOW THE CAPITALS OF THE PILLARS.

EAST SIDE.





Architectural drawing of a capital.

Architectural drawing of a bracket.

Architectural drawing of a capital and bracket.

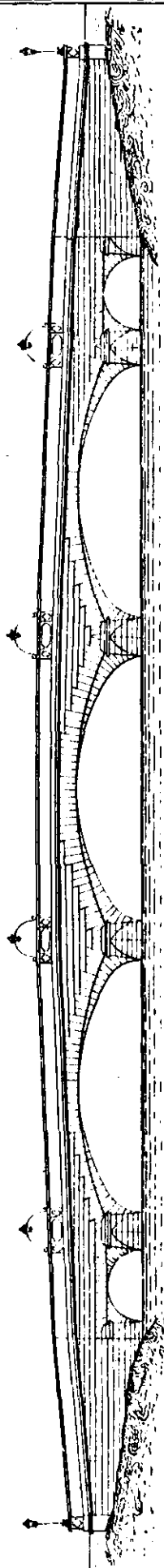
PLAN AND ELEVATION

OF

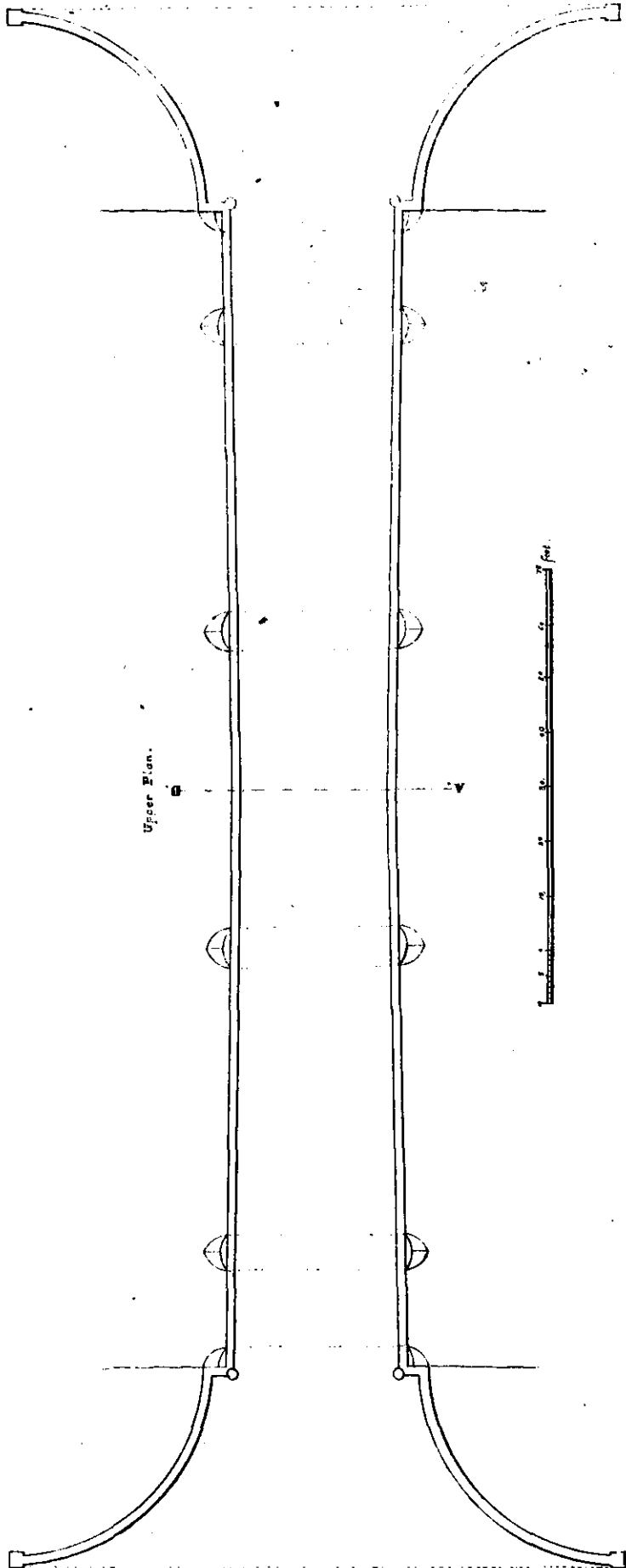
ST ANDREW'S BRIDGE MADRAS.

DESIGNED A.D. 1827.

Elevation.



Upper Plan.



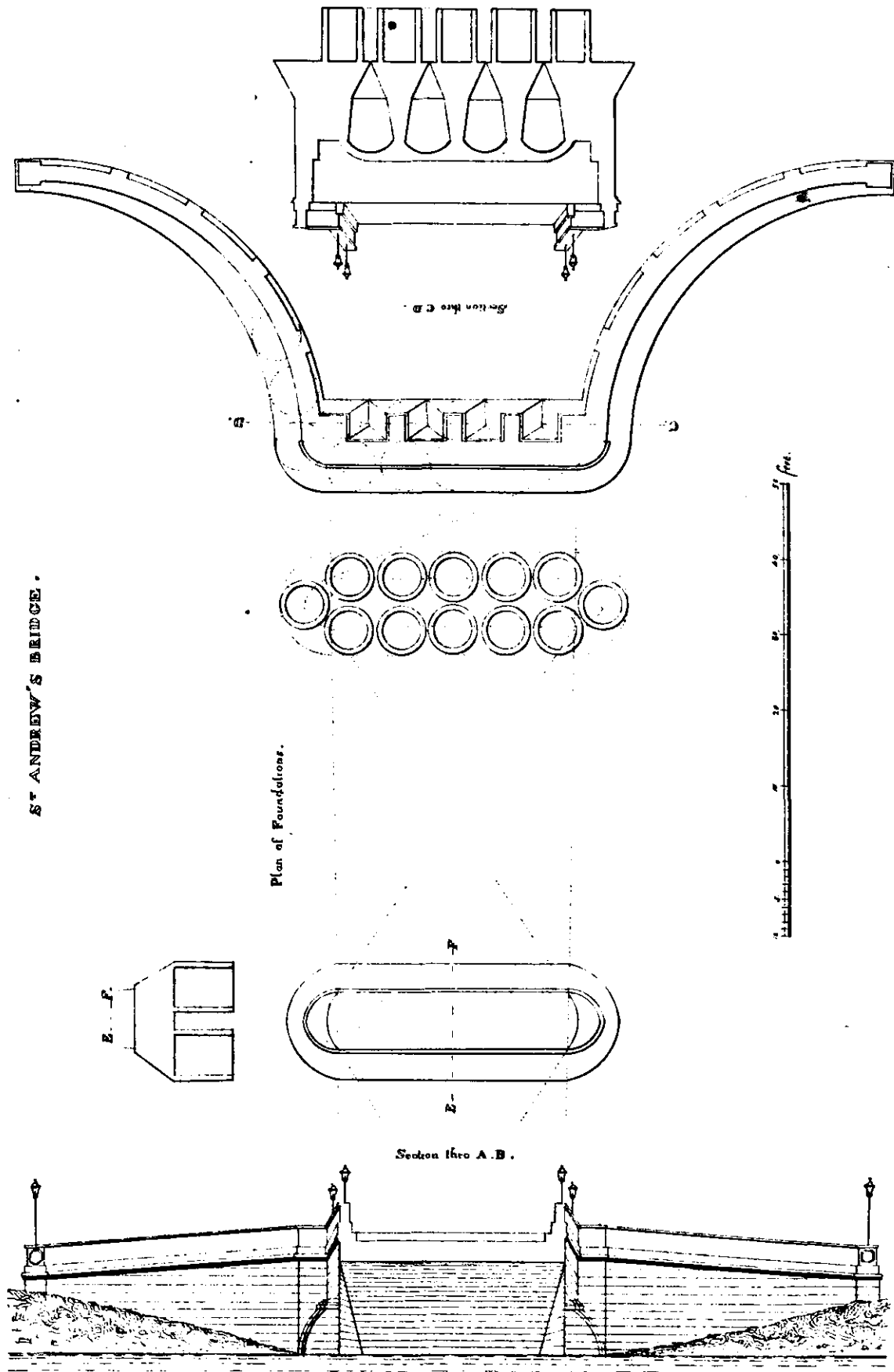
From the Orig. by Lt Col. de Meville.

as stored by the Architect.

Printed by W. H. & Co. Calcutta.

PLAN OF THE FOUNDATION AND SECTIONS

OF
ST ANDREW'S BRIDGE.



From the Design of J. G. & H. G. in 1840. on Stone by Hallfort. Printed by W. D. & J. G. in 1840.