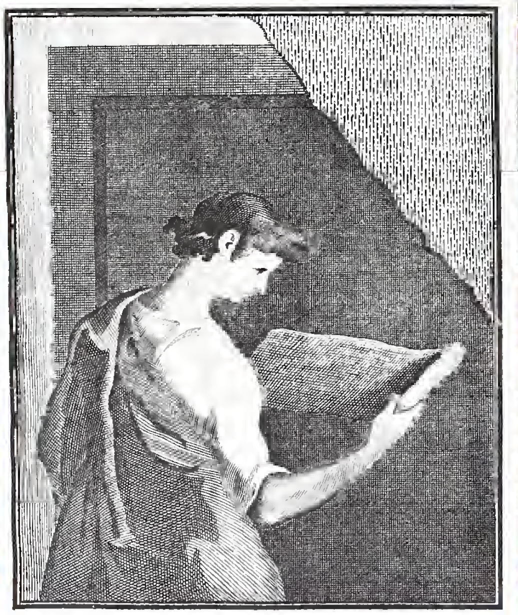

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QUARTERLY PAPERS

ON

ARCHITECTURE.

VOLUME IV.

WITH NUMEROUS ENGRAVINGS,

PART OF WHICH ARE COLOURED.

EDITED AND PUBLISHED BY

IOHAN WEALE

LONDON:
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MDCCCXLV.

LONDON:
GEORGE WOODFALL AND SON,
ANGEL COURT, SKINNER STREET.

TO

EDWARD SMIRKE, ESQ.,

BARRISTER-AT-LAW, M.A., ETC.

THIS VOLUME,

BEING THE FOURTH AND LAST OF A SERIES UPON SUBJECTS IN WHICH HE

HAS ALWAYS SHEWN MUCH INTEREST,

AND UPON WHICH HE HAS BESTOWED GREAT ATTENTION,

IS WITH MUCH RESPECT DEDICATED,

BY HIS VERY HUMBLE SERVANT,

JOHN WEALE.

June 30, 1845.

ADDRESS.

PART VII. of the "Quarterly Papers on Architecture," as well as the present Part, are published at the cost of production, which, exceeding the prices of the former Parts, requires some explanation.

It were a vain presumption to suppose that a paying circulation could be accomplished by the attempt to perpetuate a periodical which should be useful and ornamental in Architecture. No stinginess of expense was for a moment thought of that might mar the fair fame or risk the success of a work devoted to the use of professional men and others engaged in the promotion of the art.

The Parts comprised in Vols. I. II. and III. are in the hands of 900 persons, from many of whom the highest encomiums have been received. The number necessary to meet the expenditure falling short by 600, I am a very considerable loser by the three volumes. I have done my part, and am content to limit my loss by that which it was anticipated would have been productive of profit for the employment of capital, and a remuneration for the trouble necessarily belonging to a work of this nature.

The work, now making four volumes, will, as a continuous publication, cease to exist, all the Papers being perfected; and is hence to be considered as complete. With much that is new, instructive, and useful in practice, it combines numerous embellishments worthy of the admirable art on which it treats.

J. W.

July 15th, 1845.

A PARTICULAR ACCOUNT

OF

THE ILLUSTRATIONS WHICH ADORN THE FOUR VOLUMES.

Abbey Church St. Bertin :—

Window remarkable for its tracery.

Very ancient and castellated farm-house.

Ancient hotel de ville, St. Omer.

Entrance to ditto.

View of St. Bertin.

Chateau de Wisque.

Ancient Stained Glass at York :—

St. Anne teaching the Virgin to read, from the east window of All Saints, York.

St. Christopher carrying our Redeemer, from ditto.

St. John the Baptist, from ditto.

Angel from the tracery of the east window of the south aisle of St. Martin's Church, Micklegate, York.

Head of our Saviour, from St. Mary's, Castle Gate, York.

Lower part of the east window, Acaster Malbis Church, York.

West window of nave, York Cathedral.

Ditto ditto.

Ditto ditto.

Emblem of the Trinity, St. John's Church, York.

Primitive Church in Norway.

Pannelled carved ceiling.

North door of the Church at Hitterdal.

South door of ditto.

West door of ditto.

Principal door of the Church at Tind.

Door of the Church at Borgund.

Architecture of Belgium,—the transition and primary pointed or lancet styles.

The secondary pointed or rayonnant style.

The tertiary pointed or flamboyant style.

Examples of ornamental alphabetical letters and decorations of the 13th, 14th and 15th centuries.

Alphabet from an illuminated MS. of the 14th century.

Miniature of St. Augustin, legend " Pray for us, pious St. Augustin," with beautiful illuminated border and letters.

Gloria Patri et Filio, &c., Gregorian letters and capitals.

Ornamental Old German letter.

Monograms, with borders and devices.

Ditto. ditto.

Miniature of the Resurrection of our Lord, with Gregorian letters and capitals and ornamental borders.

Portion of a stained glass window at Gouda in Holland, shewing in the attitude of prayer Queen Mary of England and Philip II. of Spain, both likenesses.

The Temple Church, London—30 Illustrations.

The stained glass windows, east end, and of the north and south aisles, in colours, fac-simile.

The stained glass east window of tower, in colours, fac-simile.

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OF THE

FOUR VOLUMES OF THE QUARTERLY PAPERS ON ARCHITECTURE,

IN THE FORM THEY HAVE BEEN ISSUED FROM ITS COMMENCEMENT AT MICHAELMAS, 1843, TO ITS TERMINATION THIS PRESENT JUNE 30, 1845.

A separate Column is annexed for those who may prefer another mode of binding and making up the Work.

Vol.

* Such an outcry was made against this Paper, that in reprinting the first portion of the Volume "The Architecture in and about St. Omer," by the Rev. Alfred Suckling, pp. 12, with seven Engravings, was advisedly substituted in its place.

Vol.

Vol.

LITHOLOGY,

OR

OBSERVATIONS ON STONE USED FOR BUILDING.

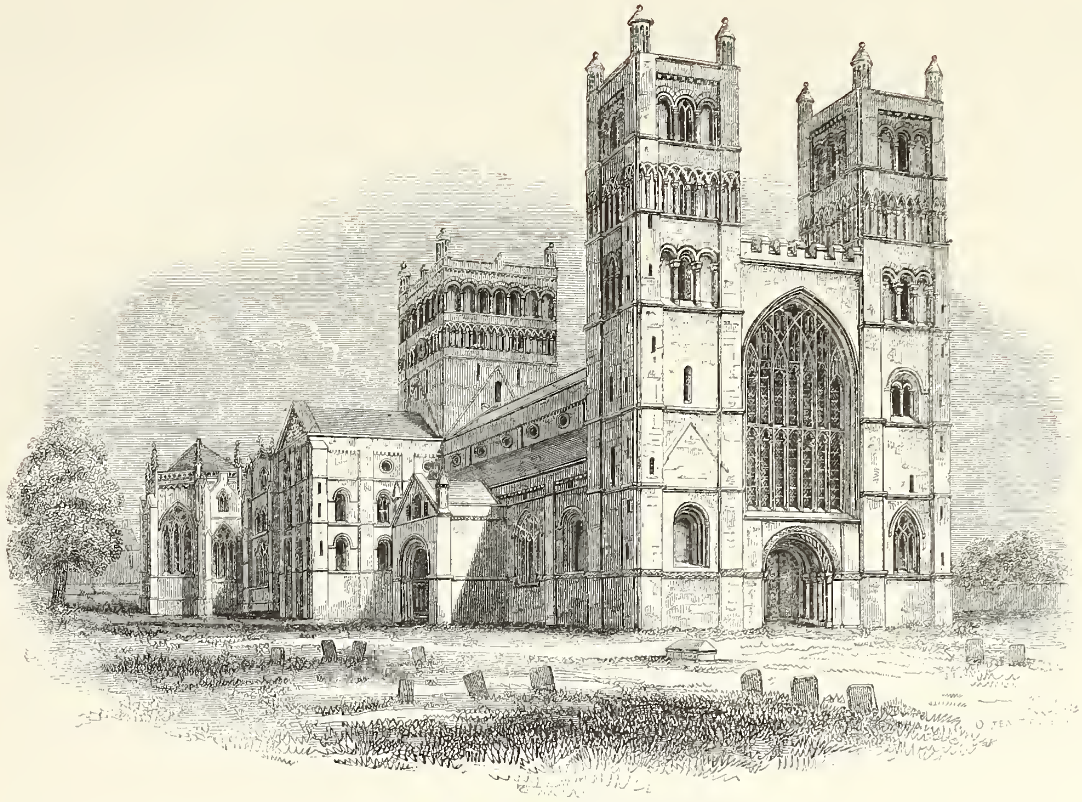
BY C. H. SMITH.

Read at the Ordinary General Meetings of the Royal Institute of British Architects, held on Monday the 29th of April, and on Monday the 3rd of June, 1844.

TREATING CHIEFLY OF THE MAGNESIAN LIMESTONES OF YORKSHIRE, DERBYSHIRE, AND NOTTINGHAMSHIRE,

WITH REFERENCE TO THE SELECTION OF STONE FOR BUILDING THE EXTERIOR OF

THE NEW HOUSES OF PARLIAMENT.



SOUTHWELL COLLEGIATE CHURCH.

PART I.

It is now freely admitted that a knowledge of the general structure of rocks, and the situations, according to local circumstances, whence the best stone may be obtained, is essentially requisite for those persons who are intrusted with the direction of stone buildings. The little attention paid to this subject, in England, before the destruction of the Parliament Houses, is a fact so notorious, that it needs no comments.

More than five years have elapsed since the country around Bolsover Moor was first inspected, with a view to the selection of a proper stone to be used in the important works at Westminster, and it is upwards of four years since the first stone was laid of the river front of the Houses of Parliament [a]; during this interval, the quarries have been very extensively opened, and the working of the stone actually tested by elaborate practical experiments. All parties who take an interest in that great work, seem to express themselves satisfied or pleased with the stone; conse-

[a] On Monday the 27th of April 1840, the first stone (a magnesian limestone) of the superstructure, was laid at the north-east angle of the river front.

quently it is presumed that a detailed account of the various circumstances which influenced the ultimate recommendation of it, may prove both interesting and useful to the architectural profession.

The subject may be divided into two parts, commencing with a general description of the magnesian limestone districts; describing briefly the principal quarries which have been worked for architectural purposes; pointing out the most conspicuous buildings which have been constructed with such materials; and concluding with a full account of the stone in the neighbourhood of Bolsover Moor, especially of that from the Norfal quarries, which is now being used at Westminster, and which has immediate reference to the subject now under consideration.

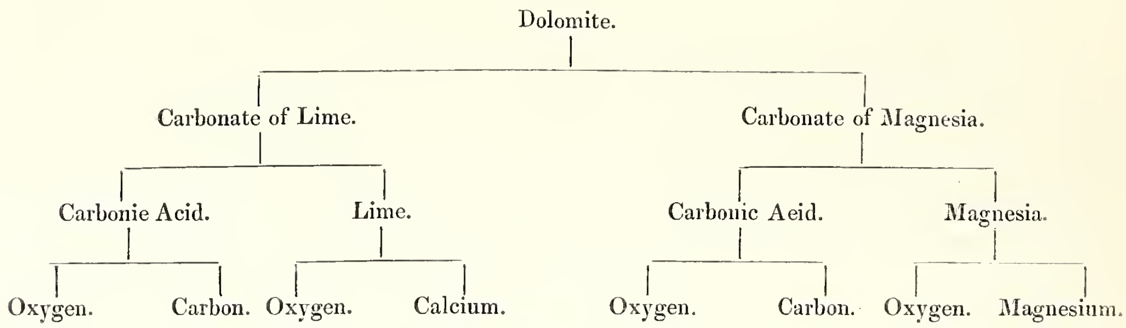
Each of the several classes of stones used for building, termed limestone, sandstone, &c., generally contains some portion of other substance in addition to that which the literal meaning of the term denotes: the name, by which we form an imperfect idea of the entire mass, is usually derived from that portion of the composition which, on attentive examination, or analysis, is found to be more abundant in it than any other. There are instances of rocks which contain scarcely more than one simple elementary substance; for example, the Liver Rock of the Craigleith quarry consists of above 98 per cent. of silica, but such occurrences may be considered rather as exceptions than general rules. Stones of the same mineralogical character, even when obtained from situations within short distances of each other, vary considerably in the proportions of their component parts; which circumstance accounts for the arenaceous, calcareous, and magnesian limestone rocks being continually found passing into each other, by almost imperceptible gradations, and rarely occurring in a perfectly separate or pure state.

All free working limestones, including the oolites, contain some portion of magnesia in their composition; in many cases the quantity is so small as to be scarcely worth noticing, as in the Portland and Bath stones, neither of which contains more than 1 or 2 per cent. of carbonate of magnesia. If limestone which is fit for architectural purposes contains 30 or 40 per cent. of magnesia in its composition, it is frequently called "Dolomite," from Dolomieu, a native of Dauphiny, who was the first to notice it amongst the Alps. When this mineral is extremely pure, and in large crystals, it is by some mineralogists termed "Bitter Spar:" for these reasons, magnesian limestone, dolomite, and bitter spar, may, for the sake of convenience, be considered nearly as synonymous terms. In the neighbourhood of Tadcaster, where the dolomite is abundantly and beautifully developed, there are also immense masses of crystalline limestone, with different shades of yellow, red, and brownish red colours, which have all the external characters of dolomite, yet they contain but a mere trace of magnesia: such examples may be regarded as extreme cases, wherein the magnesia has almost disappeared. From this state of combination, in which the bulk of magnesian earth is so trifling as scarcely to be detected, there are numerous specimens, containing all the various proportional quantities of carbonic acid, lime, and magnesia, until the equivalent proportions are precisely such as to neutralize each other, and form a triple salt in crystals of genuine dolomite, consisting of 54.18 carbonate of lime, and 45.82 carbonate of magnesia. This seems to be the greatest amount of magnesia that can be chemically united with carbonic acid and lime; and although occasionally thin beds are found, which contain a larger proportion of magnesian earth than is usually to be met with, the excess, beyond 46 per cent., is generally uncombined, remaining in minute flakes, or in a powdery and incoherent state.

The analytical table (overleaf), of various magnesian limestones, will show the relative quantity of carbonate of magnesia in each specimen ; as indicated by the uppermost line ; arranged progressively in a decreasing order, beginning with dolomite, which chemists and mineralogists consider to be a perfectly neutralized compound ; and the nearer a stone of this class approaches to the equivalent proportions of dolomite, all other conditions being equal, the more durable will be the stone ; because magnesia is not so readily decomposed as lime is, by moisture and the usual atmospheric influences. Frequent reference will hereafter be made to this table, therefore, at present, it is only requisite to explain, that the Roman capital letters at the top of each column, signify from whose authority the analysis is taken, thus D means Professor Daniell, of King's College, London ; P Richard Phillips, Esq., of the Museum of Economic Geology, Craig's Court; and H the Rev. J. Holme, from the Transactions of the Geological Society, 3rd volume, second series.

This table is sufficiently particularized for the general tenor of the essay ; if a more minute analysis should be required, it would involve a long, patient, and diligent research; which might perhaps be interesting to the chemist, but certainly foreign to the architect. For the sake of illustration, one example may be given, as a specimen of the complicated nature of such inquiry; for which purpose, we will select dolomite, because it is the simplest compound of a magnesian limestone, and consider it, in the first instance, as a composition of two substances, namely, carbonate of lime, and carbonate of magnesia; each of these in its turn is generated by a pair of bodies, carbonic acid and lime on the one hand, and carbonic acid and magnesia on the other; these are, however, themselves compounds, the acid being an oxide of carbon, the bases are the oxides of the two metals, calcium and magnesium. The following diagram will, perhaps, render this more intelligible:—

		P (NORFAL)	P (NORFAL)	P (NORFAL)	P	P	P	P	D	P
	Dolomite.	Upper Bed.	Fourth Bed.	Eighth Bed.	Steetley, upper or Yellow Bed.	Kiveton Park, or Pennyholme.	Bolsover Moor.	Steetley, lower or White Bed.	Mansfield, Woodhouse.	Kiveton Park, or Red Hill.
Carbonate of Magnesia...	45.82	45.20	44.70	44.40	44.30	43.84	43.83	42.96	42.60	42.50
Carbonate of Lime	54.18	52.00	52.50	52.80	52.80	52.78	52.17	51.14	51.65	51.42
Silica, Iron Alumina	....	2.00	2.10	2.10	1.15	2.00	2.57	2.60	3.70	4.56
Water and loss	......	0.80	0.70	0.70	1.75	1.38	1.43	3.30	2.05	1.52
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00



Thus it appears that the dolomite, which in its purest state is so rare a mineral, as to be considered almost hypothetical, must consist of at least the four clements, oxygen, carbon, calcium, and magnesium; but as usually found, like the Anston or Bolsover stone, it almost invariably contains, in addition to the above, small quantities of iron, silicium, aluminum, and frequently other elementary substances, which would render a more accurate analysis exceedingly tedious, and for general purposes quite unnecessary.

According to the authority of geological maps, magnesian limestone has not been noticed either in Scotland or Ireland [a]; and, as compared with other rocks, is but scantily supplied in England. Small patches are to be found in many parts of the kingdom, generally situated over or near extensive deposits of coal: there is a good

[a] In a short article in the Philosophical Transactions of the Royal Society, (June 6th, 1799,) on different sorts of lime used in Agriculture, by Smithson Tennant, Esq., F.R.S., experiments are recorded, on "Magnesian Limestone from Iona, one of the western islands of Scotland."

Sir Humphry Davy in his Lectures on Agricultural Chemistry, page 284, states that "Magnesian Limestones abound in many parts of Ireland, particularly near Belfast."

	D	D	D	D	D	H	P	D	P
	Park Nook, near Robin Hood's Well.	Huddlestone.	Bolsover Moor.	Roche Abbey.	Old Window, jamb of Westminster Hall.	Mansfield Rock Valley.	Conisburgh Castle.	Mansfield Red.	Mansfield White.
Carbonate of Magnesia..	41.60	41.37	40.20	39.40	23.80	22.375	20.40	16.10	7.30
Carbonate of Lime	55.70	54.19	51.10	57.50	68.75	52.250	76.20	26.50	41.30
Silica	0.00	2.53	3.60	0.80	0.05	20.250	} 1.80	49.40	} 50.00
Iron Alumina	0.40	0.30	1.80	0.70	0.50	3.375		3.20	
Water and loss	2.30	1.61	3.30	1.60	6.90	1.750	1.60	4.80	1.40
	100.00	100.00	100.00	100.00	100.00	100.000	100.00	100.00	100.00

deal of magnesian limestone in the neighbourhood of the great coal-fields of South Wales; it is also to be found rather abundantly between Bristol and Wells; but the chief supplies are obtained from the localities of the coal-fields of Derbyshire, Nottinghamshire, Yorkshire, and Durham; occupying, with few interruptions, the distance of about 150 miles, from Nottingham to Tynemouth, the breadth rarely exceeding a few miles. Throughout this range, the upheaving or subsidence of the rocks, from their original position, has occasioned various undulatory surfaces to the landscape, such as long continuous terraces overlooking an extensive country beneath; in other places the rocks are divided into small hills, which have been gradually modified by the constant operation of denuding forces, so as to produce many scenes of great variety and beauty. During feudal times, these tors, or protuberances, were generally occupied by the barons, either for the beauty of the prospect, or more probably on account of their commanding situation, thus we find Conisburgh, Pontefract, Bolsover, Hylton, and Knaresborough Castles; Hardwick Hall, and Tynemouth Abbey and Castle, each resting either on an escarpment, or on an outlier of magnesian limestone[a].

Although, geologically considered, the magnesian limestone rocks extend from Nottingham to Tynemouth, the principal quarries that yield stone fit for architectural decorations, are situated between Mansfield and Knaresborough, distant about 70 miles. On this line, and frequently within very short distances, we find stones to all appearance totally different; but such as the chemist considers to be nearly identical, because the denominating portion preponderates. North-east of Mansfield, close

[a] In geological language, an "Escarpment" is the abrupt face, or steep declivity of a continuous ridge of high land. If a portion of a stratum occurs at some distance, detached from the general mass of the formation to which it belongs, such a hill is called "an outlier."

to the town, in Rock Valley quarry, the stone is of a dull brick-red colour ; on the south-west of the town, it is of a greenish grey white; and about a mile northward the Woodhouse stone has precisely the tint of yellow ochre. In the vicinity of Tadcaster, the stone is of a cream colour, whereas that of Roche Abbey is of a fine greyish white. These different hues arise from a small quantity of metallic oxide, generally ferruginous, rarely exceeding 2 or 3 per cent. The presence of iron may be traced in rocks of all ages and formation ; the most transparent calcareous spar of Iceland, and the whitest statuary marble of Carrara or Pentelica, are seldom or never perfectly free from it. By attentively examining the exterior of numerous old buildings, constructed with stones which are slightly tinged with iron, there appears no reason to suppose, that a small quantity of colouring matter assists, in any appreciable degree, either the decomposition or durability of a stone.

From our earliest recollections, we all seem to be somewhat acquainted with the meaning of the term "magnesia," as applied to medicine ; although its properties, as a mineral substance, in combination with other things used for building, have not been investigated, nor even noticed, beyond a mere allusion incidentally expressed. The existence of magnesian earth appears to be altogether a modern discovery ; it was originally introduced at Rome, as a medicine, under the name of Count Palma's powder, in the beginning of the 18th century, where it was offered as a remedy for all disorders, and long continued to be a very lucrative secret. Magnesia has been supposed to be named after the Greek cities of the same name, where this earth is said to be abundantly found, although there is no foundation for such a supposition. Magnesia Alba, was a general term which the early chemists gave to all substances that really had, or were supposed to have, the power of attracting some important principle from the atmosphere. Magnesia was formerly considered to be nothing more than a different kind of lime : Dr. Hoffman was the first who distinguished it from all other earths ; and about the year 1752, Dr. Black, of Edinburgh, described it as a perfectly elementary substance.

Before I attempt to describe the stone itself, it may be as well to say something about its component parts, and then endeavour to describe the distinctions between dolomite and common limestone. You are all so far acquainted with the nature and properties of lime, as to require no explanation of that material, further than to point out in what respect magnesia differs from it. Dry magnesia, in its purest state, is a fine grained, extremely light powder ; perfectly white, and absolutely insipid, though, as usually prepared, it generally retains a small portion of lime, to which circumstance may be attributed the slightly acrid taste which it frequently possesses. If wet, it is more transparent than when perfectly dry. No heat is produced when water is thrown upon it, as is the case with lime. When exposed to the air it does not slack. It takes a long time to increase in weight, and regain carbonic acid from the atmosphere, which had been driven off by calcination; in this respect, also, it differs remarkably from lime [a]. It is almost insoluble in pure water. Kirwan states that 7900 parts of water will only dissolve one part of magnesia; therefore it is about sixteen times as insoluble as lime; for this reason stalactites and incrustations, formed by the infiltration of water through magnesian limestone rocks, contain only a mere trace of magnesia, being composed almost entirely of carbonate of lime.

These remarks may be sufficient to show that lime and magnesia are essentially different. In the formation of dolomite, some peculiar combination takes place between the molecules of each substance; they possess some inherent power, by which the invisible or minutest particles intermix and unite with each other so intimately, as to be inseparable by mechanical means. On examining, with a highly magnifying power, a specimen of genuine magnesian limestone, such as that of Bolsover Moor, it will be found not composed of two distinct sorts of crystals, some formed of carbonate of lime, others of carbonate of magnesia; but the entire mass of stone is made up of rhomboids, each of which contains both the earths, homogeneously crystallized together. When this is the case, we know, by practical observation, that the stone is extremely durable, as exemplified in the Norman part of Southwell Church; and, if theory is admissible, the inference may be drawn, that if two specimens of stone were equally good in every other respect, the one containing an equivalent portion of magnesia would certainly be more durable than that composed wholly of carbonate of lime, because magnesia almost effectually resists the solvent

[a] It is a mistaken notion to suppose that magnesian limestone is more injurious to vegetation than that which is entirely calcareous. If pieces of each sort be reduced to coarse powder, and seeds of different plants be sown in them, and properly watered, they will grow equally well in both kinds; and in the same manner as they would in sand, or any other substance which affords no nourishment to vegetables. One of the most fertile parts of Cornwall, the Lizard, is a district in which the soil contains a large proportion of magnesia, derived from the decomposed serpentine of the rocks beneath. The Lizard downs are, however, reckoned fine pasture land, and the cultivated parts are amongst the best corn lands in the county. In confirmation of this evidence, the agriculturists of the magnesian limestone districts in Nottinghamshire, Derbyshire, and Yorkshire, all agree in pronouncing their land to be extremely fertile.

But if magnesian limestone be calcined, and then mixed with the soil, it will continue for a long time pernicious to vegetation. Magnesia has a much weaker attraction for carbonic acid than lime has, therefore it will remain in a caustic or calcined state for many months, although freely exposed to the air; and so long as any caustic lime remains, the magnesia cannot be combined with carbonic acid, because lime instantly attracts carbonic acid from magnesia. During the process of burning a magnesian limestone, the magnesia is deprived of its carbonic acid much sooner than the lime is.

power of water, and, thereby, it is not likely to be affected by the decomposing influence of rain or aqueous vapours.

It may be useful to know in what manner magnesian limestone can readily be distinguished from common limestone. If it is not sufficiently hard to scratch glass, but effervesces feebly, and makes the acid in which it is tested appear somewhat milky or turbid, it may be fairly presumed to contain at least ten or fifteen per cent. of magnesia. The acid usually employed to detect carbonate of lime is muriatic, or, according to modern chemical language, hydrochloric acid, diluted with not less than two-thirds water. If diluted nitric acid or aquafortis be used, the turbid appearance will be rendered more evident. The acid should be sparingly added to the water containing the magnesian limestone, taking great care not to put in too much ; it will then only dissolve and take up the lime, leaving the magnesia in a state of white powder at the bottom of the vessel. Continue to add acid to the mixture, and if all the lime is dissolved, the acid will then begin to act upon the magnesia, but not while there remains any portion of lime.

In describing the different qualities of stone, and the situation of the quarries, the direct course will be to begin with those which have been, from a remote period, most extensively worked for architectural purposes. The district of Bramham Moor, in the neighbourhood of Tadcaster, appears, by almost direct evidence, to have been renowned for its limestone quarries from the time when the Romans were in Britain. Either Tadcaster, or Newton Kyme, a village still nearer to the stone quarries, was the Roman station "Calcaria," no doubt so named from the nature of the soil, which abounds with calx, or limestone. This place was one of the outports, or gates, on the Consular way to their chief military station at York. Here are amazingly extensive and evidently very old stone quarries, which have been the property of the ancient family of Vavasours during many centuries. In the reign of Edward the First, William Vavasour, who was summoned to Parliament among other barons of this kingdom, gave the stone, from the remarkable quarry then called "Petre's Post," now named Jackdaw Cragg, in Thiefdale, for the erection of the magnificent cathedral at York [a]; and it is worthy of remark, that after the partial conflagration in 1829, his lineal descendant, the present Sir Edward Vavasour, gave the stone for its reconstruction from the very same quarry.

As the Romans made York the metropolis of their empire in Britain, it is pro-

[a] The church was rebuilt, "by the assistance of the neighbouring nobility and gentry, particularly the Percies and Vavasors, as appears by their arms within the church, and the statues of Percy holding a beam, and of Vavasor holding a stone, on the west door, the former having furnished timber, the latter stone, for the new fabric."—*Camden's Britannia, Gough's edition.*

bable that they used stone from the vicinity in the construction of their numerous civil and military edifices; and, accordingly, various remains of Roman architecture have been found in that city, executed in magnesian limestone, similar to that of Bramham Moor. Most of these are in a better state of preservation than the generality of structures of later date; but whether this has arisen from any superiority in the material, or from the circumstance of the buildings to which such fragments belonged having been thrown down and buried soon after they were constructed, in some of the turmoils which so frequently devastated the city in those times, and hence have been preserved from further influence of weather, is a question not easily answered. From the appearance of the stone, it seems probable that their good condition, for their age, arises entirely from not having been exposed, more than a century or two, to the action of atmospheric influence. The same cause of preservation cannot be attributed to the multangular tower at York, an undoubted Roman work, built with stone, precisely like that of Bramham Moor, and not much decomposed, considering it to have been erected at least thirteen or fourteen centuries. It must be observed, however, that this building, and the walls adjoining it, were never ornamented; they consist of nothing but plain rude stone walling, and, as such, not so easily acted upon by the decaying influence of moisture and variation of temperature; neither can the same amount of decomposition be so readily perceived on the surface of a rough wall, as it would be on an elaborately finished architectural façade.

The churches at Hull, Beverley, and Tadcaster, are mostly built with magnesian limestone from Bramham Moor, and are in such a condition as to convey to the beholder a very unfavourable impression of the durability of that material.

In the city of York, there are the remains of not fewer than seventy churches, chapels, and other religious establishments; many of these are in a state of absolute ruin; others are neglected, and allowed to become dilapidated, because there are more churches than the inhabitants require; consequently, only about seventeen are actually used. Although I am not in possession of direct evidence, there is good reason to believe, that the whole of these sacred structures were built between the twelfth and sixteenth centuries, with stone from some of the quarries at Bramham Moor: all these beautiful examples of architecture are now more or less in an extremely decomposed state; in many instances, the ornamental details are wholly obliterated. The magnificent, but ill-fated cathedral, towering majestically above the churches and other buildings of the city, is recorded to have been built and rebuilt, at various times, with stone from Jackdaw Craig, given by the family of Vavasors; and although it may display an example of liberality worthy of imitation, it also exhibits a conspicuous and lamentable specimen of the perishable nature of such material; the south transept is so much decomposed, that the enrichments are nearly effaced; the west front and towers were in such a state of decay thirty or forty years since, that it was deemed necessary they should undergo a complete restoration.

The appearance of the stone, from any of the quarries at Bramham Moor, is much in its favour; the best beds are of a beautiful deep cream colour, and very fine grained, but of a dull, earthy, uncrystalline lustre; in many instances, the blocks present a delicately veined or streaky surface, but these indications are in no way loose, or easily separable: the stone requires care in working, because its texture is rather crisp or brittle, and the fracture is often conchoidal.

"On the 4th of March, 1446, (A. R. 25,) Henry the 6th granted to the provost and scholars of King's College at Cambridge, for ever, a quarry of stone, called Thefdale quarry, in the Lordship of Heselwode, in the county of York: a perpetual grant of which he obtained of the Lord of the Manor, (Henry Vavasour,) with a way to carry the stone through his lands, directly to the river Querf, (now called Wharf)." [a] Most likely this stone was never used in any part of the construction of King's College Chapel: I have carefully examined the building, without being able to find stone of a similar quality; this seems the more probable, because, "on the 25th of February, 1448, within two years after, he granted to the provost and scholars of King's College, and to the provost of Eton College, another quarry at Huddlestone, near Sherbon, in Elmet, (not far from the former quarry,) in the county of York; of which he obtained a grant from Sir John Langton and his son." [a] This ancient quarry of Huddlestone is situated near the town of Sherburn, about seven miles south of Bramham Moor; it has supplied stone for the construction of some of the finest Gothic buildings in this country, especially those erected in the fifteenth and sixteenth centuries: the quarry consists of one immense excavation, between thirty and forty feet deep, exhibiting a number of beds, rarely exceeding two feet six inches thick; but blocks of very large dimensions in length and breadth may be obtained, more free from vents and other defects than are usually to be found in other quarries. The stone, which is of a yellowish-white tint, varies considerably in its quality, or in its resistance to the decomposing influence of weather; some of the beds have a sparkling lustre, others are much less crystalline, and appear to have a more earthy or loose texture. The necessity of a judicious selection of the beds proper to be used in building with this stone, is remarkably evident at the manor house, (Huddlestone hall,) near the quarries, erected in the fifteenth century, which is generally in excellent condition, the mouldings of the chapel window, facing the

[a] Henry Malden's account of King's College Chapel at Cambridge, 1779, page 18.

south-west, show scarcely any symptoms of decay; whereas the gate piers in the fence wall, erected long since the chapel, are now in a very decomposed state. The lower portion of King's College Chapel at Cambridge is constructed with stone from the Huddlestone quarries; it was erected some time between the years 1448 and 1484; from the latter date, the use of this stone was discontinued at Cambridge, but for what reason, the records of the time do not inform us; they only state that the remainder of the building was to be finished with "*goode, sufficent, and hable stone from Weldon quarry's.*"[a] In this example, the whole of the stone from Huddlestone is very much decomposed. Huddlestone was used in great part of the construction of Westminster Hall; and the repairs of the interior, as well as the east and south exteriors of that edifice, were executed in the same material, a few years since, under the direction of Sir Robert Smirke.

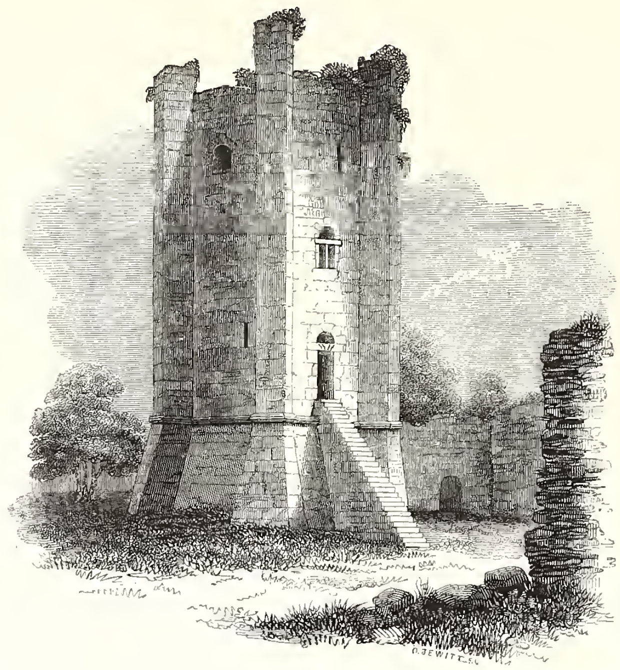
About five miles south-east from Pontefract, close to the river Went, are the quarries formerly opened and worked by the Kirk Smeaton Stone Company, who expended large sums of money in machinery, together with levelling, and laying down many miles of railway; a speculation which failed completely, notwithstanding the appearance, texture, and general quality of the stone are pretty good; but the rock is so much shattered, that the quarries are now entirely forsaken in consequence of the vast labour and cost of obtaining blocks of a reasonable size free from vents. My motive for calling attention to this otherwise unimportant quarry is, because there is a house, with two elevations, faced with Kirk Smeaton stone, situated at the eastern extremity of Carlton House Terrace, (No. 17,) the residence of Andrew Spottiswoode, Esquire; which is probably the only building in London faced with magnesian limestone, before the erection of the New Houses of Parliament.

Large quantities of stone, varying considerably in quality, are to be found a few miles west and south of Doncaster; at Brodsworth the rock is amazingly solid, even within five feet of the grass, and forty-five feet deep of good-looking marketable stone has already been excavated, in beds varying in thickness from eighteen inches to four feet; in several places the joints are twenty feet apart, therefore blocks of that length might be procured, provided the stone were strong enough to bear the removal. This stone, although decidedly a magnesian limestone, has the appearance of being partially oolite, and might, at first sight, be easily mistaken for Bath stone or soft Portland. Brodsworth stone has been much used at Doncaster, especially at the old church, built in the fifteenth century, which is frequently undergoing extensive repairs in consequence of the stone mouldering away so rapidly.

About five miles south from Brodsworth, near the village of Cadeby, is a quarry

[a] Not only the upper part of King's College Chapel, but the "Round Church," and all the oldest buildings at Cambridge, are of Weldon stone.

of stone very similar to the last named, indeed resembling it so much, that they might be used indiscriminately in the same elevation; both are, to a certain extent, oolitic, but on examination, the grains are found to be less uniform in size, and not so spherical as in the Bath oolite; a recently fractured surface will show that the component parts are not well cemented together, as, after examining the specimens, an unusual quantity of loose powdery matter is left on the fingers; and when fresh chippings are rinsed in clean water, a milky turbid appearance is instantly produced. This stone possesses the least cohesive strength, absorbs the greatest quantity of water, and is the lightest of all the magnesian limestones used for building, a cubic foot weighing little more than 126 pounds[a]. Day and Martin's Blacking Manufactory, in Holborn, is faced with Cadeby stone, and although only fourteen years since its erection, the stone crumbled away so rapidly, that the proprietors were obliged to have some of the mouldings renewed within a very few years after, and the whole elevation was painted with oil colour, to preserve it as much as possible from further decay.

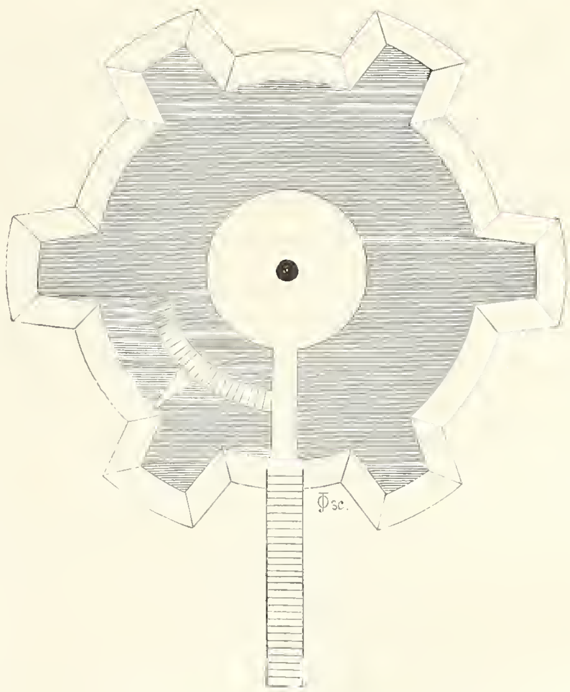


CONISBURGH CASTLE.

Within three quarters of a mile of Cadeby quarry, the stone is as remarkable for durability, as the Cadeby is for rapid decomposition: the keep, or round tower of Conisburgh Castle, the remains of which constitute so interesting an object

[a] Report on selection of stone for building the New Houses of Parliament. London, 16th March, 1839.

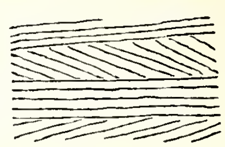
to the antiquary, is undoubtedly as old as the time of the Normans, and probably much older, for various historians who have written on the subject, are of opinion that a fortress existed there previously to the conquest. All that is important to the object we now have in view, is to state that the present edifice is at least 800 years old, a period of sufficient length to test the durability of the stone. The building may be described as a cylinder, between seventy and eighty feet high, with four circular apartments over each other, the lowest, which is a dungeon, and the first above it, are each twenty-two feet diameter, with walls fifteen feet thick, exclusive of the buttresses ; the walls of the two upper rooms diminish in thickness eighteen inches each, therefore the uppermost room, with walls twelve feet thick, is six feet in diameter larger than the two lowest : externally there are six buttresses, each about eight feet square, placed at equal distances round the cylinder, and con-



PLAN OF CONISBURGH CASTLE.

tinued from the foundation to the top of the building. This brief description is sufficient to give a general idea of the construction and magnitude of the tower : it is built with a coarse-grained, semi-crystalline, and partially oolitic magnesian limestone, no doubt procured from the hill eastward of the castle, where there is still, to all appearance, a superabundance of similar material : the analysis of a specimen taken from the lower part of one of the buttresses will be found in the table (page 6.) This tower has evidently suffered severely by cannonading, or other violent means, especially on one side, facing a commanding hill, where the loop-holes, angles of the buttresses, and such other vulnerable parts, are broken away; in other respects the building may be considered in a perfect condition. The masonry has been executed most carefully, although the joints are now open in consequence of the decay and disappearance of the mortar formerly within them: the angles of each stone are as sharp as when first worked; the surfaces of the stones were never rubbed, consequently at no period very sharp; this appears certain on attentive examination, for the marks of chiseling may still be observed on the surface, particularly about that part of the castle wall where the draw-bridge was situated. Especial notice is called to this example, because it is one of the most extraordinary instances ever observed in this climate, of stone resisting the decomposing influence of weather.

Roche Abbey is situated near the village of Maltby, between Tickhill and Rotherham: it was erected some time between the years 1147 and 1186. The present ruins of the abbey are but small, compared with its once great extent; the chief portion of materials having been carried away at various times, to repair or construct any building in the neighbourhood. The condition of the stone-work is generally very favourable, some of the mouldings and decorated parts are nearly perfect; whereas the gate-house, which appears to be about the same date as the abbey, is much more decomposed. The old quarry from whence the stone has been obtained is so close to the sacred structure, as to induce a supposition, that the stone must have been excavated from the side of the hill, before the workmen could have had space enough to lay the foundations. There are many buildings in the vicinity constructed at various periods with this stone; among others, the most remarkable is Tickhill Church, erected during the reign of Henry the Seventh, in the best style of the later period of English architecture; its general design, and the elegance of its details, the mouldings and ornaments of which are still in a high state of preservation, may be viewed as an excellent example of the durability of well selected Roche Abbey stone.

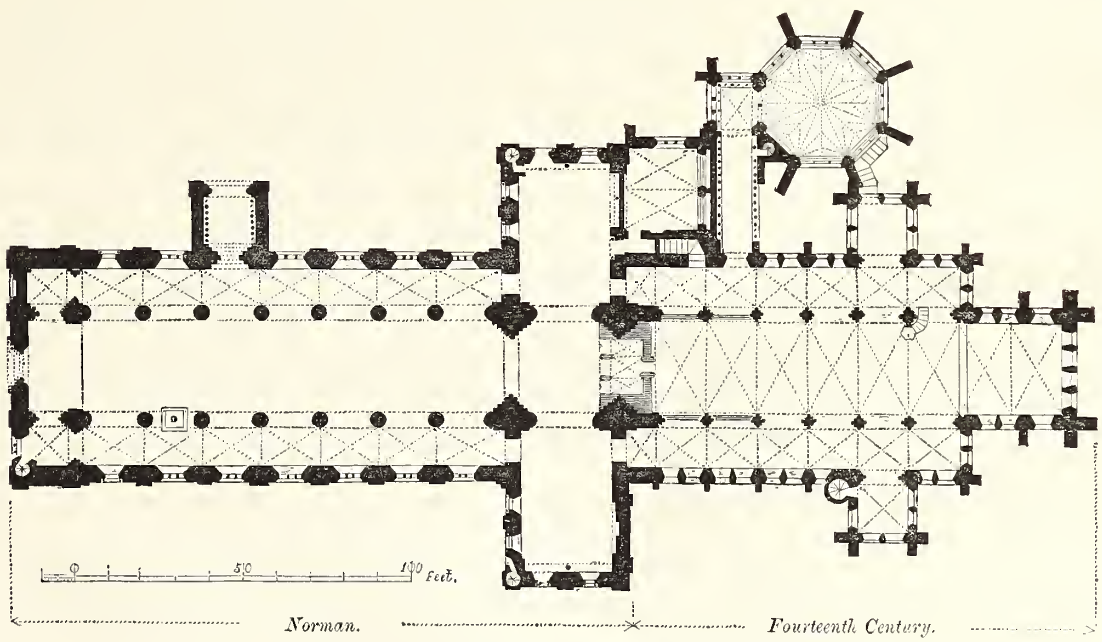
The stone may be described as bright, crystalline, and fine grained, of a grayish white, occasionally faintly streaked, in different directions, thus:  and a few minute specks of black, or dark brown, clustered in stellated forms, are often irregularly diffused through it. Only four or five beds are worked, the strata above and below these are of the same character and colour, but of a softer, coarser, and more earthy texture; and on that account are not recommended for architectural purposes.

It is a curious fact, that when Sir C. Wren was inquiring about the best stone to be used in the building of St. Paul's Cathedral, after having recommended Portland, he mentions no other stone, except Roche Abbey, (Rock Abbey,) as, in his opinion, the next best and most durable [a].

I am not aware of any entire edifice being constructed or faced with Roche Abbey stone, in or near London; but there are several large sepulchral tombs executed in this stone, by the late Sir F. Chantrey and others, in Hackney Church Yard, most of which exhibit evident symptoms of decay. The sculptures in the pediments of Buckingham Palace are also carved in Roche Abbey Stone, by order of the architect, the late Mr. Nash.

The next advance southward brings us directly to Norfal Quarries, the spot from whence the whole of the stone is now procured for the exterior of the great work at Westminster. The circumstances which gave rise to the inquiry, undertaken by authority of the Lords Commissioners of her Majesty's Treasury, with reference to the selection of stone for building the New Houses of Parliament; the method of investigation adopted by the party who were appointed to make the inquiry; a brief description of various quarries in the neighbourhood of Bolsover Moor; the mode of experimenting on the specimens, and the causes which ultimately led to the recommendation, and entire use of Norfal Stone, will form the leading points of the Second Part of this Essay.

[a] Parentalia, page 288.



GROUND PLAN OF SOUTHWELL COLLEGIATE CHURCH.

PART II.

As soon as it was determined to rebuild the Parliament Houses, on a scale of magnificence becoming the dignity of the British Senate, numerous stone merchants, and proprietors of quarries, were vigilant, in the hope of supplying stone for the new fabric. Our neighbours the Normans lost neither time nor opportunity in their endeavours to persuade the English, that Caen stone was the best material in the world for the grand object then in contemplation : they not only called upon, and wrote letters to the architect, and all the most influential persons in London, but they sent boxes containing samples of stone, with descriptions, prices, and so forth, to many of the leading members of our government.

The importance of the object to be attained, the extraordinary and conflicting opinions of those persons who were supposed to be well acquainted with such matters, together with other incidental events, and more especially the recommendation of C. Barry, Esq., and Sir H. T. De la Beche, induced her Majesty's government to appoint a commission of inquiry, to investigate all circumstances connected with the subject ; whose business should be, to determine the most fit and proper stone to be used for the exterior of the New Houses of Parliament. The minute details relative to the quarries and buildings examined would be rather a digression from the main object of this essay ; especially as they have been so fully described in the Parliamentary Report. The commissioners appointed were Charles Barry, Esq., R.A., the architect, Sir H. T. De la Beche, F.R.S. and F.G.S., on account of his geological attainments ; the late Wm. Smith, Esq., D.C.L. and F.G.S., not only for his judgment as a geologist, but from being long acquainted with the entire country, and the localities of stone, and Mr. Charles H. Smith, as a practical man, well acquainted with the working of stone.

It was on leaving Mansfield for Newark, on our way into Lincolnshire, in the afternoon of the 19th day of September, 1838, that, on approaching the town of Southwell, rather by accident than intentionally, we suddenly came in sight of a church, with western and central towers, nearly as large as Westminster Abbey, of an age sufficient beyond all doubt to test the durability of the stone ; its appearance and colour, especially when viewed by the light and shade received from a western sun, is extremely beautiful; many of the mouldings and enrichments are as sharp as if just from the workman's hand; the natural colour of the stone is modified by tints of time and vegetation, which give a rich and luxuriant appearance to the surface that might be studied with pleasure and advantage, even by the most talented artist [a].

After examining this venerable monument, both externally and internally, with more than ordinary attention, and being informed that the stone with which the Norman portion is constructed had been obtained from Bolsover Moor, distant eighteen or twenty miles, in a contrary direction from that which we had previously made arrangements to pursue, it was not considered advisable or convenient to visit the quarries at that time; we therefore left Southwell Church, with a more favourable impression on our minds of the beauty and durability of Bolsover stone than of any that we had yet seen, and agreed that it was well deserving reconsideration.

From the number of quarries which were visited, and from the many old buildings examined, constructed with stone from their vicinity, we were enabled to obtain a sufficiently accurate knowledge of the varied character of each of the several kinds of building stone; and having well considered the evidence afforded by such mode of procedure, were convinced that many varieties of stone employed for architectural works successfully resist the destructive effects of weather, and possess very great advantages as building materials in particular situations: but for the great work then contemplated many other important circumstances were necessarily to be taken into consideration; as, for example, that the situation of the quarry should be within a reasonable distance of water conveyance, that the probability of the supply might be at least equal to the demand, or in other words, not to begin the Parliament Houses with stone from a quarry that might be exhausted before the edifice should be completed; and that the cost of labour should not exceed that of the best building stones in general use throughout the kingdom. These were a few of the most important considerations to determine; and among numerous others of less moment,

[a] Southwell was distinguished at a remote period, by the establishment of one of the three primitive Christian Churches in England; namely, at York, Lincoln, and Southwell. At what period the oldest portion of the present edifice was erected is uncertain, as the records were destroyed during the civil wars. Many of the Archbishops of York have frequently resided at Southwell, even so early as before the Norman conquest. Cardinal Wolsey made Southwell his favourite place of retirement from the public business of the state; and during the greater part of the last year of his life his retreat was almost confined to the palatial buildings of this Collegiate Church. After the civil wars, Southwell afforded a brief asylum to Charles the First and his Queen; it was here that the king gave himself up to the Scotch Commissioners, who sold him to the Parliament for £400,000.

such as colour, homogeneous texture, and the like, the stone similar to that of Southwell Church appeared to offer the greatest number of advantages.

On returning to London, much time was occupied during the following six months with receiving the small blocks of stone, not less than eighteen inches long, nine inches broad, nine inches thick, from different quarries, amounting to about 150 varieties, examining them most carefully in order to ascertain that they were of a fair average quality, corresponding with the small samples which had been selected at each quarry; also in preparing the two six-inch cubes of each stone, now deposited in the Museum of Economic Geology; and two two-inch cubes, with an inch cube of each stone, for the experiments of Messrs. Daniell and Wheatstone, as given in the Parliamentary Report. By working these cubes and specimens, an opportunity was offered of forming some notion of the relative value of labour, or expense of masonry, on each kind of stone. From the entire number of specimens, thirty-six were selected in the first instance, for experiments to ascertain their physical and mechanical properties, and sixteen of these were submitted to chemical analysis. Some of them were examined without the least idea or likelihood of their being suited to the purpose in view; nevertheless, they were considered to be fit and proper representatives of the particular class of mineral substances to which they belong; for instance, Bath stone, although notorious for its rapid decay, was experimented upon as an example of soft oolite; and, as more useful information frequently arises from the result of a well understood failure than from the most complete success, it was deemed advisable to investigate the subject both ways; because it is the office of a scientific observer, first to obtain direct practical knowledge of individual facts, and afterwards to reduce those facts to general principles.

Each additional experiment, or scientific inquiry, seemed more satisfactorily to confirm our previous notions in favour of Bolsover stone; it was therefore indispensable to visit that part of the country, in order to ascertain the state of the quarries already opened, the probability of similar material being obtained from other sources in the neighbouring districts, in the event of any particular quarry failing to supply the requisite demand, and many other circumstances connected with local interests, facility of transport, &c.

In compliance with further instructions from the Commissioners of her Majesty's Woods, &c., we made a tour of inspection in the environs of Bolsover, during the month of April, 1839. We examined several quarries at Kiveton Park, Bolsover Moor, Anston, Steetley, Mansfield Woodhouse, and many others of less importance; extending through a tract of country about fifteen miles from north to south, and averaging about two miles from east to west; and were perfectly satisfied of the existence of an abundance of building stone of the best quality, which might be obtained at a moderate cost, and by the Chesterfield Canal might be transported to Stockwith, and thence shipped direct to Westminster at no unusual expense. We were thus far gratified, and fully convinced that we had not only obtained the object of which we had been in search so long and so perseveringly, but also that it was perfectly conformable with the recommendation in the final paragraph of our Report on the Selection of Stone, &c., of which the following is a copy:—"Having weighed, to the best of our judgment, the evidence in favour of the various building stones which have been brought under our consideration, and freely admitting that many sandstones as well as limestones possess very great advantages as building materials, we feel bound to state, that for durability, as instanced in Southwell Church, &c., and the results of experiments as detailed in the tables; for crystalline character, combined with a close approach to the equivalent proportions of carbonate of lime and carbonate of magnesia; for uniformity in structure, facility and economy in conversion, and for advantage of colour; the magnesian limestone, or dolomite, of Bolsover Moor and its neighbourhood, is, in our opinion, the most fit and proper material to be employed in the proposed new Houses of Parliament."

During the last named tour, in the vicinity of Bolsover, we ordered to be sent to Westminster specimen blocks, averaging about a ton weight each, of the several varieties of stone which were to be found in that locality; they were afterwards worked into mouldings, similar to such as might be required for the intended building; these, together with blocks similarly worked, of Darley Dale, Portland, and Mansfield stones, were placed side by side, for the inspection of the architect, and such builders as were invited to tender for the carcass of the river front, and a portion of the north and south flanks. At each of the quarries in the vicinity of Bolsover, from whence the large specimen blocks were ordered, we brought away with us small pieces of the identical beds of stone from which the blocks were directed to be taken; these little specimens were then analysed and experimented upon exactly in the same manner as all the other stones, described in the Parliamentary Report, and the result proved that the specimens from the quarries situated near to the village of North Anston did not materially vary from the genuine magnesian limestone of Bolsover Moor, otherwise than might be expected, even in different parts of the same block.

The following table will show the result of the experiments by J. F. Daniell, Esq., and C. Wheatstone, Esq. Bolsover is inserted with the others, and placed at the top of the list, that the eye may more readily notice the extent of variation.

Results of experiments upon cubes of two-inch sides in duplicate.									Results of experiments upon cubes of one-inch sides.		
1. Name of quarries from whence specimens are procured.	2. Weight in ordinary state in grains.	3. Weight when well dried in grains.	4. Weight when saturated with water in grains.	5. Weight of water absorbed in grains.	6. Bulk of water absorbed; volume of a two-inch cube being taken as unity.	7. Weight of particles disintegrated in grains.	Cohesive powers. 8. Weight producing first fracture. 1=2.53 cwt.	Cohesive powers. 9. Crushing weight. 1=2.53 cwt.	10. Specific gravity of the dry specimens.	11. Specific gravity of the solid particles.	12. Bulk of water absorbed; total bulk considered as unity.
Bolsover	4890.8	4881.4	5042.0	160.6	0.079	1.5	70	117			
Ditto	5052.2	5043.0									
Ditto	...	...	...	...	...	...	...	...	2.316	2.833	0.182
Norfal	4717.4	4702.6	4812.4	109.8	0.054	1.67					
Ditto	4771.3	4756.2	...	...	...	...	56	83			
Ditto	...	...	...	...	...	...	...	...	2.386	2.793	0.135
Kiveton Park, Pennyholme.	4717.1	4710.2	4897.9	187.7	0.092	1.84					
Ditto	4724.6	4718.1	...	...	...	...	66	87			
Ditto	...	...	...	...	...	...	...	...	2.417	2.803	0.137
Stone ends	4936.0	4922.2	5076.8	154.6	0.076	3.56					
Ditto	4951.0	4938.0	...	...	...	...	65	130			
Ditto	...	...	...	...	...	...	...	...	2.463	2.805	0.122
Kiveton Park, Red Hill.	4988.2	4971.1	5123.6	152.5	0.074	4.17					
Ditto	4990.3	4974.8	...	...	...	...	74	151			
Ditto	...	...	...	...	...	...	...	...	2.454	2.750	0.107
Steetley, white or lower bed.	4047.4	4043.2	4347.0	293.8	0.145	0.42					
Ditto	4170.4	4168.1	...	...	...	...	43	45			
Ditto	...	...	...	...	...	...	...	...	2.063	2.856	0.276
Steetley, yellow or upper bed.	4255.3	4252.3	4612.0	359.7	0.177	0.95					
Ditto	4194.9	4192.6	...	...	...	...	57	73			
Ditto	...	...	...	...	...	...	...	...	2.030	2.880	0.280

(Bracketed beside Norfal to Steetley: These four quarries are situated very near to the village of North Anston.)

(Signed) J. F. DANIELL.
C. WHEATSTONE.

The sixth column shows the relative bulk of water absorbed by the specimens, after having been immersed, for several days, in a vessel freely exposed to the atmosphere.

The twelfth column shows the relative bulk of water absorbed by the stones, when saturated under the exhausted receiver of an air-pump; the quantity of water absorbed in this process, may be considered to represent the space occupied by the pores, or interstices between the grains of the stone.

TABLE OF CHEMICAL ANALYSIS, BY R. PHILLIPS, Esq.

	Norfal, upper bed.	Steetley, upper, or yellow bed.	Kiveton Park, Pennyholme.	Bolsover Moor.	Steetley, lower, or white bed.	Kiveton Park, Red Hill.
Carbonate of Magnesia	45.2	44.30	43.84	43.83	42.96	42.50
Carbonate of Lime	52.0	52.80	52.78	52.17	51.14	51.42
Silica and Oxide of Iron	2.0	1.15	2.00	2.57	2.60	4.56
Moisture and loss	0.8	1.75	1.38	1.43	3.30	1.52
	100.0	100.00	100.00	100.00	100.00	100.00

The importanee of these latter investigations, eonnected with the evidence afforded by several old and extensive buildings in the neighbourhood of the quarries, must be apparent when it is eonsidered that the same elements, uniting in the same proportions, do not necessarily generate the same body; and also that two mineral substanees from the same neighbourhood may so preeisely resemble each other in appearance as to deeeive the most experieneed eye, and yet, on subjecting them to accurate tests, they may prove to be essentially different; and hence, if exposed to the same atmospheric influenees, the one might deeompose or disintegrate eenturies before the other.

All that could be aceomplished by experience, science, and philosophieal reasoning upon the subjeet, was now eompleted in the most satisfaetory manner, but there were practical diffieulties and interested prejudiees of no common kind to overeome. One of the most important eonsiderations to determine was the question of cost, or whether the building eould be executed in the proposed new material at a price not greatly exeeeding that of the best stone, with labour thereon, heretofore in general use. Letters were offieially sent to eaeh of the respeetive freeholders of the quarries in the vicinity of Bolsover, as well as to those of Portland, Darley Dale, and a few others, to ascertain if they were willing, in the event of their stone being used for the Parliament Houses, to give up their interest in the quarries for the consideration of 1½*d.* per eubie foot being paid to them for all the stone whieh might at various times be taken away[a]. To this proposal the freeholders unanimously agreed, whieh was a

[a] This sum, small as it may sound, is about the usual charge for stone in the rock, throughout the kingdom; the labour of removing the superincumbent rubble to get at the good stone, wear and tear of expensive machinery, carriage of the blocks by land and water, wharfage, &c., &c., enhances the cost of the rough blocks to between two and three shillings per cubic foot in the London market. The most expensive item for erecting a building, especially if it be of a highly decorated character, like the Parliament Houses, is for labour, the stone only in the quarry being comparatively of little value; for this reason some people have been deceived, by receiving that as a donation which in the end turns out to be extravagantly

very important object completely settled, for it prevented the possibility of anything like monopoly, and it gave the assurance of being able to obtain from any of the quarries as much stone at the usual fair average cost as might be required for the entire structure. The contractors were severally required to give tenders for the building in each kind of stone, with the understanding that they might take the requisite quantity from either quarry on the terms above named, but that the cost of quarrying, transport to Westminster, together with all other contingent expenses thereon, was left to themselves to make such arrangements as might appear to be most consistent or economical. The following table is extracted from the two lowest tenders for the external stonework of the river front, and part of the north and south flanks, in five various kinds of stone, exhibiting the difference of cost between a surface neatly chiselled, with the tool marks left on the mouldings and plain work, and one wherein all the tool marks are effaced or rubbed out with sand and water.

	Messrs. Grissell and Peto.		Messrs. Baker and Son.	
	Fine Chiselled.	Rubbed.	Fine Chiselled.	Rubbed.
	£	£	£	£
Darley Dale	62,910	61,427	71,417	69,395
Anston	61,073	59,585	63,060	61,095
Bolsover	59,840	57,447	68,892	66,867
Portland	54,695	52,350	58,954	57,221
Steetley	48,842	47,278	58,211	56,623

When the tenders from the different builders were opened, an inference might have been drawn, that collectively they were of opinion, that an edifice might be executed in the new material for no very great amount more than if it were to be constructed with Portland stone: this has since been further exemplified by a greater number of contractors in the case of the New Royal Exchange; in which, if 3*l.* 11*s.* 7*d.* per cent. be added to the total amount of all the tenders for Portland stone, it will be very nearly equal to the total amount of all the tenders to execute

dear, owing to the extra cost of labour thereon. Several noblemen possessing large quantities of granite on their estates in Scotland proposed that should such material be considered fit and available for the New Houses of Parliament, they were willing to make a free gift to the nation of their interest in any quantity that might be required for the purpose; this liberal offer was not accepted, on account of the enormous cost of working granite into enriched decorations. Suppose, for example, that the cost of labour on the stone of such a building as that at Westminster, should amount on the total to five shillings upon every cubic foot, and that had granite been used, the cost would have been at least double that amount, it must be obvious that while the nation had been receiving a gift of $1\frac{1}{2}d.$ it would have been at the additional expense of $4s.\ 10\frac{1}{2}d.$ for every cubic foot of stone, to render it available for the same purpose as that which is now being used.

the same design in magnesian limestone similar to that which is being used at Westminster [a].

It was now generally known amongst architects, stone merchants, and the principal builders, that the New Houses of Parliament were to be built with magnesian limestone, similar to that of Bolsover Moor and its neighbourhood; this being the case, it seemed probable that the Portland trade would, in due time, have to contend with a formidable rival: prejudice, ignorance of the subject, and assurance, were consequently rising in all directions, not only against the stone which was recommended to be used, but also against those persons who were considered to have been the cause of its introduction into the metropolis. Some of the critics pronounced judgment on the durability of Bolsover stone, by the present mouldering condition of Bolsover Castle, which is certainly in a deplorable state of decay; but this may be answered by stating, that the castle is built with stone taken from the intrenchment immediately adjoining the walls, and totally different in every respect from the stone of Bolsover Moor, which is nearly three miles distant. Some of the Portland merchants, after having visited the locality of Bolsover, pronounced in the most unequivocal terms, that there was not stone enough in the quarries to complete the river front; and before that elevation should be half erected, the architect would be compelled to finish it with Portland stone. Reports of this kind were sure to find interested parties, even among the highest classes of society, who were ready and willing to listen to them; but fortunately the commissioners of woods and works appeared to have full confidence in the discrimination of those to whom they had confided the investigation.

All was now ready to make final arrangements, for the constant supply of stone from the quarries; consequently, on the 26th of November, 1839, I accompanied Mr.

[a] It is extremely difficult to ascertain correctly the relative value of labour on a stone that has not yet been found in the London market; one cause is, the prejudice that generally exists, both amongst journeymen and their employers, in favour of a material which has been long in use. If experiments are made on a small scale by a workman trying how much work he can perform in a given time, such a test is likely to lead to erroneous conclusions by overrating the amount; as however clever or experienced the artisan may be, he is sure to feel awkward or unhandy at the first attempt, and to imagine the stone to be considerably harder and more refractory than it really is, or than it appears to be, under the hand of one who has been accustomed to work the material during a long period: neither is it safe to depend upon the judgment of the principal London contractors, unless taken collectively, as evinced by the tenders for the New Royal Exchange; in which they all agree, that the new material is more expensive to work than Portland stone. By reference to the table (page 24) we learn that Messrs. Grissell and Peto consider the labour on Anston greater than on Bolsover; whereas Messrs. Baker and Son are of opinion that Bolsover is much more expensive than Anston.

Barry to Worksop, where we met by appointment Messrs. Grissell and Peto, and proceeded directly to the various quarries: we first inspected those in the vicinity of Steetley, where there are many excavations of considerable extent, and to all appearance of a remote date; two beds of good stone, nearly in a horizontal position, neither of which exceed two feet in thickness, are all that are worked for architectural purposes; the uppermost is rather yellower than the one beneath, but not so different in tint as to render its appearance objectionable, even were it to be mixed in the same elevation. This stone is remarkable for its beautifully shining, crystalline lustre, light specific gravity, great power of absorption; and yet it is extremely durable: Steetley stone is softer and more easily worked, than any other in that vicinity; and certainly it appears to be more durable than any of the soft stones in general use: a small quantity of this stone has been used at the Parliament Houses, chiefly for ashlar to some of the subordinate courts. It has been used in the erection of all the chief buildings within many miles round the neighbourhood, during a very long period; some ecclesiastical remains of Norman date are still but slightly decayed for their age; Welbeck Abbey, a seat of the Duke of Portland, erected in the reign of James the First, is generally in a fair condition; Clumber, a seat of the Duke of Newcastle, and Worksop Manor, recently belonging to the Duke of Norfolk, erected about the middle of the last century, exhibit scarcely any symptoms of decay or disintegration [a].

A question has frequently been raised with reference to the effect of vegetation on the surface of stone-work. By attentively examining the magnesian limestone buildings of this part of the country, it would appear that lichens exercise a sort of pernicious influence; at Bolsover Castle, the keep of which seems to be constructed with magnesian limestone similar to that of Steetley, wherever lichens have vegetated on the exterior of that edifice, decomposition has certainly taken place; and where they were then growing, upon removing them, we found that the surface of the stone for about one sixteenth of an inch in thickness, was reduced to a state of white powder: in such instances the lichen seems to possess some inherent power of chemically acting upon the stone; but whether the plant appropriates only the carbon to its own use, and leaves the lime and magnesia, or whether it takes up the carbonate of lime and rejects the carbonate of magnesia, is a question of great interest, although it has not yet been investigated by a scientific observer.

[a] The magnificent estate of Worksop Manor has, within a few years, been purchased by the Duke of Newcastle, who is proprietor of the adjoining property; the mansion and offices are now gradually being demolished, and the materials carted away; so that, at no very distant period, not a vestige will remain of that ducal residence, which has successively been the abode of noble and illustrious families during many centuries.

According to a traditional account, the stone with which the oldest part of Southwell Church is constructed was obtained from Bolsover Moor; but tradition is at all times doubtful evidence, especially of events that happened several centuries back. During the civil wars, all records belonging to the church of Southwell were destroyed, except the "white book," (registrum album,) which escaped the general destruction; and, notwithstanding it contains numerous memoranda, together with grants of most of the lands, revenues, &c., belonging to that church, from a period very little posterior to the conquest, no document or intimation of any kind is mentioned, from which a probable conjecture can be formed respecting the period of building the Norman portion, or of the materials with which it is constructed. After having attentively inspected the Norman part of this venerable edifice, whoever is well acquainted with the various kinds of stone to be found near the town of Mansfield, will admit that appearances are quite as much in favour of the stone having been obtained from some of the quarries in that locality, as from those at Bolsover Moor. A large quantity of stone in the western towers bears a remarkable resemblance to that from the quarries south-west of Mansfield; the remainder is just as likely to be from Mansfield Woodhouse, as from Bolsover Moor; and it is almost impossible for two substances to resemble each other more completely, both in colour and composition. The table (page 6) contains two analyses of Bolsover Moor stone, one by Daniell, the other by Phillips, showing slight variations; but observe, the Mansfield Woodhouse is between them; proving the proportional quantities of its component parts to be nearly similar, and quite within the range of variation in one and the same quarry. A glance at the situations on the map, will show that Mansfield is only about half way between Southwell and Bolsover; an important consideration in the carriage of so heavy a material as stone, at a time when the roads were bad and canals were not in existence.

The "White Book" contains a licence from King Edward the Third, in the eleventh year of his reign, (1338,) to the Canons and Chapter of Southwell, to carry away stone, from their own quarries, near Mansfield, for the purpose of building their church; which it seems the foresters had opposed, as unlawful, unless toll or road duty were paid for the same [a]; this is the earliest, well-authenticated record of Mans-

[a] The following is a translation from the original, which is in Latin.—Licence of our Lord the King for the carriage of stone from the quarries near Maunsfield (Mansfield) in the forest of Schyrewode (Sherwood). Edward, by the grace of God, King of England, Lord of Ireland, and Duke of Aquitaine, to his beloved and faithful Ralph de Neville, Ranger of his Forest beyond the Trent, or to his locum tenens (deputy Ranger) in the Forest of Schyrewode (Sherwood), these presents greeting. Whereas it was enacted by the great council of our kingdom, that no forester, excepting such as are foresters *in fee*, that is to say, giving se-

field stone being used in the construction of Southwell Church ; and it contains nothing that can lead to the idea of such stone having been, at that time, recently introduced ; or, that it was a material, different from any which had heretofore been in general use : even suppose Bolsover stone had previously been used, it could not have been conveyed to Southwell, without passing through the forest of Sherwood, somewhere near Mansfield, consequently it must have been equally liable to toll.

Having well considered these facts and concurrent events, it seems extremely doubtful, whether Bolsover stone were ever extensively used in the construction of Southwell Church ; possibly a few stones from the more distant quarry may have been casually introduced, owing to some cases of emergency, with which we are unacquainted ; but appearances are certainly in favour of by far the greater quantity of stone having been obtained from various quarries in the vicinity of Mansfield.

After examining several quarries at Bolsover Moor, some of which had not previously been opened, there can be no doubt of finding in that locality plenty of excellent stone ; but the beds are so thin, rarely exceeding a foot in thickness, and so strangely contorted in all directions, as to render the cost of obtaining a great number of moderate sized blocks, too expensive to become generally useful. At the commencement of the new works at Westminster, a small quantity of this stone was ob-

curity for their bailiwick, may take *chiminage* (toll or road duty), that is to say, for the cart *two pence* (*denarios*) during half of the year ; for the horse which carries burden (*sumpter horse*) during half of the year one farthing (*obolum*) ; and again during the other half of the year, one farthing ; excepting always from such persons as from a bordering bailiwick in the character of merchants come by due license into the bailiwick of the forest in order to purchase peat (*mæremium corticum*) or coal, and to carry it elsewhere to such purchasers as they may choose ; and that from no other cart, carriage, or sumpter horse shall *chiminage* be taken. Neither shall chiminage be in any case taken unless in places where by ancient custom and precedent established it has been beforehand duly levied and taken : Now be it known to you that complaint has been made to us on behalf of our well beloved, the canons and chapter of the church of St. Mary, Southwell, that when some of their waggons were sent by them on sundry occasions for stone from their own quarries for the purpose of building the aforesaid church ; and while passing through the aforesaid forest, certain foresters in our said forest of Sherwood, their servants aiding them, have oft times stopped their said waggons and horses by a demand of *chiminage* against the terms of the aforesaid statute, and have caused them for days together manifold hindrance and annoyance, to the no slight damage of the said canons and chapter, and to the manifest injury of the said church ; therefore they pray us to provide a remedy for the aforesaid grievance. Taking the prayer of their petition into our royal consideration, we hereby enjoin you, provided always that the alleged complaint be as stated, that you cause (as is justly due) the said foresters, their servants, or their agents, equally to desist from their aforesaid hindrance of their carts and carriages aforesaid, and from all other obstructions to them of this kind henceforward ; and that you and they in nowise permit them or their servants, or their carts or carriages, by means of the officers of the said forest, to be stopped or impeded against the provisions of the said statute.

"Given at Westminster, on the sixteenth day of October, in the eleventh year of our reign."

tained; but the supply appeared to be so inadequate to the demand, that the means of procuring the material from that source, was very soon discontinued. The most southern point where stone has been found, of the same description as is now being used at the Parliament Houses, is that of the quarries at Mansfield Woodhouse, situated within two miles north of Mansfield. The nature and quality of this stone has so recently been described, that it is scarcely necessary to say more upon the subject; the disposition and irregularity of the beds, as well as the general character of the stone, resembles that of Bolsover Moor so nearly, that it would be extremely difficult even for the most learned mineralogist to detect the difference: the most remarkable circumstance in which it differs from the Bolsover stone is, that its colour is rather deeper, partly owing to its having a greater number of minute black specks, which is a peculiarity more or less to be found in all varieties of the magnesian limestone rocks.

After traversing the kingdom in numerous directions, no spot presented so many favourable opportunities for obtaining the requisite qualifications to supply stone for the erection of the Parliament Houses, as that of North Anston; the very name of the village is no doubt derived from the appearance and physical condition of the soil, which abounds in stone. It is but reasonable to suppose, that during remote ages, before the elements had disintegrated the softer portions of rock, and converted them into loose earthy ground, fitted for animal and vegetable life, this locality must have been "all stone; one stone; ain-stone;" and thus, by gradual modifications, its present appellation of "Anston;" it was this train of association that led to the idea, "what is there in a name," that induced me to inquire, within a few miles of the spot, whether there was any stone to be found about that village; and the answer was, that "I should find plenty growing out of the ground, as big as great hay-ricks." In some places, the rocks are exposed in contorted masses of considerable height and extent above the surface of the ground; and at others, in precipices of great elevation and length, where the beds are of considerable thickness, and nearly in a horizontal position, so as to resemble a gigantic work of ancient masonry, dilapidated and falling to ruin. Occasionally enormous lumps of rock appear to have rolled from the precipitous face of the hill, and lie confusedly piled in the valley beneath; here and there large irregular masses rest upon the escarpment, and might, at first sight, be mistaken for immense boulders, but on examination, they are found to be in their primitive situation, and are the hard, indestructible remains of beds which were once continuous, of which the softer portions have long since been removed by the action of weather, denudation, and various other means, constantly operating during vast periods of time.

In some places the contrast is most remarkable, large patches on overhanging rocks, with their smooth, bleached, time-worn surfaces, discoloured by a few lichens, and here and there a little moss or wild ivy. In other parts, rough angular masses elevated considerably above ground, are nearly overshadowed by large trees of hazel, thorn, and ash, which are vegetating in the most flourishing condition from the holes and fissures in the stone, giving altogether an appearance of wildness to the scene which is highly interesting. Such was the serenity, or solitariness of the situation until the beginning of the year 1840: throughout the whole district, occupying, at a moderate calculation, at least a square mile, there was an appearance of profound stillness and undisturbed rusticity, as if the influence of civilized man were unknown in that region. The state of things in that neighbourhood is now strangely altered. Those who visited the peaceful hamlet of North Anston a few years back, would now be surprised to find that, instead of the rustling of trees and melody of birds, they would hear the clang of sledge hammers, rattling of chains, and numerous other implements in the hands of three hundred quarrymen, labourers, carters, &c. The lanes and avenues leading from where the quarries are situated, to the Dog Kennel Wharf, on the Chesterfield Canal, a distance of two miles, were formerly rendered almost impassable by the profusion of brambles and weeds; the same are now in an equally bad state, owing to the excessive traffic and constant passing of horses and waggons, each laden with several tons of stone.

There is but one old building in the immediate vicinity of the quarries, and that is Anston Church, erected probably in the fifteenth century; the tower and spire are the only parts constructed with magnesian limestone from the neighbourhood, and they are in as good a state of preservation as ever, although situated on a hill, consequently exposed to the severest tests of weather.

The best stone for architectural works is found at a depth varying from ten to fifteen feet beneath the surface, as shown by the section of strata, (Plate II.): when the superincumbent rubble is cleared off, eight beds of good stone lie very nearly level, having scarcely any appreciable inclination. The upper bed, which is the thickest, affords blocks of considerable dimensions, in consequence of the natural vertical joints being wide apart; so that, if requisite, blocks of from twelve to fifteen feet square, by four feet thick, might occasionally be obtained; the remaining seven beds vary in thickness from eighteen inches to two feet six inches. Being desirous of ascertaining how far the various beds might chemically differ from each other, and from the Bolsover dolomite, specimens of the eight beds were forwarded to the Museum of Economic Geology; and three of them, namely, from the uppermost, the fourth, and the lowest, or eighth bed, were analyzed by Richard Phillips, Esq., at the laboratory of that establishment, and the results may be seen in the Table, (Page 6). From these analyses, the various beds may be considered as remarkably identical, for there can be no reason to suppose that in chemical or mineralogical character the other beds differ materially from them; and although the proportional quantities of the component parts of this stone are not precisely the same as that of Bolsover Moor, it is a very close approximation to it, the variation bringing it still nearer, and in fact the nearest of all the specimens examined, to the equivalent proportions of genuine dolomite.

All the stone that is now used for the exterior of the Parliament Houses is procured from the Norfal quarries, (this name is corrupted from "North Field," situated north of the village.) There are many other quarries of precisely similar stone, in the immediate neighbourhood, known by the respective names of Red Hill; Pennyholme; Stone Ends; Kiveton Park, and several others; all of which are the property of his Grace the Duke of Leeds. There are also some large fields adjoining the Norfal quarries, belonging to William Sikes, Esq., and Charles and William Wright, Esqs., beneath which, according to the opinion of geologists, there is every reason to believe similar stone may be found. Hence, it must be evident that the quantity in this district alone is sufficient to reconstruct all the public buildings in this great metropolis. In addition to the above, there are prodigious quantities of stone to be had, of an equally good quality, at many other places in the neighbourhood besides North Anston; indeed there is unequivocal proof of this through a tract of country at least fifteen miles in length, from Mansfield Woodhouse, in the south, to Anston in the north; where stone, similar in every respect either to the Bolsover, or the Anston, has already been found in numerous places.

It is presumed that Messrs. Grissell and Peto work the Norfal quarries exclusively, because they find a superabundance of stone, the property of one freeholder, conveniently situated for transport, plenty of room for their machinery, implements, and a thousand quarrymen to work, should their services be required. The advantage and convenience of having all the forces collected into one focus, rather than being distributed in various places, several miles distant from each other, must be sufficiently obvious.

Weight per cubic foot, of magnesian limestone, mentioned in this Essay.—The weights were ascertained from accurately formed six-inch cubes, two of each, and the duplicate amount multiplied by four; the cubes were weighed, after having been exposed for several weeks to an ordinary summer atmosphere.

	lbs.	oz.	dr.		lbs.	oz.	dr.
Bolsover Moor	151	11	0	Huddlestone	137	13	7
Mansfield, Red	148	10	13	Park Nook	137	3	0
——— White	146	9	0	Brodsworth	133	10	8
——— Woodhouse	145	12	4	Yellow Steetley	130	9	4
Stone-Ends, Anston	144	3	9	White Steetley	128	3	0
Norfal, Anston	144	0	8	Bramham Moor	127	8	7
Roche Abbey	139	2	3	Cadeby	126	9	8

REMARKS ON SOME OF THE STONES IN THE PRECEDING TABLE.

The Mansfield red and the Mansfield white stones seem to form a connecting link between the sandstones and the magnesian limestones; they contain the greatest quantity of silica, and the smallest quantity of magnesia, of any of the specimens which have been examined in this class. The choir of Southwell church is built with these stones, indiscriminately mixed together; they are generally in very good preservation. The "Stone-Ends," Anston, is rather different from the generality of stone in that neighbourhood; it is of a somewhat coarse, nodulous, and irregular looking texture: the lowest magnesian limestone plinth of the river front is formed of this stone. The Steetley stone is remarkable for its light specific gravity, great power of absorption, and yet extremely durable; its resistance to atmospheric influences may be attributed to its beautifully sparkling crystalline structure, without having any dusty incoherent matter in its formation, the crystals being all well cemented together.

The total quantity of stone for the exterior of the river front of the Parliament Houses, with part of the north and south flanks, Victoria tower, &c., delivered on the works, between January, 1840, and December, 1844, amounts to 456,485 cubic feet: almost the whole of this quantity has been obtained from the Norfal quarries; at the commencement, a small portion was obtained from Bolsover Moor and from Mansfield Woodhouse.

The above is a period of 260 weeks, therefore the average supply is about 110 tons per week.

Copy of an Authority, from the Office of Woods, &c., to examine the Stone used of building the new Houses of Parliament; and the Quarries for furnishing the supply. Also the Report upon the subject to Her Majesty's Commissioners.

Office of Woods, &c., 17th April, 1843.

SIR,

On behalf of the Commissioners of her Majesty's Woods, &c., in reference to your report made in consequence of the instructions given to you, in conjunction with Mr. Barry, Sir Henry De la Beche, and Dr. Smith, to inspect various stone-quarries in the kingdom, and to visit various public buildings, with a view to the selection of a proper stone to be employed in the erection of the new Houses of Parliament; I have to request that you will forthwith, with Mr. Barry and Sir Henry De la Beche, who were originally named to make the enquiry, to carefully inspect the stone used in building of the new Houses of Parliament, so far as already executed, and also the stone delivered on the premises, and the quarries now in work for furnishing the further required supply; and, jointly with those gentlemen, report to this Board whether the stone so used and delivered, and in progress of being supplied, is of the quality and description which, at the termination of your joint report dated the 16th of March, 1839, you suggested as most fit and proper for the purpose.

Mr. Barry has been requested to arrange an appointment with you to proceed with the business.

I am, Sir,
Your most obedient servant,

To Mr. C. H. Smith. (Signed) A. MILNE.

REPORT, &c.

Museum of Economic Geology, Craig's Court.
28th August, 1843.

MY LORD AND GENTLEMEN,

In conformity with the instructions contained in your communication respecting an examination of the stone employed in the new Houses of Parliament, we visited the buildings now in progress, in company with Mr. Barry, and after due inspection of them, and of the stone upon the wharf, we have to report that the quality of the stone hitherto employed, and looking at the subject generally, appears to us very satisfactory, and that we found the supply at the wharf ample.

With respect to the localities whence the stone has been supplied, we would wish to observe, that the magnesian limestone or dolomite of Bolsover Moor, having been found to occur in such a manner as not to afford stone of the required sizes, investigations were undertaken, and stone from other localities in that neighbourhood, but of the same kind, and of about the same quality, was obtained, being a magnesian limestone or dolomite, and comprised in the same range of rocks; and that finally, quarries were opened at North Anston, between Rotherham and Worksop, it being considered that the magnesian limestone or dolomite of that locality would afford both an abundant supply, and of the required quality.

Agreeably to the further instructions in your letter, it being inconvenient for Mr. Barry at that time, from very pressing engagements, to visit Anston, we proceeded to that place in company with Mr. Allen, in the employ of Messrs. Grissell and Peto at the new Houses of Parliament, and who was capable of affording us much necessary information.

Before visiting the quarries, we inspected Anston Church, and observed with satisfaction that the old tower and spire, apparently constructed with magnesian limestone of the vicinity, in the fifteenth century, were in good condition, though well exposed to atmospheric influences.

The quarries are situated on the escarpment of the hill at North Anston, and are the property of the Duke of Leeds, under whom they are worked by Messrs. Grissell and Peto, who pay to the duke a royalty of $1\frac{1}{2}d.$ per cubic foot, or 14 cubic feet being considered a ton, 1*s.* 9*d.* per ton.

As sometimes happens in this range of magnesian limestone or dolomite, the stone varies much in character, the bedded structure here and there disappearing, and one more massive arising; in the latter case the arrangement of the parts being so coarse, and structure so hard, that the stone is unfit for the better kind of buildings. From this circumstance, bosses or tors of hard rock project from several parts of Anston Hills, so that the stone proper for such decorated edifices as the new Houses of Parliament is only to be obtained where these bosses of hard rock may not interfere with the working of the stone possessing the necessary qualities.

The present quarries are thus situated, and out of the magnesian limestone, as it there occurs, eight beds are selected, of these the uppermost is the thickest, and affords blocks of considerable size, employed in the new Houses of Parliament, where the largest are required for sculpture or otherwise; these eight beds, as a whole, are nearly level, having scarcely any appreciable inclination; they all vary in thickness, the upper one being most uniform in this particular; the estimated average thickness may be taken at about fifteen feet, in some places, the total depth being seventeen feet.

The natural vertical joints being rare, the blocks are obtained from the beds by driving wedges along the lines considered to divide the beds up in the most effective and convenient manner, so that blocks of very varied sizes can be found. We found the quarries well and effectively worked, a large mass of stone being rejected as being unfit to be sent to London; a proof of the care necessary in selecting this material for building purposes. An average of about 400 tons of selected stone is obtained per month, or about 4800 tons per annum.

With respect to transport to London, the stone is carted two miles from the Anston quarries to the Dog-kennel Wharf, on the Chesterfield Canal, and thence passes by the canal to Stockwith, where it is shipped for London.

We found the quality of this stone to be nearly the same in the different beds, and though not exactly the same as that of Bolsover, to be a somewhat close approximation to it. Being desirous of seeing how far they might chemically differ from each other and from the Bolsover dolomite, formerly examined, we forwarded specimens of the eight beds to the Museum of Economic Geology, and three of these, namely, from the uppermost, the fourth, and the lowest or eighth bed, were subjected by Mr. Richard Phillips, F.R.S., to analysis at the laboratory of that establishment, and the following are the results:—

	Upper bed.	Fourth bed.	Lower or eighth bed.
Carbonate of lime	52.0	52.5	52.8
Carbonate of magnesia	45.2	44.7	44.4
Oxide of iron and earthy matter	2.0	2.1	2.1
Moisture	0.8	0.7	0.7
	100.0	100.0	100.0

It will be observed from these analyses that, as regards chemical composition, these beds may be considered as identical; and we have no reason to suppose that in this respect the other beds differ from them. We also consider, from careful examination, that the arrangement of the particles of which they are composed is nearly the same in those portions which are selected for use: as a matter of course, the amount of cohesion of the minute crystals of the carbonate of lime and magnesia, forming the chief mass of the stone being of the utmost importance.

In conclusion, we consider that if due care be taken, as appears to have been hitherto done, in the selection of the Anston dolomite, it is a fit material for the purpose for which it is employed in the new Houses of Parliament, and from our inspection of the locality whence it is obtained, we see no reason to suppose that an ample supply may not be obtained from thence.

We have the honour to be,

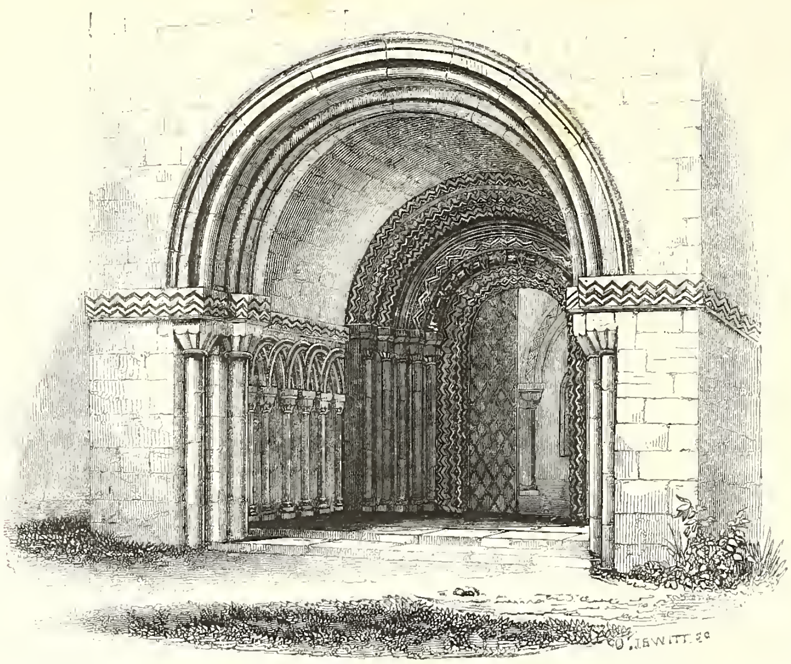
My Lord and Gentlemen,

Your very humble and obedient servants,

(Signed,) H. T. DE LA BECHE,

CHARLES H. SMITH.

The above Report, &c., is published by permission of the Commissioners of her Majesty's Woods, &c.



PORCH OF SOUTHWELL COLLEGIATE CHURCH.

Bramham Moor

Huddleston

Kirk Smeaton

Brodsworth

London: John Weale, 59, High Holborn.

SECTION OF STRATA IN THE QUARRIES AT NORTH ANSTON.

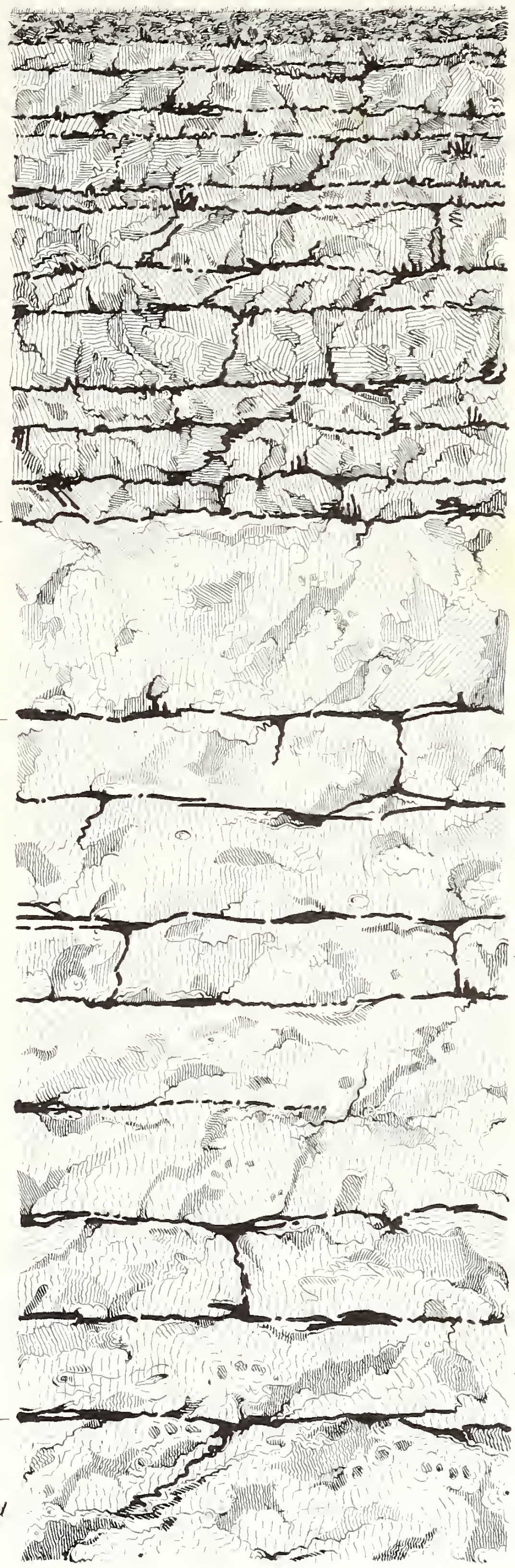
Grass, and a few inches of soil

Coarse rubble stone, 10 to 15 feet; rarely used except in small quantities, for rough walling, and other ordinary purposes in the neighbourhood of the quarries.

Top bed of good stone, 4 feet; valuable on account of its superior thickness

Seven beds of good stone, 15 to 20 feet; average working thickness, from 18 inches to 2 feet 6 inches, the lowest beds are rather harder than those above. Occasionally two beds gradually become incorporated together, so as to form one, out of those which in other parts of the quarry, are divided into two distinct beds as indicated by the fifth & sixth beds. This circumstance is of rare occurence.

These beds are of a hard coarse texture, & consequently not used: Their thickness & number has not been ascertained



Scale of 0 1 2 3 4 5 10 15 20 *feet*

F. Bedford, Lithe London

C. H. Smith, Del.

London, John Weale, 1845.
Printed by Standidge & C°

SOME ACCOUNT

OF

BISHOPSTONE CHURCH,

IN THE COUNTY OF WILTS.

By OWEN B. CARTER, Architect.

On the stream anciently termed the Chele, afterwards the Chalk-bourne water, and now that of Stoford, which flows through the hundred of Chalk, and to the south of that district, lies the insulated portion of the hundred of Downton, named Bishopstone. The parish by which it is occupied is also called Bishopstone, from its ancient lords, the Bishops of Winchester. It is not mentioned by name in Doomsday Book, although it is included in the description of Downton, given in the survey of the hundred made in the third year of the reign of Edward the First. The manor, co-extensive with the parish, continued in the see until the Reformation. Whether at that time it followed its prebend in the church of Salisbury, which, being seised as a lay impropriation, was granted to Sir William Herbert, afterwards Earl of Pembroke, or whether it was obtained in the exchange of episcopal estates under the Act of 1st Elizabeth, has not been ascertained. It is at least certain, that Henry Earl of Pembroke was lord of the manor in 1582, and died seised of it nine years afterwards, since which time it has uninterruptedly continued, and still remains, in the possession of that noble family.

The church is dedicated to St. John the Baptist, and deserves the peculiar notice of the antiquary, as affording a variety of decoration which may fairly indicate the fostering influence of its early episcopal patrons. Its principal addition was evidently made during the prosperity of the Bayntons, about the time of Henry the Sixth, when it appears that the windows were emblazoned with their arms.

The Bayntons were at that time proprietors of the neighbouring tithing of Fulstone, or Fullardstone, upon which some remains of their castellated residence still exist, consisting of a round tower, now used as a dove-cote. According to Aubrey, it was a "noble, old-fashioned house, with a mote about it, and a draw-bridge, and strong high walls embattled."[a]

The church, as it at present exists, consists of a nave, transepts, and chancel, with sacristy on the north side. There is also a singular erection attached to the end of the south transept, which has been variously called a Lich-ward, a tomb, and an almonry. The latter is probably its most appropriate designation; but, as it will be found fully described in the accompanying delineations, some of our antiquarian readers may hereafter be enabled to throw a new light upon the subject of its application. The ground-plan comprehends also a north porch of considerable projection, above which was formerly a parvise, or record loft. The priests' door or entrance to the chancel is also sheltered by an elegant porch or hood, which may be regarded as unique of its kind.

The style of the building ranges from the early part of the thirteenth to the fifteenth century: the principal material employed in its erection is the Chilmark stone; and its appearance when viewed from the beautiful grounds of the neighbouring rectory is extremely picturesque and pleasing. The colour of the stone (which is a warm grey) conduces not a little to the effect of the building; but this will be better understood by the perspective views which it is proposed shortly to add to the geometrical drawings we have now given.

The nave, with the exception of some insertions of the fifteenth century, is evidently the most ancient portion of the existing edifice. The north and south door-ways are of early English character; that on the south side disused, and its space internally occupied by some rich tracery in panels. The west doorway is also closed, and a rising platform with seats, and an excellent organ, occupies the place of the late unseemly gallery. The west doorway has a four-centred arch, and is evidently an insertion of the fifteenth century, as are also the north and south windows of the nave. The west window is of three lights, tri-foliated, and of decorated character. The ceiling is of late date and nearly flat, the tie-beams supported by brackets and spandrels resting upon small corbels.

The transepts, together with the chancel and arches supporting the tower, appear to be of contemporary construction, and are of late decorated character, exhibiting in their details much that is singularly beautiful and instructive in its design. The

[a] Aubrey's Natural History of Wiltshire.

tracery of the windows is particularly good ; the jambs well moulded, and worthy of notice on account of several peculiarities, the mullions in some of the transept windows being simply chamfered, whilst the section of the tracery in the heads is of equal richness to those in the chancel. The situations of two chantry altars are marked, the one in the north the other in the south transept, by niches, brackets for statues, and other usual accessories. The niches are of good decorated work, and the piscina in the north transept a very elegant model of its kind. It is ogee-headed, trifoliated, with a hood-mould finialled ; in the hollow moulding are introduced the rose and ball flower alternately. The drain is destroyed, but the chamfered shelf remains. Of these niches, &c., we have given ample delineations. The ceiling of the north transept is of wood, coved and ribbed, with bosses at the intersections ; whilst the south transept is vaulted with stone, having bold moulded ribs springing from sculptured corbels. These corbels, which are principally ornamented with busts, as also the bosses at the intersection of the ribs, are extremely bold in their execution, and have all the characteristic excellence of the period to which they belong. The groining also exhibits traces of illumination.

Beneath the window at the northern extremity of the transept, is a large sepulchral recess formed within the substance of the wall, under a segmental arch ; the arch multifoliated, extending across the transept, the canopy terminated on either side by pinnacles. In the hollow moulding of the arch, the ball flower ornament is very thickly set. This remain is traditionally termed "The Founder's Tomb ;" and the style of its architecture and important situation render it not unlikely that such may have been its original destination.

Under the opposite window—the south window of the transept—has been lately erected another monument, which is not more remarkable on account of its elegance, than from the melancholy circumstance which led to its position in this church. It is in commemoration of the late rector, the Rev. George Augustus Montgomery, M.A., and consists of an altar tomb surmounted by a deeply moulded ogee canopy, richly crocketted, finialled, and pinnacled. The back of the recess is diapered, and the hollows of the principal arch profusely ornamented with the rose ornament. On the tomb is inlaid a processional cross of brass enamelled, surrounded after the same fashion by a legend recording the circumstances of his death, and having the emblems of the Evangelists at the angles. The front is decorated with quatrefoils bearing shields charged with armorial bearings in brass enamelled.

The window above this tomb has been carefully taken out and restored, and is now filled with stained glass representing the Resurrection. It is said that a portion of the glass is imitated from a church in the city of York, which has been lately lost or destroyed. The window is well executed by Wale, of Newcastle. The design forms a portion of the memorial to the late lamented Rector, and is (together with the tomb) from the pencil of the celebrated Pugin. The effect is altogether rich and good, and much enhances the interest of this portion of the church.

The canopy of the piscina near the above tomb is of modern design, and the finial of the opposite monument is an introduction of the same date. It is of later character than the work to which it forms a termination, as will be perceived upon reference to the plates.

The arches supporting the tower are recessed, the wall chamfered, the recessed arch chamfered also, both continuous, and having a chamfered termination at the bottom. The arch opening to the south transept is of different form, being a pointed segment; the jambs, however, similarly chamfered to those of the other arches. A stone seat surrounds the south transept upon its west and south sides, as will be perceived on reference to the sections.

Upon the platform under the tower, which is at present elevated one step above the nave, are placed the pulpit, reading-desk, and font. The two former are composed of various fragments of continental carving, collected and arranged by the late Rector; the latter is ancient, but has been enriched by some modern panelling. The ceiling under the tower is formed by the belfry floor, the massive beams of which are supported by stone corbels. It may be observed, that the floor line of the nave and transepts appears to have been raised above the original level.

The chancel is approached by one step from the tower platform, and is lighted by four windows, a portion of one on either side being stopped by the erection of the sedilia and sacristy. The east window, though not so elegant in form as those on the sides of the chancel, is very highly decorated, the tracery approaching the flamboyant, and the window arch slightly ogee-headed. It consists of two principal compartments, each subdivided into two lights, trifoliated. Over the head runs a hood-moulding, with returns running horizontally to the side walls, and thence, along them, over the heads of the side windows. A bold string course, or surbase moulding, also surrounds the interior of the chancel under the windows, forming a label or hood-mould to the inside opening of the priests' entrance. There are two niches awkwardly placed in the jambs of the east window; but as they are evidently of late introduction, and have not been very successfully restored, we have omitted them in our geometrical drawings. The platform for the altar is approached by three steps, and the reredos is composed of richly carved oaken panelling, of foreign character, and arranged by the late reverend Rector. The altar table is of dark oak, also well carved, and has on each side a piscina, groined and ribbed, and recently illuminated with the usual inscriptions. The altar rail is of oak, and consists of a series of open lozenge-formed panels, with foliations or cusps. Above the altar table is a good copy in miniature of the Descent from the Cross, by Rubens.

The sacristy on the north side of the chancel is approached by a door communicating almost immediately with the outer platform, and is a valuable example for the purposes of a modern vestry or robing room. It is about 10 feet by 8, and lighted by two small windows containing some fair specimens of painted glass. At the north-east angle of the church, and commencing in the sacristy, is a spiral staircase leading to the vaulting over the chancel, and from thence to the tower, to which it is in fact the only mode of approach. The sacristy is covered by a leaden roof of low pitch, having a parapet, plain on the north and east sides, but elegantly pierced on the west, the piercing being trifoliated. The staircase turret at present terminates in a flat roof covered with lead; but this was evidently not intended to be the original finish, the steps being carried up to the under side of the roof-bearers.

On the south side of the chancel we find remaining, in tolerable preservation, the very fine sedilia, or seats for the officiating priests. They are relieved from the wall, and present a rich composition of pinnacles, with finialled and crocketed gables to each seat. The appearance of the pinnacles in our elevations is rather heavy, but the effect in execution is perfectly bold and good.

Of the external porch communicating with the sedilia we have furnished a perspective sketch, for the purpose of giving a better idea of its extremely picturesque and original character, than could have been obtained from the geometrical drawings. The structure is of stone, elegantly groined, and exhibiting in elevation a foliated arch under an ogee gable, crocketed, finialled, and springing from grotesque heads, similar to those on the pinnacles of the sedilia to which it more immediately conducts. The eccentric manner in which the corbelled springing for the support of the arch is derived from the buttress is worthy of notice.

The groining of the chancel is similar to that of the south transept, the easternmost bay exhibiting on its sculptured bosses the evangelistic symbols.

The chancel windows are filled with modern stained glass, the design in some degree resembling the ancient glass in the south transept of the neighbouring cathedral of Salisbury. There are also some fragments of old glass in the heads of some of the other windows. The modern glass was inserted by the late Rector, and the seats on each side of the chancel were ornamented with old panelling, under the same superintendence.

The end windows of the north and south transepts and of the chancel, have above each a small triangular window, trifoliated, with spherical sides. These windows are connected with the ogee dripstones of the windows, and form their terminations in place of the more usual finial. The parapets of the transepts and chancel exhibit some singular ornamental panelling in relief, of which we have given detailed representations, as well as of the gabled terminations to the buttresses, which afford some singular varieties in detail. It will be observed that the nave appears to have received its buttresses at the time of the erection of the transepts and chancel, their character and workmanship being evidently of the same date.

The tower is a plain embattled structure of two stages, the upper containing three bells. It is perpendicular in style, and was evidently built some time after the suspension of the alterations made by the erection of the present chancel and transepts. Had these been carried out at the time in question, we should probably have seen an elegant tower and spire occupying the place of the present unpretending structure.

It has been before observed, that the staircase turret to the chancel roof appears to have been also left in an unfinished state. Its termination would most probably have been pyramidal, if completed by the original builders.

The windows of the nave are unprovided with dripstones, and, as before observed, are of perpendicular character. Of the building attached to the south end of the transept, I am unable to give any further account than is contained in the suggestions already thrown out; and of its details (which are extremely curious) we have given ample delineations. The perspective sketch represents it in its present state; and the niche-like form which the upper torus of the plinth mouldings is made to describe in the angle of the buttresses, will not escape the notice of our readers. The groining is covered externally with a weathered roof of flagged stone, and the appearance of the whole is singular and picturesque.

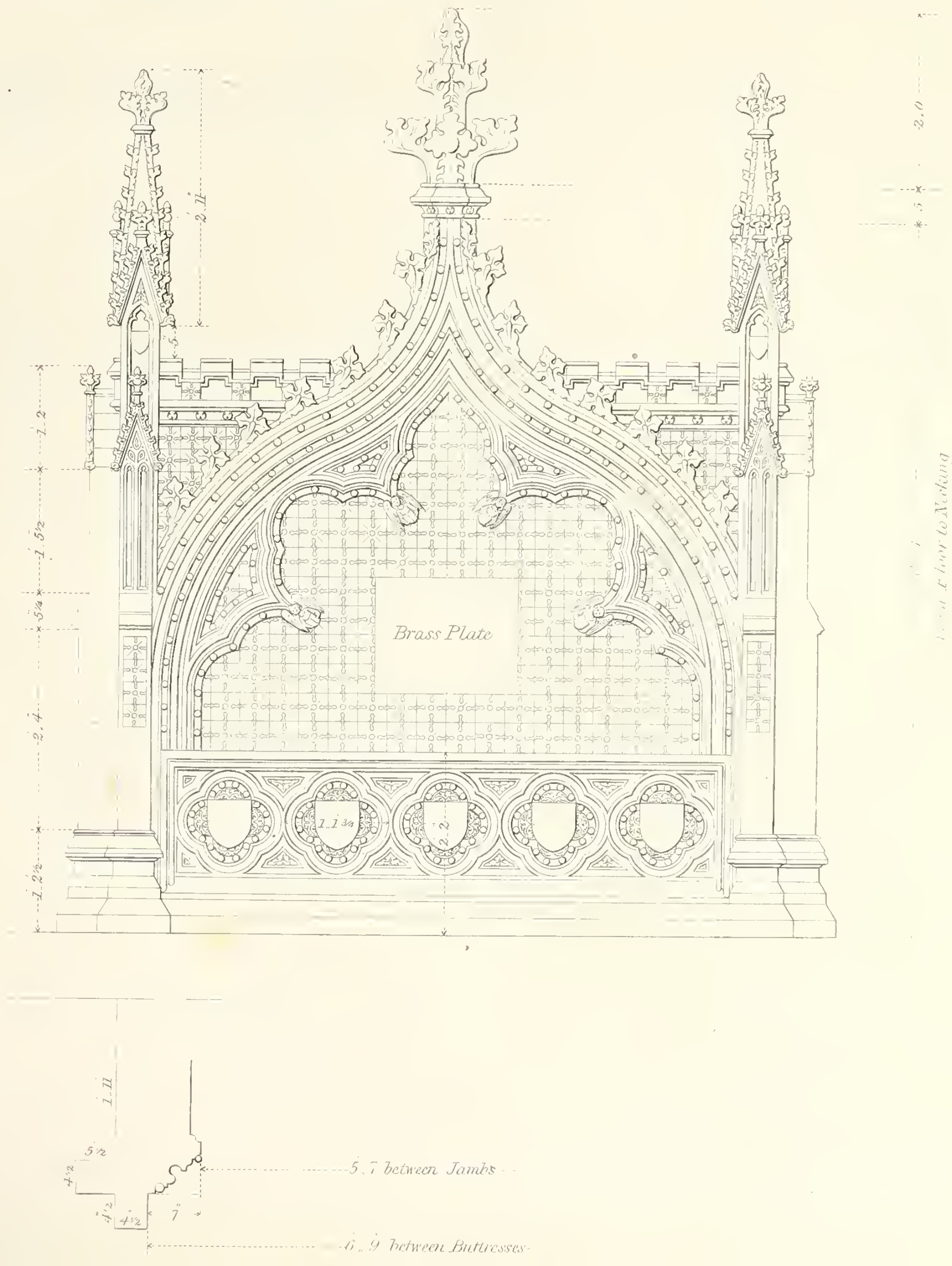
Beneath its arches are at present deposited portions of two ancient memorials of monumental character; one of which, ornamented with a plain ball ornament, apparently served as a base to the tomb which formerly stood under the ancient decorated canopy occupying the north end of the transept.

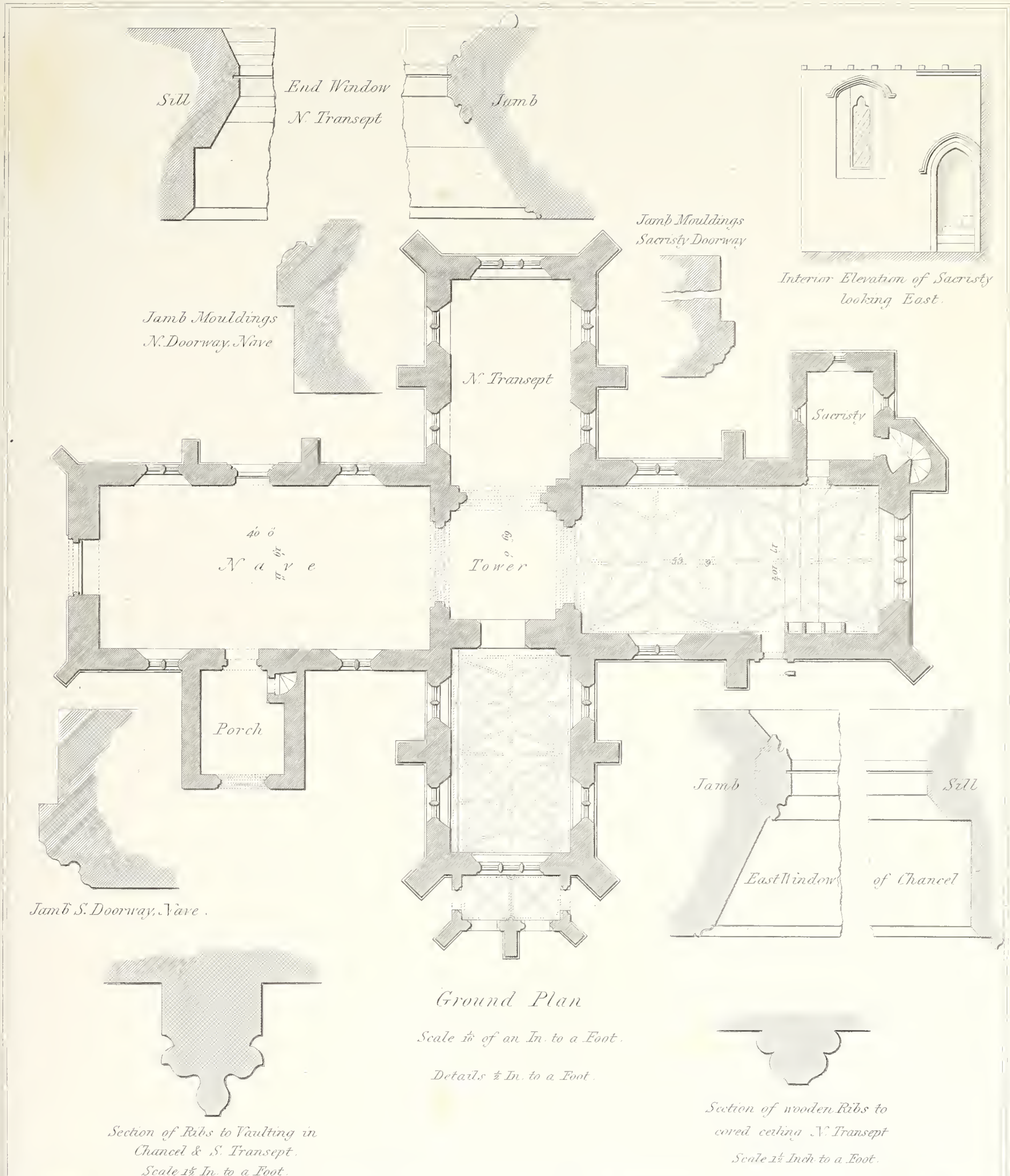
The registers of the church are of no higher antiquity than 1560. The church plate is very handsome, and was given by Bishop Earle, who was sometime rector. A.D. 1663.

We may close our sketch of this very interesting church by observing that its present state evinces the great care and attention which have been bestowed upon it, both by the late and present Rectors; the former of whom left a bequest for the further improvement of the church by the introduction of appropriate seats in lieu of the former unsightly pews which encumbered the nave and transept. At the time when the accompanying sketches were made, these and other improvements were in progress under the superintendence of the present Rector, the Venerable Archdeacon Lear, for whose kind assistance and condescending attention during the examination of this church, the writer of these remarks has to offer his most sincere and respectful thanks.

OWEN B. CARTER.

Winchester, March 25, 1845.



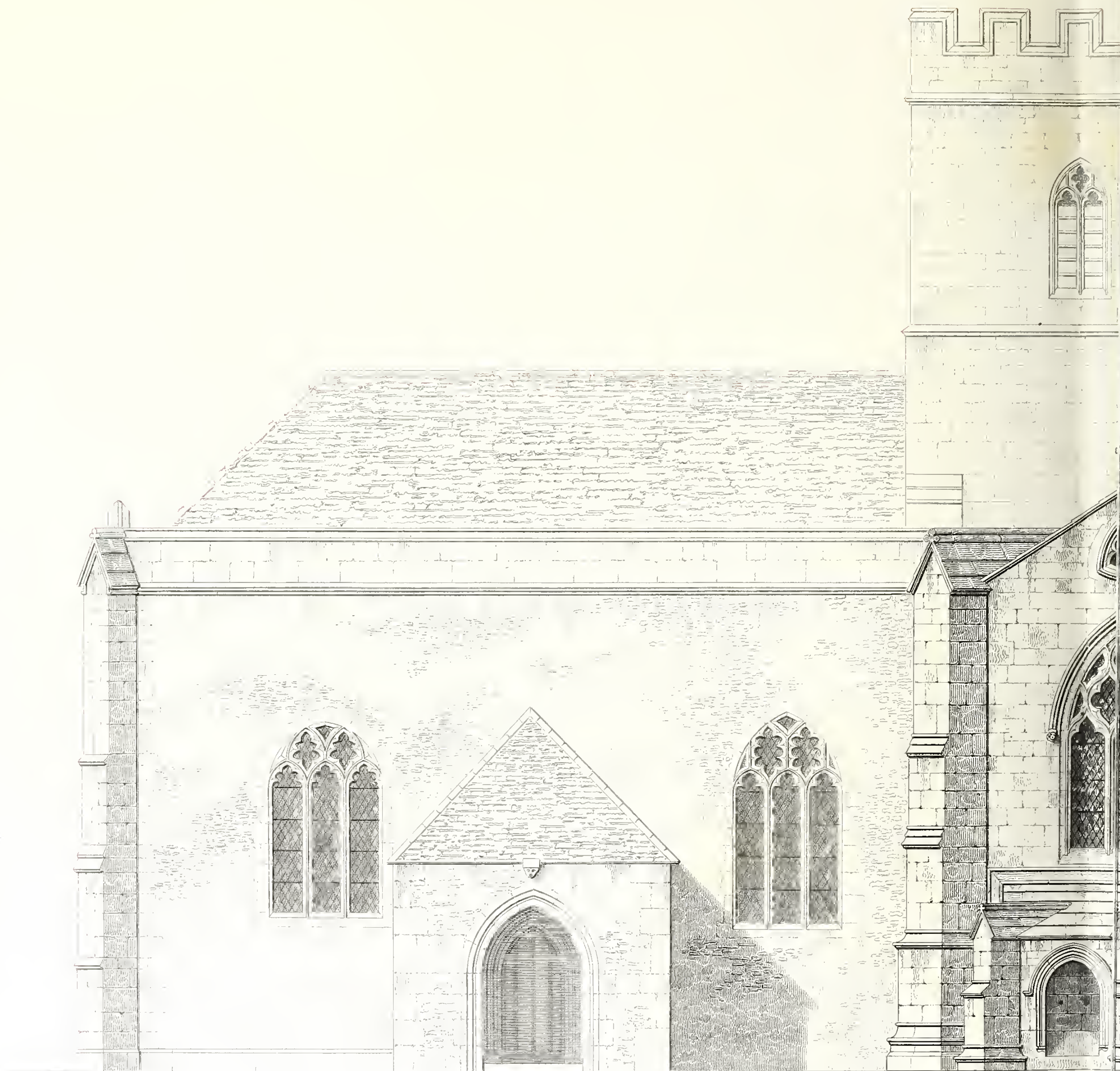


J. Woodman, Archt. del.t Sketched & Measured by O. B. Carter Archt. J. Le Keux, sculpt.

THE CHURCH OF ST JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

Published by John Weale 59, High Holborn London April 1st 1845.

Plate II.



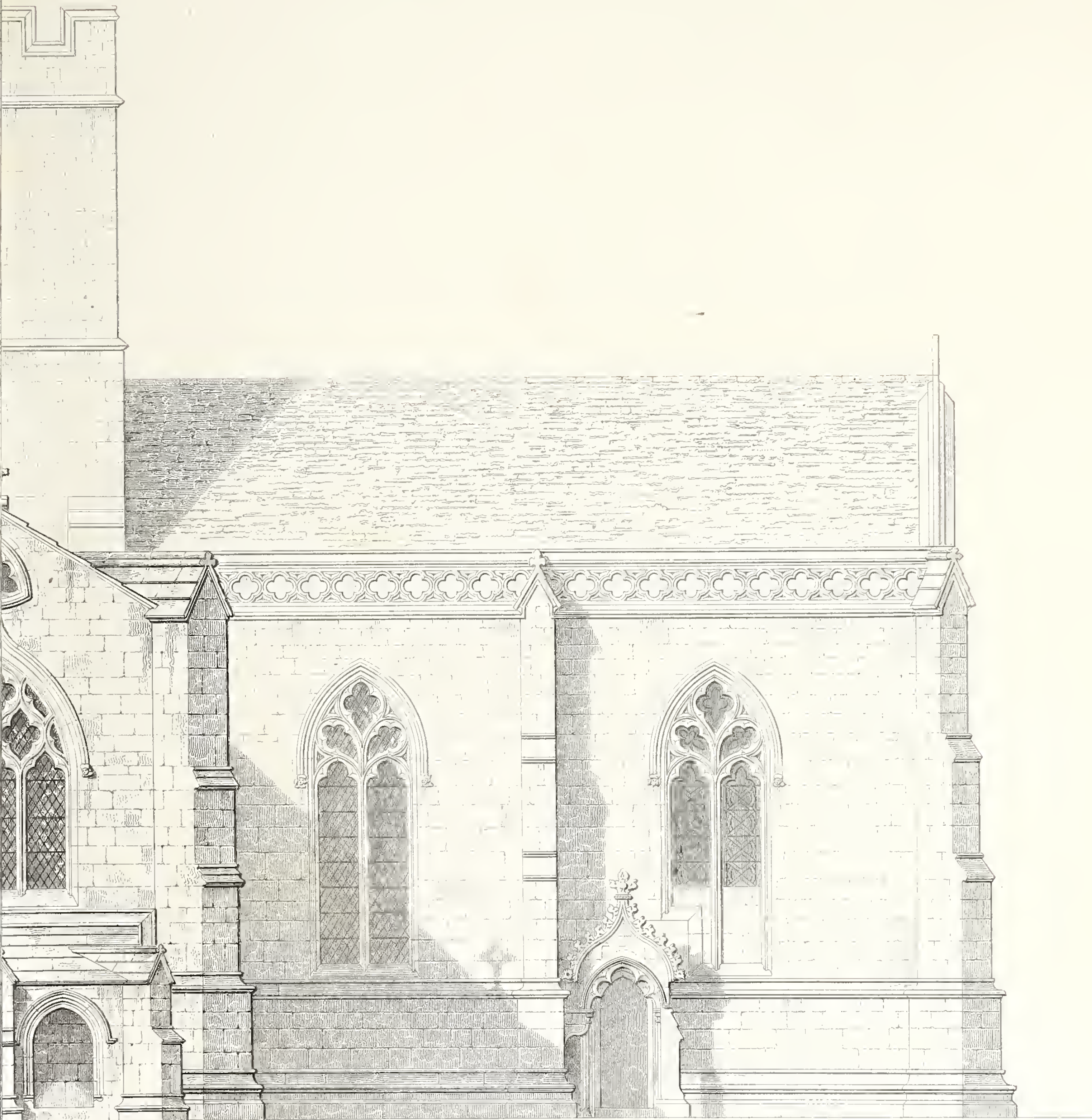
South Ele

Woodman Arch^t del^t

Sketched & Measured by

THE CHURCH OF S^T JOHN THE BAPT

Published by John Weale, 59, High Holb



...tion.

...rter. del. J. Le Keux, sculp.[t]

...T, ...OPSTONE, WILTSHIRE.

London, ...l 1st 1845.

Plate II

East Elevation

Sketched & Measured

THE CHURCH OF ST JOHN THE BA

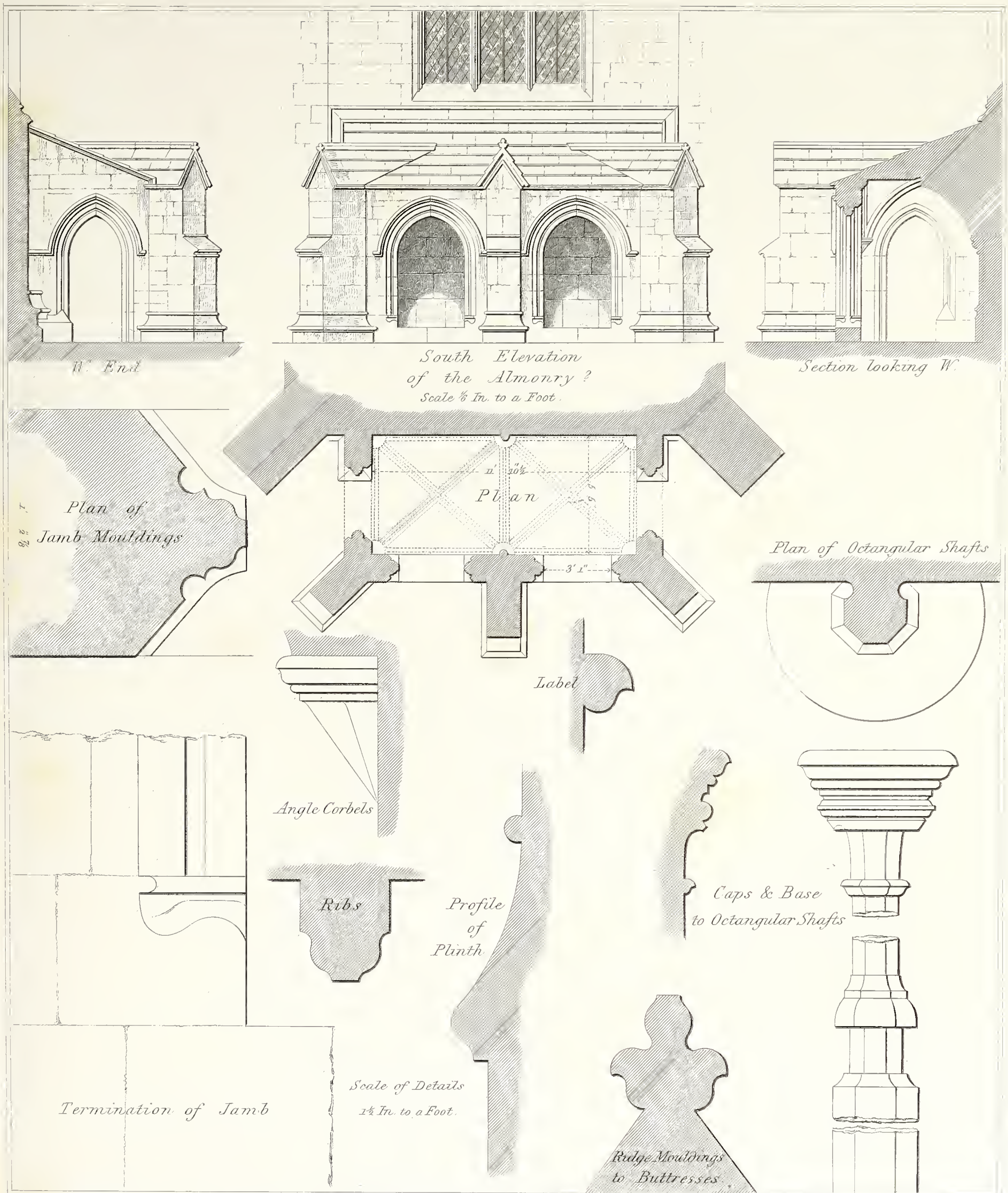
Published by John Weale 59, High

N. Elevation of Sacristy.

B Carter Arch

J Le K[illegible] sculp^t

11



J. Woodman Archt. delt. — Sketched & Measured by O.B. Carter, Archt. — J. Le Keux, sculpt.

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

Published by John Weale, 59, High Holborn, London, April 1st 1845.

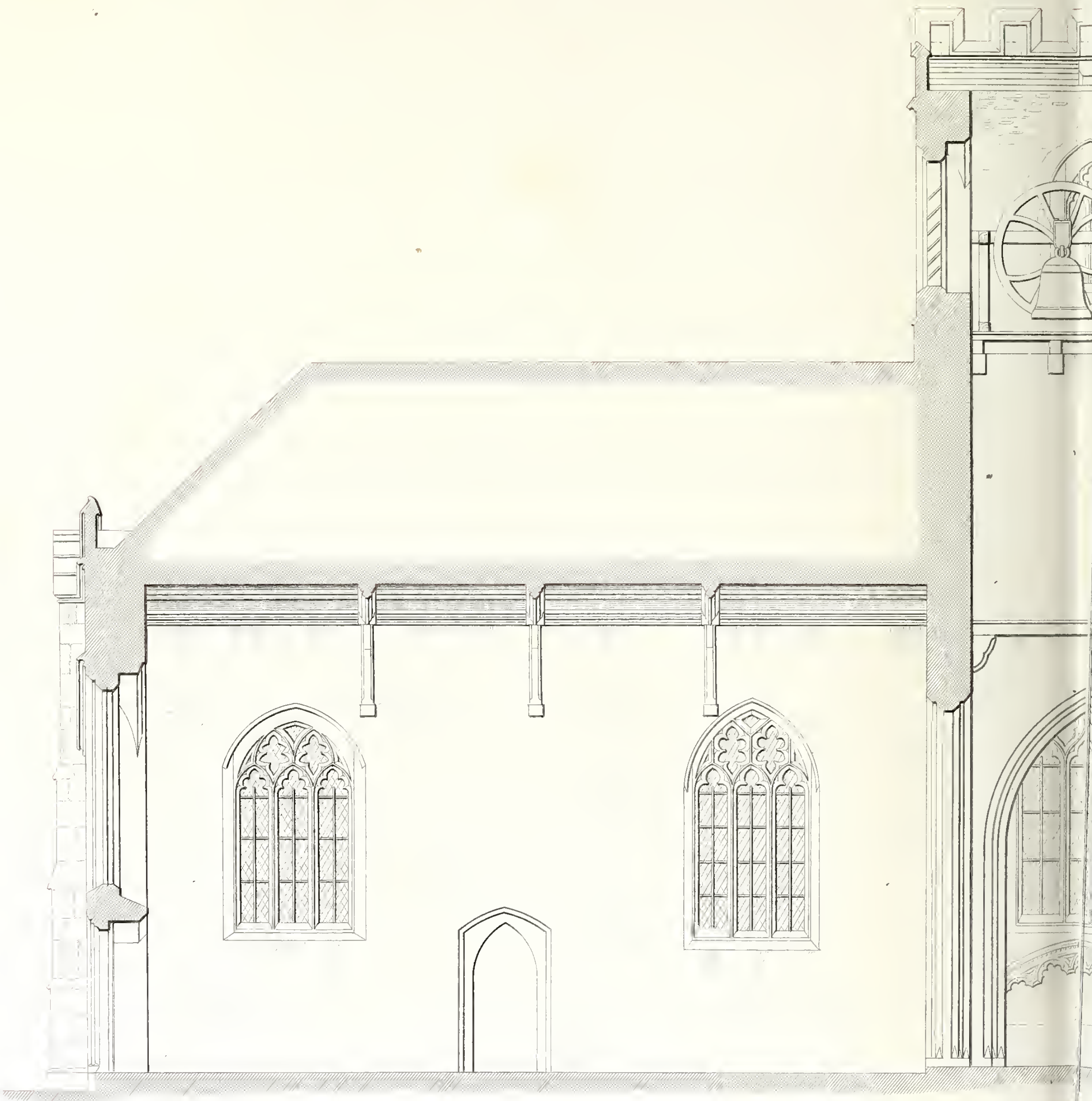
Elevation of Priest's Entrance.

J. Woodman, Archt. delt. *Sketched & Measured by O. B. Carter, Archt.* J. Le Keux, sculpt.

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

Published by John Weale 59, High Holborn, London April 1st 1845.

Plate VI.



Longitudinal Section through N

Scale ⅛ of an inch

J. W[illegible] Arch[t] del[t]

Sketched & Measu

THE CHURCH OF S[T] JOHN THE BA

Published by John Weale, 59, H

Tower & Chancel looking North.

h to a Foot.

O. B. Carter, Archt J. Le Keux, sculpt

ST. BISHOPSTONE, WILTSHIRE.

born, London, April 1st 1845.

Plate VII.

Section through Transepts looking East.

Sketched & Measured

THE CHURCH OF ST JOHN THE BA

Published by John Weale, 59, H

Section through Chancel looking East.

.B. Carter. Archt. — J. Le Keux. sculpt.

IST, BISHOPSTONE, WILTSHIRE.

olborn. London. April 1st 1845.

Plate VIII.

Transverse Section through N. Transept.

Transverse Section through S. Transept.

Scale ⅛ of an Inch to a Foot.

WILTSHIRE.

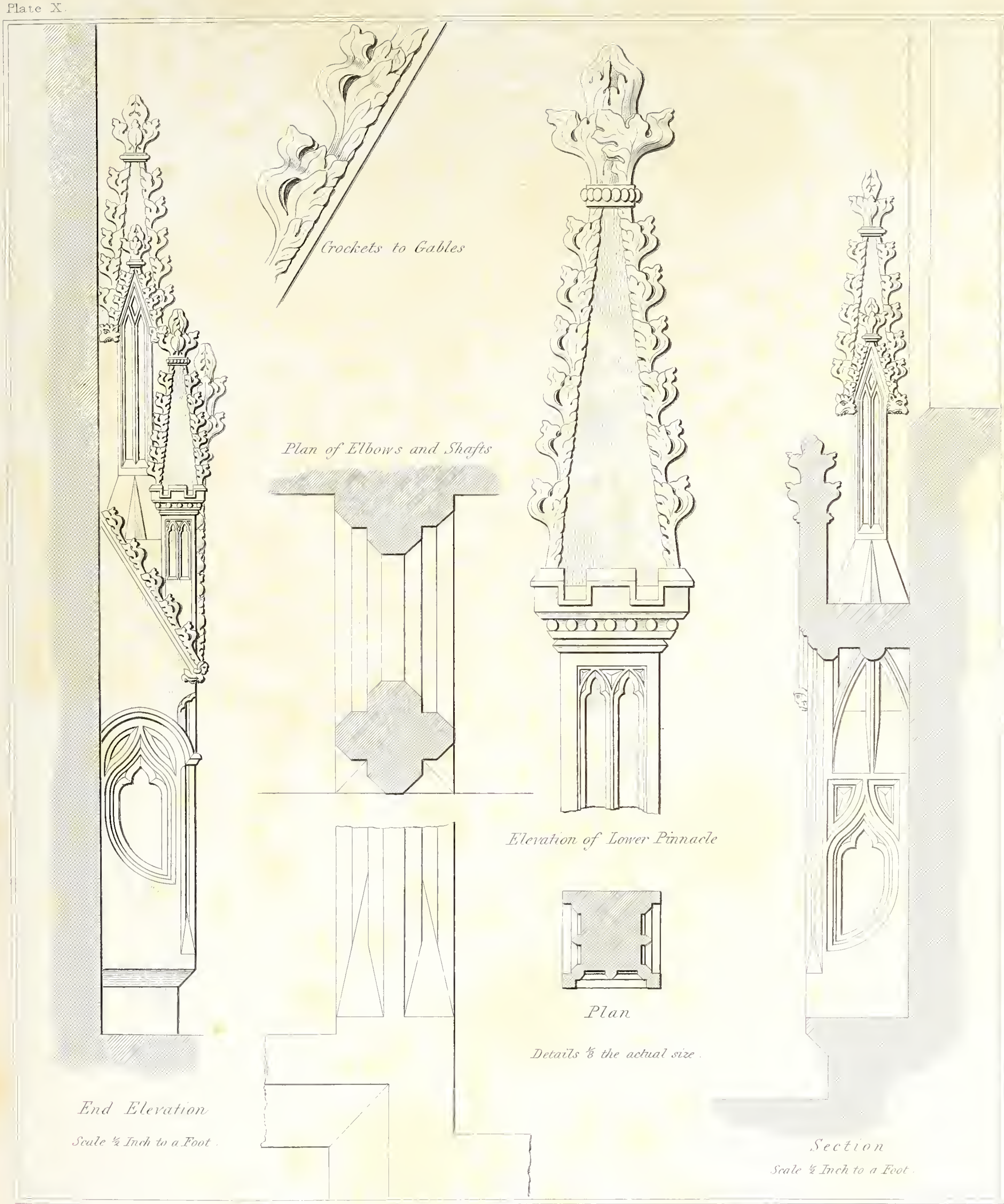
Scale 1/2 Inch to 1 Foot. *Elevation of Sedilia & Priests Entrance*

J. Woodman. Archt. del.t *Sketched & Measured by O. B. Carter. Archt.* Le Keux sculp.t

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE

Published by John Weale, 59, High Holborn, London, April 1st 1845.

Plate X.



Woolman, Archt. delt. — Sketched & Measured by O.B. Carter, Archt. — J. Le Keux sculpt.

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

Sedilia.

Published by John Weale 59 High Holborn London April 1st 1845.

Elevation of "Founders Tomb".

Scale ½ Inch to a Foot.

J. Woodman, Archt. delt.

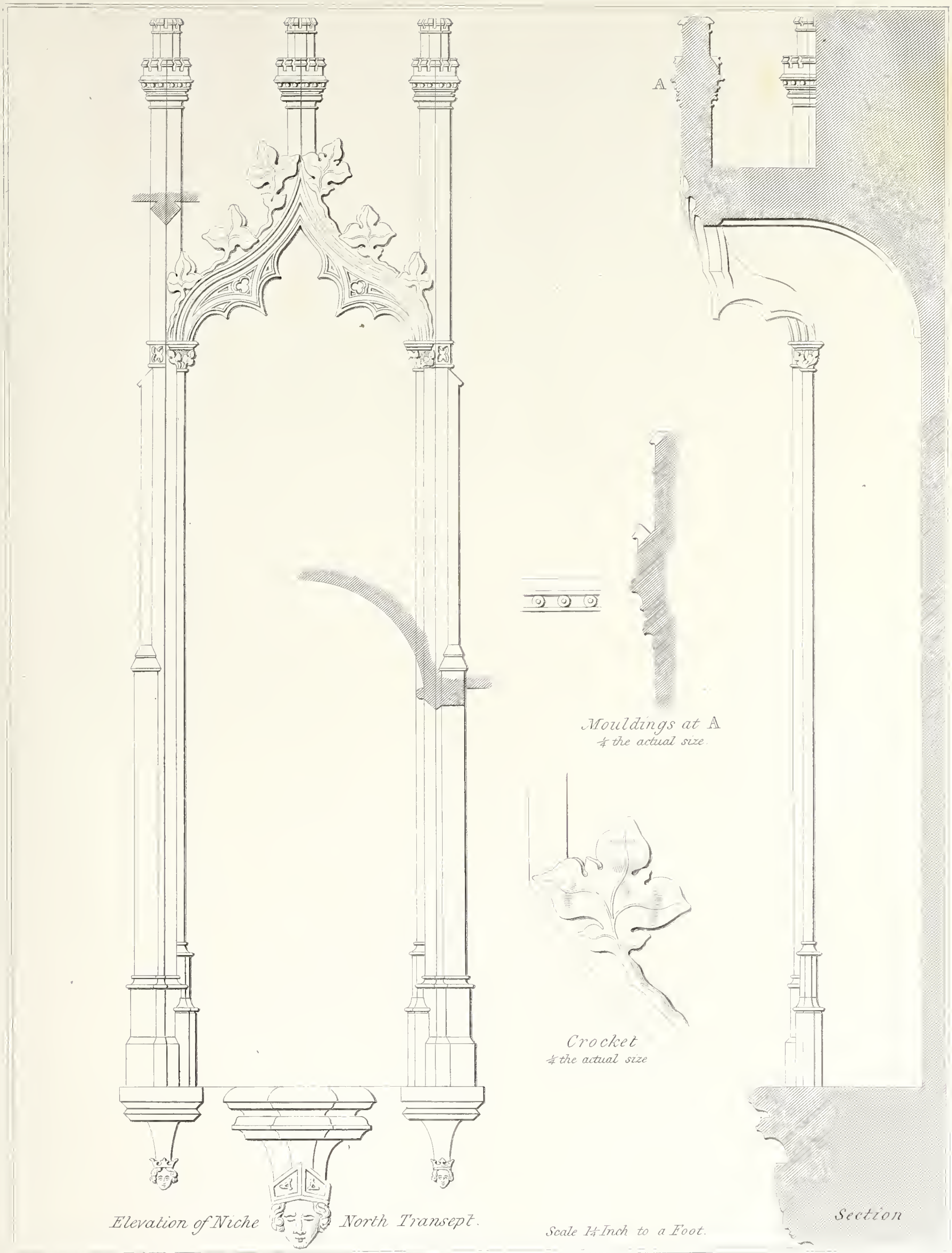
Sketched & Measured by O. B. Carter Archt.

sculp

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

Published by John Weale, 59, High Holborn, London, April 1st. 1845.

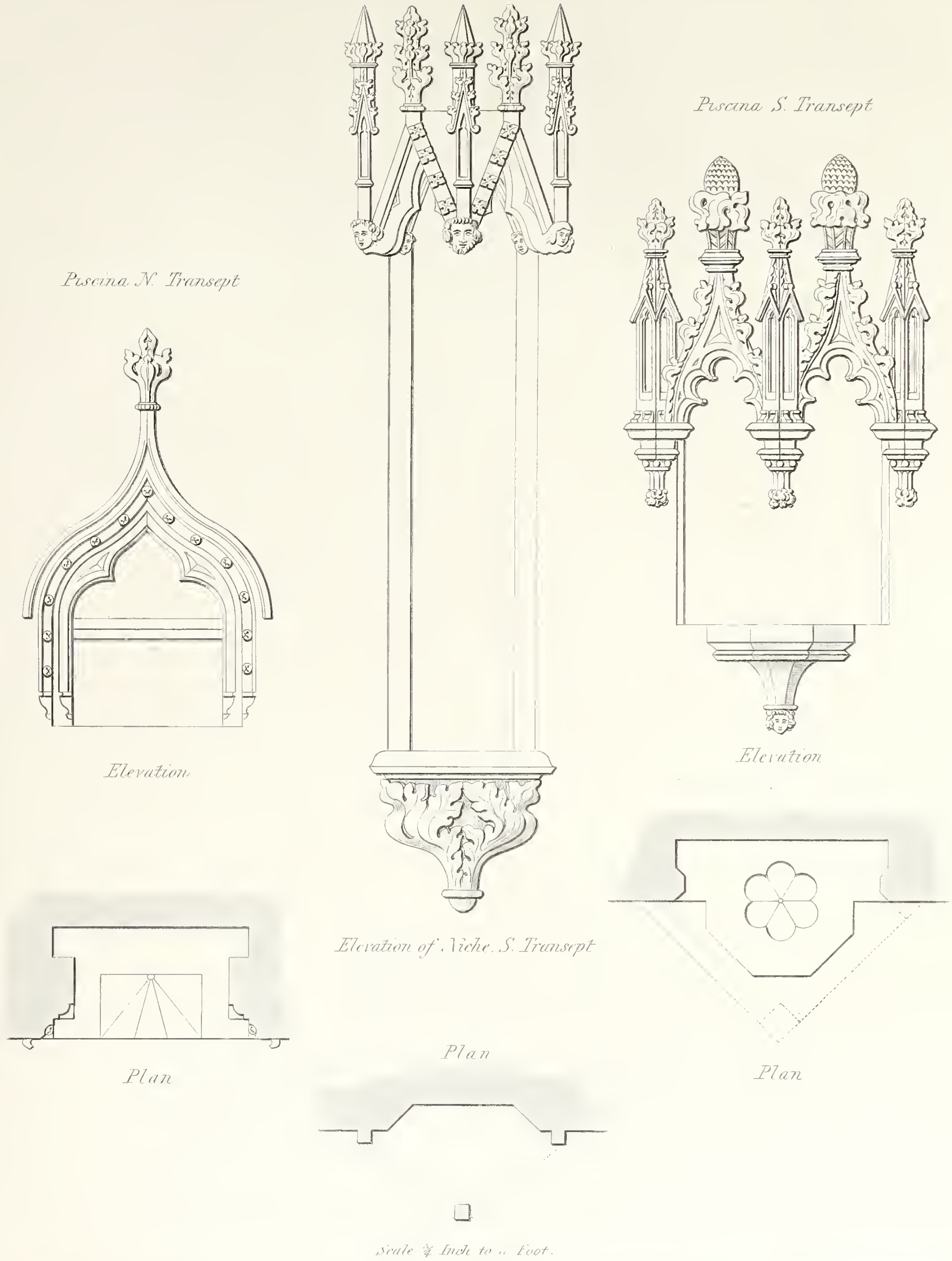
Plate XII.



J. Woodman, Archt. delt. Sketched & Measured by O. B. Carter, Archt. J. Le Keux, sculpt.

THE CHURCH OF St. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

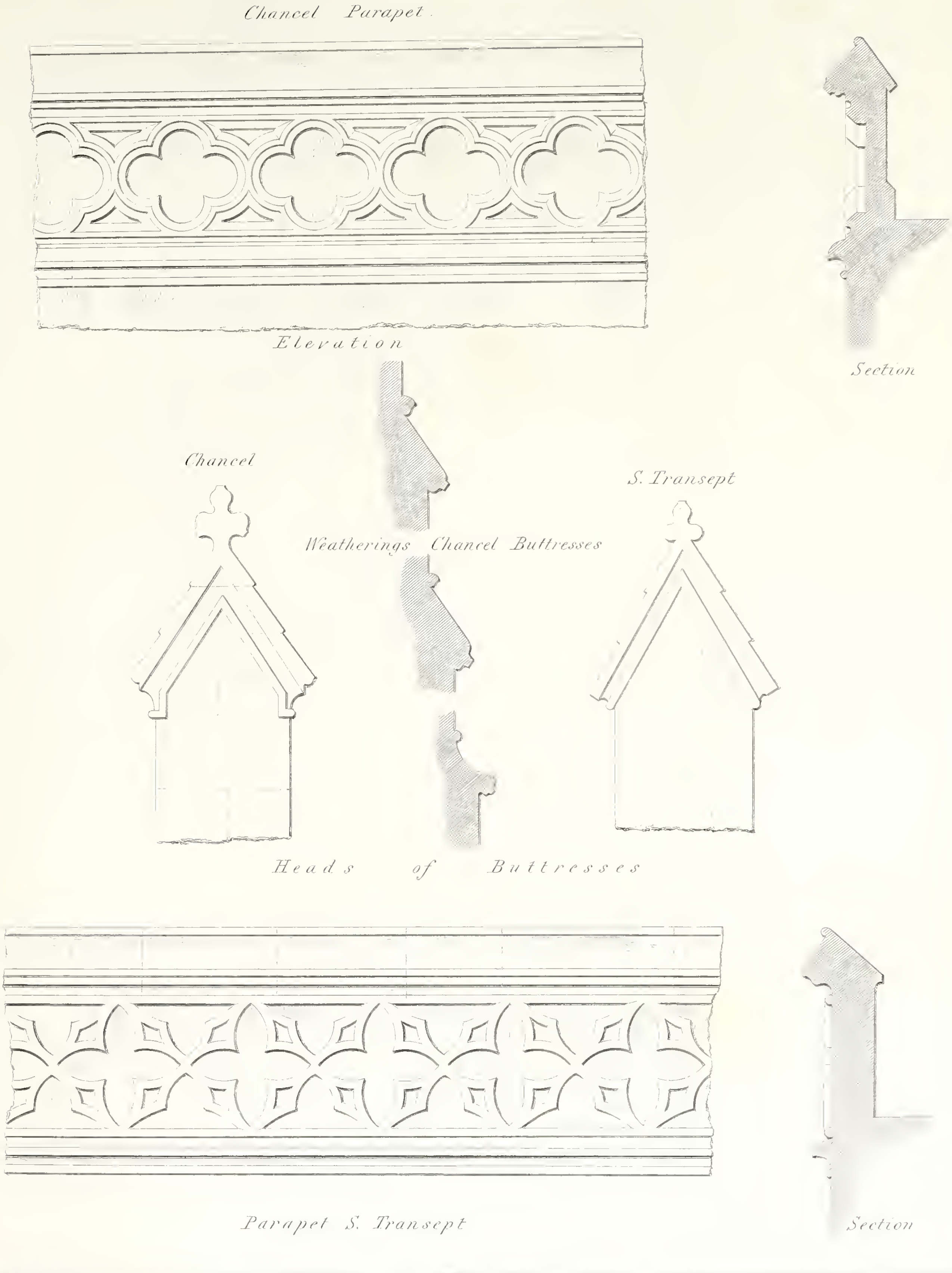
Published by John Weale 59, High Holborn, London, April 1st 1845.



Sketched & Measured by O.B. Carter Archt

THE CHURCH OF ST JOHN THE BAPTIST, B[illegible]NE, [illegible]

Published by [illegible] Weale 59 High Holborn London [illegible] 1845



Sketched & Measured by C. F. Carter

B. Carter, Archt. delt.

J. Le K[illegible] [illegible]lpt.

View of Priest's Entrance.

THE CHURCH OF St. JOHN THE BAPTIST, BISHOPSTONE, [illegible]HIRE.

Published by John Weale, 59, High Holborn, London, April 1st. 1845.

Plate XVI

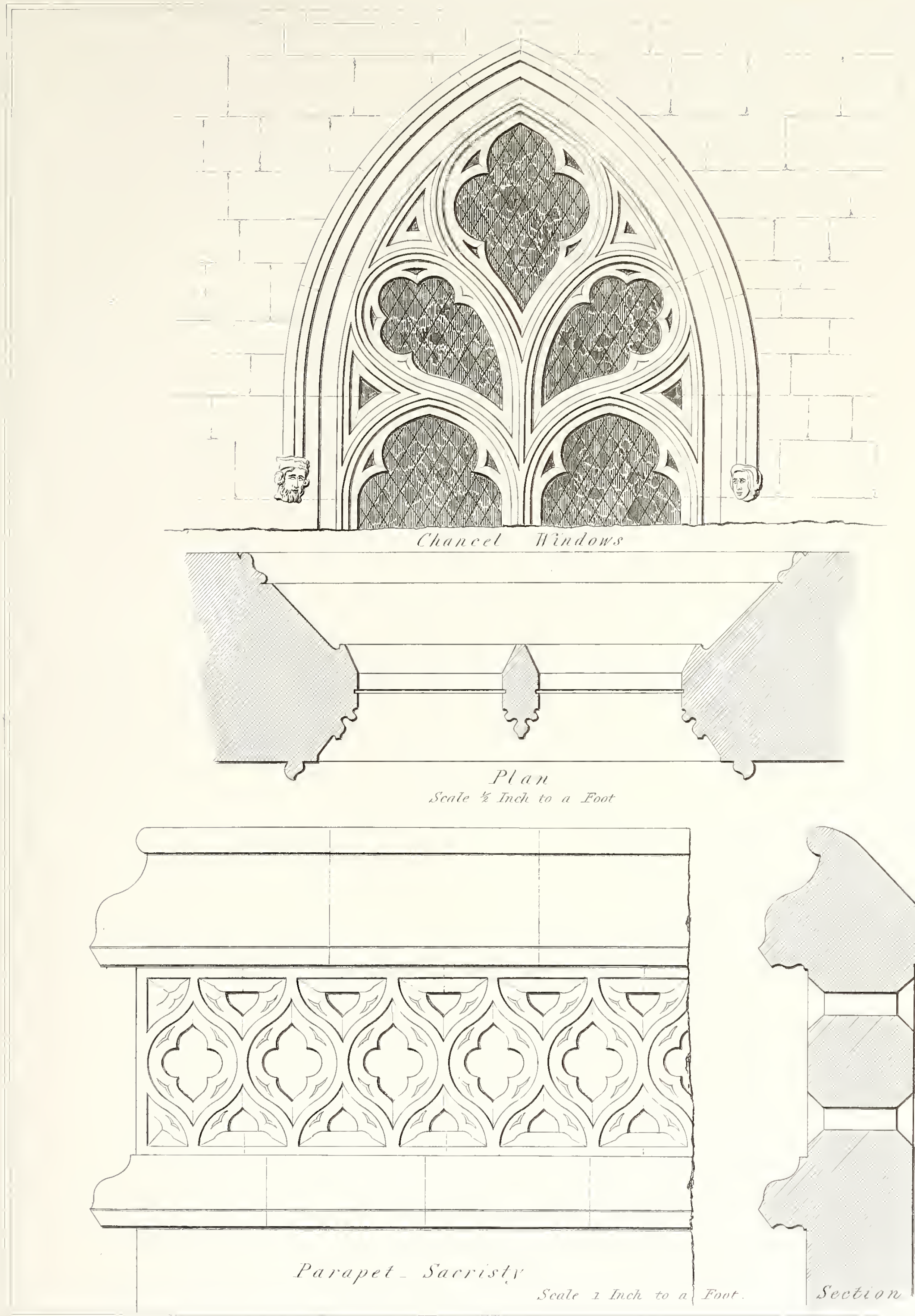
O.B Carter Archt. delt.

J. Le Keux, sculp

THE CHURCH OF ST. JOHN THE BAPTIST, BISHOPSTONE, WILTSHIRE.

S. W. View of Almonry.

Published by John Weale 59, High Holborn London April [illegible]



[illegible] Woodman, Arch^t del^t. — Sketched & Measured by O. B. Carter, Arch^t — [illegible] sculp^t

THE CHURCH OF S^T JOHN THE BAPTIST, BISHOPSTONE, [illegible].

Published by John Weale 59 High Holborn [illegible]

THE

HISTORY AND ANTIQUITIES

OF THE

COLLEGIATE CHURCH OF ALL SAINTS, MAIDSTONE.

By JOHN WHICHCORD, Jun., Architect,

ASSOCIATE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Like other towns of early importance, the name and antiquity of Maidstone have been a fruitful source of etymological speculation and learned fables. Many celebrated antiquarians, including the learned Camden, recognise in the situation of this place the "Vagniacæ" mentioned by Antoninus in his Itinerary, and reckoned by Ninius in his catalogue, one of the principal cities of Britain. However this may be, Maidstone is generally allowed to have been Roman, and from a remote period a town of some importance; this is probable from its situation in the county, and the circumstance of Roman remains being occasionally discovered in the vicinity.

The name of the place is found variously written, as Medweyston, Meddestane, and Maidstone, and on the authority of Lambard, who quotes the ancient Saxon book of the bridge work at Rochester, "Meghanstone, or the mighty and strong town;" and in the records of the justices itinerant of the time of Edward I., it is said to have been called Maydenstone, or the town of maidens, alluded to in the punning rhyme in the black book at the Tally Office.

"Petra puellarum pulcherrima villa mearum."

The Latin name of the Medway, the river on which the town stands, is supposed to have been "Vaga," to which the Saxons are conjectured to have prefixed 'Med,' and called it 'Medweg,' written by the old historians Medweig, Medwei, and Medweg, from its course through the centre of the county. Hence is derived the name of the town, "Medway's Town," Meddestan or Maidstone, still pronounced Medstone in the vernacular of the district.

Maidstone is in the bailiwick of Eyehorne, Lathe of Aylesford, west division of the county, and division of the justices of the corporation of Maidstone; the church is in the diocese of Canterbury and deanery of Sutton, and is thus entered in the black book—"de Maidstone cum capellis de Loose et Detling."

Placed in the centre of a fertile valley, on the banks of a navigable stream, and in easy communication with every part of the county, this town must early have risen into that consideration which, without recession, it has maintained by a course of quiet unventuring industry. Though a place of much resort, enriched by the passage of the Canterbury pilgrims, and a favoured residence of the archbishops, it can scarcely be said to have any history of its own, but, responsive only to influence from without, has served here and there to give a site to an historical event, and fill its unambitious part in social organization.

Maidstone, however, possesses several objects that arrest the attention of an antiquary; the due proportion of religious foundations that one expects in an ancient town flourished here; the liberality of the archbishops augmented and upheld its ecclesiastical establishments, and private wealth and station have left their record in such buildings as one would expect to proceed from the aristocracy of a country town, too great to be adorned by the hand of baronial and feudal power, and not great enough to leave any remarkable memorials of itself to posterity. Leland gives the following description of it, as it was in the reign of Henry VIII., about 1538. "Ther is in the town a fair colledge of prestes. The castel [a] standeth about the myddes of the town, being well maynteyned by the Archbishop of Canterbury. Ther is the common gayle or prison of Kent, as in the shyre town; it is a market town of one long street, and full of ynnes."

As it is chiefly to the munificence of the archbishops that Maidstone is indebted for its architectural embellishments, a brief sketch of their connexion with the town may with propriety be introduced here.

At a very early period, even as far back as Edward the Confessor [b], the manor of Maidstone was owned to be the property of the Archbishop of Canterbury, probably by the gift of one of our Saxon princes; it is thus entered in Doomsday Book: "Meidestane est proprium manerium archiepiscopi et in T. E. R. se defendebat pro x full.' Et ex iis tenet Radulphus unum full.' quod est appreciatum 50*s*. Et Willielmus frater Episcopi Gundulphi full.' Et sunt appretiat £10. Et ansetillus de Ross unum full.' quod est appretiatum 60*s*. Et duo homines habent inde 1 full.'

[a] This castel or palace would, at that time, be about the middle of the town.

[b] Newton.

qui reddunt altari Sanctæ Trinitatis 16*s.* et tamen valet illud full.' 20*s.* Hoc manerium habet hundret in seipso."

This manor, however, must subsequently have been alienated, for we are told that William de Cornhill gave it, together with the castle, to Stephen Langton, Archbishop of Canterbury, in the seventh year of King John, or about A.D. 1207.

This house or castle appears to have been situated on the south side of the church and to have been the building which Courtney partly pulled down and extended when he founded his college here; some remains of about the above date were discovered lately in repairing the present building, which may have been continued to have been occupied by the archbishops until the middle of the fourteenth century: traces of extensive alterations about the beginning of that century are still discernable.

John Ufford, Archbishop of Canterbury, began to build the manor house or palace [a] at Maidstone, A.D. 1348, but dying in the following year, and before he could bring his work to perfection, his administrator was sued by Archbishop Simon Islip for dilapidation, who recovered upwards of £1100 [b].

Islip proceeded vigorously with the work, and not only pulled down a house belonging to the archbishops at Wrotham, for the sake of the materials, which he brought to Maidstone, but obtained the Pope's license to charge his whole province with a tax of 4*d.* in the mark, under colour of which his officers demanded and collected (at least in his own parish) a whole tenth towards the building of this house and other like purposes [c].

Cardinal Morton, who was promoted to this archbishopric in 1486, was a liberal benefactor to the see, in repairing and augmenting his houses at Knoll, Aldington Park, Charing, Ford, Lambeth, and Canterbury, and particularly this palace of Maidstone, which had become much decayed and dilapidated.

Both the manor and palace continued the property of the Archbishops, until Cranmer, by command of King Henry VIII., in the 29th year of his reign, granted "among other premises, to that King, all this manor or lordship, with its appurtenances, the advowson and patronage of the college and church of our Lady at Maydestone, and the advowson, donation, &c., of the Chantry, founded in Maydestone by Archbishop Arundel, and his prison house in Maydestone, together with all liberties, &c., and all other estates whatsoever, belonging to him in this parish, except all advowsons and presentations, &c., not particularly mentioned and excepted," [d] in exchange for other revenues; Henry soon after granted them to Sir Henry Wyatt, of Allington

[a] Lambard, Kilburn.

[b] Hasted.

[c] Newton, quoting Vitæ Archiep. Cantuar.

[d] Hasted.

Castle and the mote in this parish, one of his privy council, from whom they descended to his grandson Sir Thomas Wyatt; who being concerned in the rebellion on the marriage of Queen Mary, was taken prisoner and executed; and being attainted, all this manor, with the palace, rectory, and other premises, and the ancient seat of the mote, were confiscated to the crown.

The palace and other premises in this town were granted by Queen Elizabeth to Sir John Astley, (son of John Astley, Esq., master of the Queen's jewels,) to whom a monument is erected against the east wall of the chancel in Maidstone church. From him it passed, among other estates, to his kinsman, Sir Jacob Astley, created by Charles the First, Baron of Reading, in the 20th year of his reign. The palace continued in various branches of this family, until Sir Jacob Astley, of Melton Constable, in Norfolk, alienated it, with other estates in this neighbourhood, to Sir Robert Marsham, First Lord Romney, of the Mote, whose descendant, the Right Hon. Charles, Earl of Romney, is the present possessor of them.

The manor seems to have continued in the hands of the crown until Charles the First, in his fourth year, granted it in fee to the trustees of the Lady Elizabeth Finch, Viscountess Maidstone and Countess of Winchelsea, from whom it passed to her direct descendant Heneage, fourth Earl of Winchelsea, who in 1720 sold it to Lord Romney.

The buildings of the palace, erected with rag stone, exhibit in the date of their various additions the changes through which they have passed. Some portions of Ufford or Islip's work are still remaining; but the bulk of the present building may be attributed to Cardinal Morton, or to Sir Thomas Wyatt, who became possessed of it in the succeeding reign. Sir Jacob Astley, on receiving them from Queen Elizabeth, seems to have made extensive alterations, and the whole has undergone much modification in modern times.

Remains are yet traceable of all the religious houses of which we have any account in this town. The most ancient of these foundations was the Hospital for Pilgrims or Travellers, dedicated to St. Peter, St. Paul, and St. Thomas à Beckett, situated in that part of the town known as the West Borough, on the opposite side of the river Medway to the site of the church, palace, and collegiate buildings, and somewhat lower down the stream; it was established about the middle of the 13th century, by Boniface, Archbishop of Canterbury, son of Peter, Earl of Savoy and uncle to Queen Eleanor, wife of Henry III. Walter Reynolds, who was translated from the see of Worcester to this bishopric, was a great benefactor to Boniface's foundation, and appropriated to this hospital the two parsonages of Farleigh and Sutton in this county. The revenues of this hospital were transferred by Archbishop Courtney to his new college, and were separately valued from those of the college at the suppression, at £159 7*s.* 10*d.*

The existing remains of this building (now confined to the chapel) correspond in date to the time of its foundation, and present some interesting features; the whole has lately been restored and considerably extended, and is now consecrated as a district church. Mention is made by Newton of "a hollow place just by, arched and vaulted with stone, which seems to go a great way under ground," as existing in his time, 1740; this was discovered and laid open a few years ago, in the adjoining property known by the name Newark.

There was also a house of the brothers of Corpus Christi established here, who were to pray for the fraternity of the Gild, and celebrate masses for the repose of their souls when dead; there is no record of any founder, although the fraternity were possessed of a considerable estate, both in land and houses. Many persons of distinction appear to have been members of this society, who all paid an annual sum towards the support of the institution and other charitable objects. There is a long and curious extract from a manuscript account, dated 1480 and 1481, given in Newton's History of Maidstone, reciting the receipts and disbursements of the society.

Their revenues at the suppression were valued at £40 0*s.* 8*d.*, after which, the lands and buildings of Corpus Christi, with their appurtenances, were purchased of the crown by the corporation of Maidstone, out of the profits of the plunder of certain vestments, plate, &c., belonging to the church, and converted to the use of a free grammar school. A portion of the hall of perpendicular character, with other old buildings, are still existing.

Newton, quoting the supplement to the Monasticon, says that "King Edward III., with his brother the Earl of Cornwall, founded at Maidstone a monastery of Franciscans or Grey Friars." There are remains of an old house not far from the church and east of the college, still called the Priory or Friary, which may possibly be King Edward's foundation; this building at the suppression was included in the possessions of the Priory at Leeds, founded by Robert and Adam de Crevequer for black canons regular of the order of St. Augustine. Such a foundation as Edward's does not appear to have existed at the dissolution of religious houses, nor is there any record of the transference of its revenues. The house has been much modernized, and is now private property.

In the 19th year of the reign of Richard II., A.D. 1395, William de Courtney obtained the King's licence to convert the parish church of St. Mary, at Maidstone, into a collegiate church of one master or warden, and as many chaplains or other ministers as he should think fit; and to assign to them the advowson and patronage of this parish church and the chapels of Loose and Debtling, then held of the King "in capite," to hold of the archbishop and his successors, in free, pure, and perpetual alms, as part of their maintenance for ever; also to appropriate for the same purpose the hospital of St. Peter and St. Paul, founded by Archbishop Boniface, with all its appurtenances, and the advowson of the churches of Sutton, Lullingstone, and Farleigh; with permission to unite and annex the hospital, and all the possessions of it, to the better maintenance of the master and chaplains, provided that the alms accustomed to be paid to the poor in the hospital should be continued.

To the above appropriations Adam Mottrum, Archdeacon of Canterbury, gave his assent, and the college had subsequently granted to it by Richard II., the advowson of the church of Crundale, together with the reversion of Tremworth and Fannes, in the same parish, and King Henry IV., confirmed by "inspeximus" the grant of the above advowson and manors, and confirmed to the master and chaplains the right of purchasing lands and tenements of the yearly value of £40 so that the same were not held in "capite;" and the same king, in the 8th year of his reign, granted his licence to certain persons to convey the manor of Wightresham, with other lands and tenements in Maydestone, Loose, Boxele, and Hoo, to the use of the college, in fulfilment of the before mentioned permission.

The advowson and patronage of this college and church continued part of the possession of the Archbishopric of Canterbury, till Cranmer, in the 29th year of King Henry VIII., exchanged them for other premises.

The buildings were erected on the bank of the river, to the south of the church, where the mansion given by William de Cornhill to Archbishop Langton was situated. As before remarked, Courtney seems in part to have made use of the existing building for his new foundation, and to have added to it very considerably. The charter for the endowment of these works was obtained by Courtney, only one year before his death in 1396, and there is reason to suppose that the greater part of the works were erected previously to his obtaining it; the whole of his project does not appear to have been carried out at the time of his death, for by a clause in his will [a], inserted

[a] Excerpta ex Testamento Willielmi Courtney, Cant. Archiepiscopi.

Volo quod corpus meum sepeliatur in Navi ecclesiæ Cathedralis Exoniensis in loco ubi nunc jacent tres Decani seriatim coram summa cruce. Volo quod episcopus loci me sepeliat, nisi venerit Thomas Episcopus Eboracensis. Volo quod illi tres Decani qui remoti erunt ratione sepulturæ meæ, in aliquo alio loco honorifico Ecclesiæ ejusdem sepeliantur meis omnino sumptibus et expensis. Volo quod in sepultura mea sint septem torches, unus ad caput et alter ad pedes ardentes circa corpus meum et quod quilebit eorum sit ponderis xx*l.* Item, volo quod x*l.* Torticii eodem die illuminentur, &c. Duo ad usum altaris ubi Reverendissimi parentes mei sepeliantur et iv. torticii Eccles. paroch. S. Martini de Exmynster ubi natus fueram. Item, volo quod below, he left the residue of his goods, after the payment of the before mentioned debts, legacies, and bequests, to the completion of this collegiate establishment. If

duo millia matutinarum dicantur, &c. Lego Excellentissimo Domino meo Regi Ricardo optimam crucem meam et *cl.* ut sit post mortem meam specialis Dominus meus sicut erat in vitâ speciallissimus Dominus meus, &c. Rogo etiam eundem excellentissimum, metuendissimum ac confidentissimum Dominum meum regem pro amore Domini Jesu Christi et beatissimæ Mariæ Virginis Matris suæ, nec non sancti Johannis Baptistæ, sanctarumque Mariæ Magdagene et Katharinæ, ac omnium sanctorum quatenus dignetur executoribus meis apponere manus adjutrices, ne successor meus michi aut eis injurietur, aut pro reparationibus quicquam plus debito petat, habendo respectum in quo statu Ecclesiam et Maneria mea una cum castro meo de Saltwode inveni et qualitur subsequentur non obstante terræ-motu non sine gravibus et sumptuosis expensis sicut novit Prior meus. Pro meo posse et tempore reparavi prout Executores mei vestram celsitudinem informabunt, quibus aurem excellentiæ vestræ inclinâre dignemini amore illius qui nemini in sua indigentia claudit viscera pietatis. In justitia enim et æquitatæ vestris confisus fiat voluntas vestra. Lego insuper et relinquo metuendissimæ Majestati vestræ ipsius devotissimam servitricem atque oratricem carissimam et unicam sororem meam Daugayne supplicans humiliter et devote quatenus eandem in hac valle miseriæ sub aliis excellentissimæ protectionis vestræ custodire, fovere atque protegere dignemini, &c. Item, lego predictæ sorori meæ c*cl.*, et modicum missale meum, &c. Et altare meum de albo panno serico unà cum tabula Domini mei de Islep. Et duos pannos sericos de popejays intext. ut inde faciat vestimenta ecclesiastica. Item, Portiforium meum, quod habui ex dono domini mei Wynton. Episcopi. Et duos meliores cruentes argenteos deauratos et duos alios. Et xxiiii. discos meliores argenteos, sex garnatos sive chargiones, xx. salsabilia et tria paria meliora coclerarea ; et duas pelves argenteas ; cum armis de Courtney et cyphum aureum rotundum ad similitudinem pennarum factum, quem habui ex dono, Domini mei regis, &c. Item, lego domino Philippo fratri meo x*l*. cum meliori cypho deaurato ac cooperculo et uno ewer. Lego sorori meæ Dominæ Annæ de Courtney xx*l*. et unum cyphum deauratum, &c. Lego carissimo filio et alumpno meo Ricardo Courtney c. marcas, et optimam mitrem in casu quo fuerit Episcopus, &c., et librum meum dictionarium in tribus voluminibus contentum, unà cum kalendarii ejusdem in casu quo clericus esse velit et ad sacerdotium primoveri et milleloquium S. Augustini et pulchrum librum meum qui Lira vocatur in duobus voluminibus contentum, se pro tempore vitæ ejus, et volo quod post mortem ejus, prædicti Libri sanctæ Ecclesiæ Cantuar. per modum legati remaneant, &c. Lego filiolo meo Wilhelmo Courtney, filio fratris mei Domini Philippi, c. marcas, &c. Lego c. marcas distribuendas inter cæteros filios et filias fratris mei Domini Philippi. Lego Ecclesiæ meæ Metropolitanæ capam cum perlis debraudatam ; et viride vestimentum meum aureum cum 7 capis ; et vestimentum album meum deauro, cum 7 capis. Item lego cc*l*. et plus juxta discretionem executorum meorum et secundum informationem ministrandum per eos pro nova factura sive constructione unius panæ claustri ab hostio palatii usque ad Ecclesiam se recto tramite extendentis. Lego priorii Ecclesiæ meæ Cantuar. cyphum meum argenteum sive bollam ; rogans quatenus in meam memoriam ipse, et successores sui utrantur eodem, &c. Lego Hugoni Lutterel nepoti meo, &c. (The legacies were either, money, plate, or vestments, too many to be inserted.) Then follow, Lego Hugoni Stafford aliquid juctadi scretionem executorum. (Then follow about a hundred more legacies.) Ordino et facio executores meos, Thomam Chillenden, Priorem ecclesiæ meæ Cantuar., Magistrum Adam de Mottrum, Archidiaconum meum, Dominum Guidonem de Mone, Rectorem ecclesiæ de Maydeston, Johannem Frenyngham Armigerum, D. Willielmum Raunton, rectorem ecclesiæ de Harwe, Johannem Dodyngton, Rectorem ecclesiæ de Crukern, Magistrum Robertum Hallum Rectorem ecclesiæ de Northfleet, D. Johannem Wotton, Rectorem ecclesiæ de Staplehurst. Reverendissimus pater languens in extremis (28 die Julii) in interiori camera manerii de Maydestone. Voluit et ordinavit, quod quia non reputavit se dignum, ut dixit, in sua metropolitana aut this bequest were acted upon, we may suppose that the Gatehouse, which was evidently built some years later than the other portion of the college, may have been finished in the lifetime of his successor.

The Gatehouse is of very ample proportion, faced with ragstone ashler, and entered in the north front by a lofty archway, having a smaller one adjoining for the convenience of foot passengers; the opening on the opposite side is embraced by a single arch, beautifully moulded—the space between comprises a square of about nineteen feet, groined with dressed chalk stone [a], and firestone ribs, springing from shafts in the angles; on either side a low arched doorway conducts into a small room, of which there are two stories in the height of the gateway. Adjoining the door on the west side is a similar opening into a passage that conducts to a turret staircase and the range of buildings west of the gatehouse; in the small room on this side of the gateway may be seen the plinth and string of the western range of buildings, cut through for the doorways that connect it with the Gatehouse, and other traces on the end wall, that lead us to conclude it to have originally been an external one, and consequently erected previously to the gate itself. Over the gateway and rooms on either side, there is a large and lofty chamber forty-nine feet by twenty, approached by the turret staircase in the south-western angle of the Gatehouse. This room, the inside of which was never finished, has three two-light windows in each side with cinquefoiled heads; those in the north front are transomed with similar tracery in the lower lights. There has been an ancient chimney-piece at the east end of this room, for which a stack is corbelled out in the external wall; the whole is surmounted by a cornice with grotesque heads, and an embattled parapet. The roof is modern and covered with tiles.

The range of buildings on the west of the Gatehouse were probably the lodgings of the fellows; it is two stories in height, terminated with a tower of three stories towards the river; the external walls on the north and west fronts, are faced externally with rough ragstone, each story lighted by a range of square headed windows, with cinquefoiled heads to the lights; we may suppose the lower story to have been used as a refectory, and that above (which has been divided into several cham-

aliqua cathedrali aut collegiata Ecclesia sepiliri, voluit et elegit sepulturam suam in Cimeterio ecclesiæ collegiatæ de Maydeston in loco designato Johanni Botelere, Armigero suo. Item voluit, quod debita sua solventur, et quod legata sua scripta in testamento præscripto quoad familiares solventur, quoad extraneos legatarios defalcarentur juxta discretionem executorum suorum; quodque residuum bonorum suorum remanens ultra debita et legata, expenderetur juxta dispositionem executorum suorum circa constructionem, ecclesiæ collegiatæ de Maydeston, &c.—*See Batteley's "Somner," Appendix, No. XIII. c.*

[a] The chalk spandrils have been scored with the tool, as if for the purpose of receiving plaister.

bers) as dormitories; on the south side of each story there existed an open corridor, filled with arch tracery after the manner of a cloister, into which the doors of the refectory and the chambers above open.

This front appears even during the existence of the foundation to have undergone some alteration, for an ancient fire place has existed, in the south wall of the refectory, the flue from which has been cut off at the upper floor, and the chimney breast probably removed when the corridors were constructed. Very good specimens of chimney pieces of a plain character are still remaining, both above and below. In the lower story of the tower, two deep cesspools of curious construction, with a large arched passage or drain leading towards the river, four or five feet high, and paved with ragstone, were lately discovered in removing the hop-drying kilns, constructed when this portion of the collegiate establishment was converted into an oast-house.

A small turret staircase in the south-east angle of the tower, conducts from the upper floor of this range of buildings, to a small room in the third story of the tower, and thence on to the roof; the little room has a very beautiful square-headed chimney piece, and a window in each of its four faces which command views of great beauty: from this tower, the buildings seem to have returned towards the south, but in this part have been taken down as far as the central portion (now a dwelling house) supposed to be the ancient house or castle of William de Cornhill, which exhibits traces of early English and decorated work, though now much altered by additions made about the Tudor period, and still more modern alterations; at the south-end there seems to have been a hall or some such large room, part of the original building, for one of the corbels, carved with mouldings of an early character, that supported the timbers of the ancient roof, still remains, concealed beneath the tiling of some low buildings. The west front overlooks the river, with a terrace throughout its whole length, and a garden descending to the river wall, in which the ancient water gate, (over which are carved the arms of the college,) still remains. Here the ancient buildings seem to have discontinued, and a few yards from the north end in a north east direction is a very picturesque gate-tower and turret, which perhaps conducted to another court; the archways are now built up, and the enclosed space used as a stable. A great deal has been lately done by the noble proprietor towards the repair of these interesting buildings, and the renovations are all in the original style of the college.

Mention is made by old writers of two churches in this town; the one dedicated to St. Faith, and the other occupying the site of the present parish church. Kilburne[a] speaking of the former, calls it the ancient parish church, but this must be an error;

[a] Survey of Kent, A.D. 1659.

for in the charter of Richard II., St. Mary's is expressly named as the parish church, nor is there any record of this town ever having been divided into two parishes. By whom the church of St. Faith's was founded, or at what time, I find no record; some portions of the ancient structure still remain, connected with a private house.

Archbishop Courtney, when he contemplated founding his college, pulled down the old parish church, and rebuilt the present edifice on the same site, of which Newton, writing more than a century ago, when its state was far more perfect than at present, asserts, that "the structure for beauty, regularity, and workmanship, much exceeds its neighbouring cathedral;" adding, "that it may in all respects be esteemed among the very best, and most noble and beautiful parish churches, perhaps, in the kingdom."

Successive local historians have repeated statements, on the authority of which the erection of the chancel only of this church is attributed to Archbishop Courtney. Newton, considering the small space of time that intervened between the date of King Richard's charter and Courtney's death, concludes "that the body of the church is part of the old parish church of St. Mary's, and that he only built the choir or great chancel, fitting the whole up for the use of his college, which he might well enough do in the time he lived, after that grant." In this conjecture Hasted follows him.

The accuracy of these surmises is confuted by the building itself, of which no architect would have any hesitation in attributing the complete re-edification to the same period. The form of this building presents none of those variations in arrangement that one finds in churches whose parts are of various dates, and where modifications were required to meet the newly introduced customs of successive generations. Perhaps few single buildings possess more completeness and uniformity than this church exhibited in its original state: one general idea is prevalent throughout, with a correspondence of parts, proportions, and details, very uncommon in middle age structures; and which is interfered with only by such deviations from the original design as may reasonably be supposed to have occurred during the period of its erection, from the difficulties of construction, limited funds, or suggested improvements of a minor character.

Although the charter before referred to, for the establishment and endowment of Courtney's College, bears date the nineteenth year of the reign of Richard II., that is in 1395, and only one year before the death of Courtney himself, it would yet appear that the whole of the buildings were before that time completed or in a state of great forwardness,—at least so far advanced as to admit of the application of the church to religious purposes; for it was certainly dedicated in his life-time. In all probability the buildings were in a state for use when the King's licence was obtained.

This church, in its plan and arrangements, is an excellent example of the principles by which the architects of the middle ages were governed in their designs. Though the same laws of symmetry that applied to classic architecture can by no means be applied to the pointed style; yet there was substituted for them a rule of no less universal application—I mean that regard to convenience or appositeness to its destination by which every structure of the middle ages is distinguished. Scarcely a building exists that has not some peculiarity of its own; and it is these very irregularities that seem to embody the spirit of Gothic architecture. Picturesque and free as are the outlines of ancient buildings, it does not appear that the free-masons were ever actuated by that horror of regularity that seems to have seized some of their modern imitators, who, fearful of running into the sin of paganism, copy, without motive or object, peculiarities which, in the original adaptation, possessed both beauty and meaning.

When we find, in one church, the tower occupying a position at the extreme west of the nave, or in another instance standing north or south of it, a little observation will soon discover a reason, either in the usage of the district or the features of the locality. Rickman observes, on the situation of the towers of the Kentish churches, that they are in "almost every possible position, except the east end of the chancel."[a] The same remark may be applied to the beacon turrets so frequently attached to the towers in this district. No particular angle of the tower is assigned as the position of these turrets; but they will be found almost universally rising from or against that side of a tower that fronts the most frequented road, or a navigable stream, (in those days used little less as a highway than the land,) and usually placed at the most conspicuous angle.

Whatever may be said of the integrity and truthfulness of Gothic edifices, it is quite certain that the builders of the middle ages liked no better to waste their labour than architects of our own day. Ornament was not placed where it could not be seen to advantage; those portions of a building that were most exposed to observation were universally the most enriched[b]; entrances were placed where they were most commodious, and windows where the end of internal effect was best answered. For these reasons the tower of Maidstone Church stands where it does; and the north side, contrary to the more general practice, was more ornamented than the south, because facing the town and the Archbishop's palace. The principal entrance to the church is also on this side, and the windows generally are more elaborate in design.

[a] Offham Church, in Kent, has the tower on the north side of the chancel.

[b] As one out of many examples, see Winchester Cathedral. The plain elevation is now laid open, the buildings existing at the time of the erection of the cathedral being removed.

Though far from being so symmetrical as many other buildings in its plan, or, irrespective of its position, so generally effective; yet, in the site this church occupies, and with regard to the different roads by which it is approached, it is strikingly appropriate. The churchyard is bounded on the west by the river Medway, above which the building itself is considerably elevated, standing on what is termed the cliff. Immediately above the churchyard the river and valley make a bend to the south-west, and at the corresponding angle of the church the tower has been placed, with its turret at the north-west angle, forming in the view from this direction a noble perspective, the lines falling from the tower, as a central object, northwards along the unobstructed expanse of the west front, with its ample windows, and eastwards along the deeply projecting buttresses of the south aisle; the picture embracing the college buildings on the south, and the residence of the Archbishop on the north of the sacred pile.

The building, in its original state, must have presented a very different aspect from the present. Executed in ragstone, in the random work of the district, the buttresses strengthened with large ashler quoins, the mullions and tracery of the windows wrought from Caen stone, the walls of the clerestory and aisles surmounted by a battlemented parapet and roofed throughout its whole extent with lead and solid oak, and the tower surmounted by a lofty spire, this church presents a sad contrast—the present to the past.

Throughout the whole extent of the nave and chancel, with their spacious aisles, there extends one expanse of lath and plaster ceiling, here diversified by a would-be Gothic cornice, there margined by a poor burlesque of groining. From the nave and chancel all vestiges of the ancient covering have disappeared to make room for a Queen-post roof, with stout ceiling joists and rafters of fir, constructed some time in the last century, whose eaves project over the clerestory windows. A similar fate has befallen the aisles, which are partly covered with slate.

The old ceiling seems to have been flat, with moulded ribs and bosses, and probably having its compartments decorated with colour and gilding; a mode of roofing very common in churches of this neighbourhood [a]. The chancel is of very ample proportions three bays in length, the easternmost division separated from the aisles on the north side by an oak screen, originally painted as restored on Plate 10, and on the south by the range of sedilia represented on Plate 5. The east window has six lights, and in the pavement immediately under it is bedded the original altar. It is a slab of Kentish rag, about seven feet in length, by three feet three

[a] Some of the bosses of the old roof are reported to be in the possession of a gentleman of this town, but I have not had an opportunity of examining them.

inches wide, and in the centre and at either angle a cross pommè is faintly marked, but so small as to be scarcely discernible. The stone is cracked, perhaps by violent displacement from its original position.

The sedilia range has seats for four persons. The compartment next the east wall has apparently been intended for the reception of the consecrated elements. This, however, cannot be ascertained, as the space is filled by a tablet erected to the memory of Jacob Astley, Baron of Reading. The whole range has suffered much from this cause, the state of mutilation in which the sedilia are now found having been in chief part produced by fixing monuments therein.

The whole space of the high chancel was probably divided from its aisles by a continuation of the screen shown on Plate 10. Of the roodscreen, only the lower portion is remaining, and this of a late date. Some difficulty occurs in accounting for the mode in which access could have been obtained to the loft over this screen, inasmuch as the turret-staircase, from which it is usually entered, is, in this instance, removed one bay further to the west.

At the west end of the chancel are arranged the seats shown on the plan, and of which a view is given in Plate 7. These are handsome, although not of an unusual style of execution, with the usual provision for turning up the seats, the under sides of which are enriched with various devices, in a good style of carving. The framing in front of these seats has been decorated in a similar manner to the screen on the north side of the chancel, the panels being alternately red and green. Under the easternmost seat on the north side, occurs the shield delineated on Plate 7, Fig. 8, the bearings of which are, as yet, to my knowledge, unappropriated. Under several of the others are the arms of Courtney, variously differenced by the mitre, crescent, or bezant, borne in threes, upon each point of the label. The first are the arms of Courtney, the others may be referred to some connexions of the Archbishop. The one shown on Plate 7, Fig. 7, is attributed to Richard de Courtney, his godson and nephew, afterwards Bishop of Norwich, and Chancellor of the University of Oxford.

There is an entrance into the north aisle of the chancel, under the window, in the easternmost bay of the north wall. This door is now used to give access from the town, to which it is convenient; but it is exceedingly doubtful whether an entrance here formed part of the original plan, and there is every reason to attribute the present form of it to a late date. At the east end of this aisle is a three-light window, and the three bays on the north side are occupied by as many windows, two of which, to the west, are represented in Plate 3. Great similarity of style prevails in all the windows of this church, with the exception of the north-west window of this aisle, though, as has been before observed, those on the north side are generally more ornate, with a double row of panels in the tracery of the heads, while those on the south side are confined to a single row. Attention has of late been directed to peculiarities in the south-west or north-west windows of chancels, which appear, from changes in the ceremonies of the church, to have been subject to alteration about the fifteenth century, and sometimes earlier. It is rather remarkable, that the north-west window of this aisle differs widely, both in material and design, from all others in the building, though such difference can scarcely be attributed to the reason above stated, as the style is contemporaneous with the rest; and there are no traces of its having been inserted. It has five lights, with a head of very beautiful tracery, all executed in sandstone, and now much dilapidated; the sill is somewhat lower, and the arch more pointed, than those of the other windows. The inner jambs and soffits of the windows of both this and the south chancel aisle are deeply recessed and hollowed, see Plate 4, Figs. 1 and 3, and the mouldings which form the inside finish run down nearly to the ground, stopping a string that runs beneath the windows, the wall at the pier being six inches thicker than at the interval under the windows.

At the east end of this aisle is an ascent, by two steps, to what was probably the altar of the chantry, founded by Robert Vinter, of Vintners, in the adjoining parish of Boxley, about the fortieth year of Edward the Third, A.D. 1366, and called Gould's Chantry, from the name of one of two estates, called Goulds and Shepway, left for the support of it. This foundation was originally instituted in the former church, but provision appears to have been made for the maintenance of the services connected therewith in the new building.

The south aisle of the chancel is entered by a doorway of similar character to that on the north side, and probably made under similar circumstances. That a door here formed part of the original plan, is, however, likely, from the analogy of other churches; and the fact that the mouldings of the plinth are returned on one side of the opening. This door opens immediately in front of Wotton's tomb, and in full view of the richly decorated canopies and painted walls that overhang and surround it.

This appears to have been the site of the chantry founded by Arundel, Archbishop of Canterbury, A.D. 1406, by licence of King Henry the Fourth, dated at Westminster, the 4th of July, in the seventh year of his reign, granting to this prelate to appropriate the great tithes of Northfleet, in the diocese of Rochester, in his own advowson, for founding two chantries of three chaplains, viz.; one of two chaplains at Christ Church, Canterbury, "ac aliam Cantariam de uno Capellano ad

Altare sancti Thome Martyris, in ecclesia collegiata de Maydestown divinæ singulis diebus pro salubri statu nostro ac ipsius Archiepiscopi dum viximus, et pro animabus nostris cum abhac luce migraverimus, nec non pro animabus parentum et amicorum suorum et omnium fidelium defunctorum Celebraturis," with a yearly stipend of ten marks, paid to the priest by the Archbishop of Canterbury. No traces of any steps or altar are however discoverable; but there exists in the south wall a niche, with the remains of a shelf and piscina, the bowl of which originally projected from the wall, and was supported on a shaft with moulded cap and base. Westward of the door-way is a stoup for holy water, shown on Plate 9, Fig. 19. In the easternmost bay, at the back of the sedilia, is seen the canopied tomb shown on Plate 11, attributed to Wotton, first master of the College, who died in 1417. On a slab of Bethersden marble was originally a very fine brass now gone, representing the master in the robes of a priest. This monument must have been prepared during the lifetime of Wotton, probably at the first erection of the church, for the upper surface of the slab supports the masonry that forms the back of the sedilia, and the stones of the canopies run quite through, from one side to the other. In front of the canopies on either side are the arms of Courtney and Arundel, and the painted subjects on the sides of the recess have reference to the dedication of the chantry, by Archbishop Arundel, in 1406. East of the recess is an opening through the screen, shown on the plan in Plate 6, through which a view of the high altar might formerly have been obtained, though, at the present level of the floor, the hagioscope is at too great an elevation for such a purpose.

Vestiges of different colours have been traced in this portion of the church, and also on one of the piers of the high chancel, where the monogram I. H. S. in cynople formed a sort of diaper over the thin coat of plaster with which the stone-work seems to have been covered. About the centre of the south wall of this aisle is the doorway shewn on plate 9, fig. 2, which admits to a vestry that occupies the whole of the middle bay. Over this vestry is a dark story or parvise, with an opening looking into the church: the upper portion, however, has undergone alterations that have destroyed the original appearance, the old windows having been stopped up and a modern roof substituted for the ancient one. Corresponding to the number of openings between the south aisle and the high chancel are divisions in the south wall, formed by what appear to have been intended as groining shafts. The shafts themselves are discontinued before they reach the level of the caps, leading to the conclusion that in this instance the builders departed from their original design, which was perhaps to have covered the whole building with a groined ceiling. This change in intention must have taken place after the external walls had been carried up to a considerable height, but before any other of the interior had been erected than a portion of the piers between the nave and chancel. The mouldings of the piers between the south aisle and high chancel do not correspond with those of these shafts, nor do the piers stand over against them, but have their intervals contracted by the width of the abutments at the east and west ends, while the groining shafts have the length of the aisle divided equally between them. Some of the stones worked for these shafts appear to have been used in other parts of the work, and are still to be seen with the projecting part of the mouldings cut away, worked into the jamb of the east window of the north aisle, a position somewhat similar to that which they would have occupied in their original destination.

The nave, in all its general features, resembles the description already given of the chancel. The pulpit formerly stood against the second pier on the north side, counting from the chancel. The west window is an exact counterpart of the eastern; and below it is a door, now disused, but doubtless originally intended for the grand entrance. The font is of rag stone, of quaint design, perhaps attributable to the reign of James I. On one of its faces are these arms, quarterly:—first and fourth, France; second, Scotland; third, Ireland, with the supporters and motto now in use. The other faces display the arms of the town of Maidstone, those of the Astley family, and various other devices. It appears to stand in its original position.

The clerestory is of simple character, lighted by six windows on each side in the nave and three in the chancel, exhibited respectively by figs. 23 and 24 on plate 9. The jaumbs rest internally upon a string course. The square windows of the nave have segmental arches in the inside, round which the jaumb moulding is continued. The sills of these windows are now splayed down to the string, from the glass; but formerly, notwithstanding their elevated position, had a flat stone seat on a level with the string, and a high sill on the outside. The heads and mullions of these windows are worked out of different kinds of stone, and evince a somewhat hurried completion.

The aisles are noticeable from their extreme width, which, though not the same in both cases, nearly equals that of the nave itself; and either, is more than double the breadth of those of the chancel; into which they open on each side by a remarkably light and graceful arch, whose proportion of height to width is nearly as three to one. The north aisle is six bays in length, with a four-light window in each bay, all of similar design: that in the second bay from the west is, however, contracted in height, to admit of a door being formed below it, which is now the principal entrance to the church. The arch is a low drop, struck from two centres, with bold jaumb mouldings, similar to those shewn on plate 9, fig. 28. The beads are finished at bottom, with moulded bases, like those of the beads on the door, shewn in fig. 2 on the same plate. In the north wall is a small door, figs. 3 and 4, plate 9, conducting to the rood turret and staircase, which forms itself out of the second buttress from the east. There has been a small door, now plastered over, high up in the wall of the church, which opened from a landing of this staircase into the top of a screen that appears to have crossed the aisle here. It is conjectured that the eastern portion of this aisle may have been the site of a chapel dedicated to Saint Mary, the patroness of the former church. Between the two buttresses in the north-west angle are the remains of a canopied niche that probably contained a statue of the virgin; and the ancient dedication of the Church to St. Mary appears to have been popularly retained even as late as the reign of Henry VIII. In the deed of exchange made between Cranmer and that prince it is called the Church of our Lady at Maidstone.

The south aisle, in its general arrangement, resembles the northern one. There also appears to have been a chapel or chantry at the east end of this aisle corresponding to that on the north side. A shaft and piscina, resembling that in the south chancel aisle, may still be seen in the north wall, but much mutilated. Some fragments of the shaft that supported the projecting bowl were used to block up the recess: enough, however, remains for a restoration of the original design.

Against the wall of the second bay from the west stands the tower, which encroaches on the space allotted to the bays immediately east and west of it, reducing the windows to small two-light ones, of elegant though not uncommon pattern. There is no tower arch; and that feature is seldom found associated with a flank tower; but a large doorway opposite to the northern entrance opens into the tower porch and forms the principal entrance on the south side. This porch was formerly groined; but, from accident or design, nothing now remains except the angle shafts, each a single column, and the clustered springers that rise from them. The existing ceiling is timber framed, with mouldings of an Elizabethan character: a section of one of the beams is given in plate 9, fig. 21. The mouldings of the outer arch of tower porch are worthy of notice from their simplicity and depth of shadow. (Fig. 22.)

The tower, seventy-eight feet in height, is externally very plain, with square-headed two-light windows in the belfry, and an embattled parapet. The buttresses are carried up to within a foot or two of the cornice, and give rather a stumpy effect to the tower: this, however, would not be the case were the spire existing. This was of wood, covered with lead, nearly eighty feet in height, and was destroyed by lightning in 1730. The turret has been already described. The tower contains a peal of ten bells, a clock and chimes.

This church formerly contained some fine brasses, of which only one now remains, of the latter part of the sixteenth century, on a tablet in the south side, against the pier of chancel arch. On the brass of Wotton's tomb was this inscription[a]:—"Hic jacet Dominus Johannes Wotton, Rector Ecclesie Parochialis de Stapilhurst, Canonicus Cicestrensis, et primus magister hujus Collegii, qui obiit ultimo die Octobris 1417."

In the centre of the chancel, inlaid in a slab of Bethersden marble, was a superb brass of Courtney, the founder of the church and college, who was buried here, according to his will, in the tomb prepared for his esquire, John Botteler. This prelate was the fourth son of Hugh Courtney, Earl of Devonshire, by Margaret, his wife, daughter of Humphry de Bohun, Earl of Hereford. Perhaps no man who ever held the see of Canterbury could boast a more illustrious descent: on his father's side he was descended from a family that enjoyed all the honours of the highest nobility of England, and that contracted in the French branch of it an immediate alliance with royalty, and had given counts to the Christian state of Edessa, and seated three emperors on the throne of the east; on the female side he inherited the blood of the Plantagenets, Elizabeth, daughter of Edward I., (grandmother of the Archbishop,) having taken as her second husband Humphery de Bohun, Earl of Hereford.

William Courtney was educated at Oxford[b], and was first promoted to be prebend in the churches of Wells, Exeter, and York, after which, by the Pope's bull of provision, he was, in 1369, promoted to the bishopric of Hereford; from the above see he was translated to that of London in 1375, and from thence to this Archbishopric, when being Archbishop elect, he appeared as Lord Chancellor, and was confirmed as such in parliament in November 9, anno 5 Richard II. He received his pall with great solemnity in his hall at Croydon Palace. He was a high and liberal minded prelate; just in the government of the church, vigilant in the defence of its jurisdiction, and statesman-like in his policy; jealous of his high position in the church and state, he sometimes punished with severity those who treated his office with contempt, and ventured to compare the splendour of his house, and number and influence of his connexion, with John of Lancaster. Besides his works at Maidstone, he was a liberal benefactor to other institutions of his diocese and the property of the see, and especially to his own church of Canterbury. He died at his palace at Maidstone, in July 1396, having occupied the Metropolitan chair nearly fifteen years. As will be seen in the Archbishop's will, (see ante, p. 6, note), the place of burial appointed by him was the cathedral church of Exeter, but whilst lying on his death bed, by a codicil, he directed the interment of his body in this church. For a long

[a] Newton. [b] Hasted.

time it was supposed he had been interred at Canterbury; a monument to his memory existing there, in the Trinity Chapel, having his effigy, in pontifical dress, lying at full length upon it; Weever, however, distinctly mentions the slab in Maidstone Church as covering the place of his burial, and here his body was found a few years ago, upon examination for that object. The brass on his tomb had the following inscription, preserved by Weever:

"Nomine Willelmus en Courtnaius reverendus,
Qui se post obitum legaverat hic tumulandum,
In presenti loco quem jam fundarat ab imo;
Omnibus et sanctis titulo sacravit honoris;
Ultima lux Julii fit vite terminus illi,
M ter c quinto decies nonoque sub anno,
Respice mortalis quis quondam, sed modo talis,
Quantus et iste fuit dum membra calentia gessit.
Hic primus patrum, Cleri Dux et genus altum,
Corpore valdè decens, sensus et acumine clarans.
Filius hic comitis generosi Devoniensis,
Legum Doctor erat celebris quem fama serenat,
Urbs Herdfordensis, polis inclita Londoniensis,
Ac Dorobernensis, sibi trine gloria sedis,
Detur honor fit Cancellarius ergo.
Sanctus ubique pater, prudens fuit ipse minister,
Nam largus, letus, castus, pius atque pudicus.
Magnanimus, justus, et egenis totus amicus.
Et quia Rex Christi pastor bonus extitit iste,
Sumat solamen nunc tecum quesumus. Amen."

Against the south chancel pier is a mural monument to Humphrey Tufton, Esq. son of Sir Humphrey Tufton, of the Mote, brother of the first Earl of Thanet.

In the chancel are several monuments of the Astley family, one of which has the following curious inscription, quaintly spelt:

"To y^e never dying memory of that
Great Souldier and Person of Honor,
Lord Jacob Asteley, Baron
Of Reading.

EPITAPH.

Let th' Island Voyage (in y^e Van) speak forth
Thy youthfull valour; thy all daring worth:
Next Neweport Battel, where thou didst pfer,
Honour to life: there made an officer;

By famous Orange (thy great Generall)
Under whose sword (y^t day) Spayn's force did fall:
What clouds of nations, could I rayse for thee
And each one, would a glorious witnesse bee
As Holland, Denmarke, and vast Germany
All greive thy losse, honour thy memory.
England (thy mother) crown'd thy hoary hea^d
With major generall: Here in honours bedd,
Thou (now) doth rest: and w^{th} more honour the^n
These times afford unto a noble man:
Faith, valour, conduct; all in souldier should
Or could be wish't for: this tomb doth infol^d."

A^o. D^{ni}. 1653.
Obiit 27 die Februarij, 1651.

In the latter end of the reign of Edward the Sixth, an order was given to take an account of the goods and ornaments formerly belonging to this collegiate church, an inventory is given by Newton, extracted from papers that existed in the Town-hall of Maidstone.

" An Inventorie brought in the fourteenth day of November, Anno RR^s. E. VI^{ti}. VI^{to}. before the King's Majesties Commissioners, according to theire commandement to us dyrected of all goods, plate, jewels, bells, and ornaments remaining or did remayne in the parishe church of Maydstone sith the first year of the reigne of the King's Majestie, that now is, King Edwarde the sixte."

By us Richarde Awger, Curate;
Nicholas Asten, Richarde Nelson, John Goseling — Churchwardens.

" The inventorie of the church goods of Maydstone, taken by the inhabytants of the same, the seconde day of Septembre, A^o. RR^s. Edwardi Sexti secundo."

After a long account of Copes and other rich vestments and ornaments, for the priests and altars, this article concludes thus:

	s.	d.
" Itm. in latten [a] candelstycks, and other lycke stuff of latten which cometh to the wayte of ccc save x lb.	liiii	iiii

To this is next added another account with this title:

" Remayning in the hands and custodye of William Collet these things next ensuing."

[a] Iron tinned over.

Many of these particulars are of the same kind with the former, and the whole ends thus:

"Itm. in the steeple five bells, and one lyttle bell ealled the morrow-mas bell."

After this is another account bearing this title:

"Certayne of the ehurche plate of Maydston, reeeived of William Collet, sextayne; by the chureh-wardens, and the inhabitants of the same, the xviith daye of Septembre, A°. 1548.

	lb.	onces.
Fyrst, the great pyeks of silvar and gilt, weyeng	vi	v
Itm. ii basones of sylver and gylt, weyeng together	vii	ii
Itm. twoo sensers of sylver and gylt, weyeng	iii	iii
Itm. one erosse of sylver and gylt, weyeng	v	i
Itm. the lesser pycks gylt, weyeng	i	ii
Itm. one payre of sylvar eandlestyeks, weyeng	v	xi
Itm. one shype of sylvar, with a lyttel spone, weyeng	i	xv
Itm. two lyttyl paxes of sylvar, weyeng	o	xiii
Itm. one lyttel bell of sylvar, weyeng	o	viii
Itm. two lyttyl payre of cruatts, and one senser ryng of sylvar . . .	o	xiii
Itm. one chalyee gylt, weyeng	i	
Itm. one other challesse, gylt, weyeng	i	qt. lb.
Itm. one ehalyse peell, gylt	i	vii
Itm. one other challyse, gylt	i	iii
Itm. one pomsed ehallise dooble-gylt, weyeng	i	i dwt.
Itm. iii pypes and 11 knobs of sylvar	iii	ix

"All this abovesaid was delyvered by hesayd Wyllm Collet unto the ehurehewardens and otherof the sayd enhabytants in the presenee of *Wyllm Crew*, eonstable, *Nicholas Mello*, *Thomas Edmonds*, *Alexander Fysher*, *James Barrett*, *John Smyth*, *Thomas Baker*, *John Lylly*, *William Kemp*, and Rydroek, the wryter thereof.

"Certayne of the sayd ehurche plate having the Founder's Arms, whieh remayneth in the hands and eustodye of the same Wyllm Collet.

	lb.	onces.
Fyrst one erosse, with a fote, beyeng gylted, weyeng	viii	iii
Itm. two great eandlestycks of sylvar, gylt, weyenge	ix	v
Itm. the payre of great sensers of sylvar and gylt, weyeng . . .	vi	vii
Itm. one great paxe, gylt	ii	v
Itm. ii eruatts of sylvar and gylt, weyeng	o	xiii

"And also remaineth in the hands and eustodye of the sayd Wylliam Collet of the sayd churehe plate the crismetory of silver and ii ehallyses.

"Of all whiehe goodes, plate, jewels, bells and ornaments aforesayde, eertayne of them were sold to the use and purehaseing of the corporation of the towne and parishe of All Saints, of Maydston aforesaid, the Brethered Haule, the Fraternitie and Landes of Corpus Christi, and of Sainct Faith's churche and churcheyarde, with all and singular their appurtenances, to the value and sum of cc lb.

"The more parte of the residue of the saide goods, plate, jewels, bells, and ornaments were delyvered into the hands and custodye of Willm Collet, as by the inventorie aforesaide thereof made more playnle, doth appear; and the sayde Wyllm Collet delyvered part of the saide goodes, plate, jewells and ornaments unto *James Barret*, *Willm Tilden*, *Thomas Goare*, and to other as he saith, he will more playnlye declare for his dischardge before yow the Kinges Majesties commissioners.

"Also there remaineth in the custodie of *Thomas Haggard* and James Catlett for a certayne pece of lynen called a vayle, and other things xxs. x*d.*

"Also there was stolen out of the saide churche of Maydston by night in the vth year of the King's Majesties reigne that now is, off the goodes, plate, jewels, and ornaments aforesaid, one cope and other thinges, which the aforesaide Wyllm Collet can more playnlye declare."

What has become of the rest of these valuables is not recorded, as the church now possesses none of them.

The only arms connected with the architecture of the building that now exist are as under:—

The arms of the see of Canterbury.

Those of Christ Church, Canterbury,—azure on a cross argent, the letter C., surmounted by the letter I., sable.

The arms of the College of Maidstone,—azure, 3 bars or.

Archbishop Courtney: or, three torteaux, on a label of three points azure, 3 mitres.

Archbishop Arundel,—quarterly, 1st and 4th, gules, a lion rampant, 2nd and 3rd, chequy azure and or.

Courtney differenced by three bezants on each point of the label and also by 3 crescents on ditto.

Also a fess engrailed between 3 beech leaves.

To whom these arms belong, I know not, but there is a shield displaying similar bearings on the font of Sevenoaks Church, which has also in another part the arms of the see of Canterbury, impaling Courtney. There is no stained glass remaining, but vestiges of painting appear upon different parts of the walls, and on the plaster under the east window is a cross within a circle, rudely drawn in red and black. Many of the wrought stones have on them the marks of the masons who worked them; the same marks recur among others in various parts of the building, which may be received as evidence of its having been completely re-erected and finished by the same hands.

DESCRIPTION OF PLATES.

PLATE I. The general plan of the church.

PLATE II. A geometrical elevation of the east end, showing the mode of building with ragstone that prevailed from the middle of the fourteenth century. The stones are arranged in random courses, averaging from a foot to sixteen inches in depth. This kind of masonry prevails in most of the Kentish churches built subsequently to the decorated period; before that time rubble work was in general use.

The raking parapet above the cornice is modern, and shows the common header work. The side buttresses are terminated in rather a remarkable manner, with hipped weatherings, the upper stone of which mitres into the coping of the parapet.

The square-headed perforations in the gable were probably intended to admit air to the timbers of the roof.

As will be seen from the line of the cornice, the ancient roof was of a lower pitch than the present one, the cornice formerly returned on the north and south sides, and was surmounted by a parapet, now removed.

PLATE III. Elevation of part of the north side of the chancel, exhibiting, towards the west, the only window in the church that differs in character from the rest.

PLATE IV. Fig. 1 shows sections of the mullions, jaumb, and label of the window marked B on the elevation (see Plate III). Fig. 2 is a section of the inner and outer sill. Fig. 3, plan and elevation of part of the window marked A, on the same Plate. Fig. 4 is a section of the sill, and Fig. 6 a section of the label. Fig. 5 is a profile of the plinth which is continued all round the building.

PLATE V. Elevation of sedilia on the south side of the chancel; there were four seats, the niche on the east containing a piscina, &c.

All the compartments were originally intended to have been surmounted by canopies similar to the three shown on the drawing; those on the sides, however, were never completed, but, instead thereof, two wooden ones, of wretched detail and workmanship, have been at some time set up. Although showing what would be the effect of the whole range, if completed, it was not thought advisable to introduce them in the Plate. The whole of this composition, with the tomb at the back, is an admirable instance of the constructive skill of the middle age architects. The supports, as will be seen from the plan and section, (Plate VI.,) are attenuated to an extreme degree, and the mortar possesses little or no cementing property, yet the work remains unshaken, and beautifully balanced. The whole is executed in fire-stone, and has been plugged and cramped together. The material is one well adapted to works of this description, where carved decoration, and a multitude of small parts, render sharpness and nicety of execution desirable. As a working material, it is, however, inferior to Caen stone, and very perishable when used externally.

Plate VI. Plan and section of tomb, with a plan of one of the canopies taken at A. The groining of the recess over the tomb has been coloured, the ribs red and gold, powdered with small black flowers; the spandrils were blue, the corbels and bosses red and gold. On the plan is shown the opening or hagioscope, referred to in the description of the church.

Plate VII. Fig. 1. Sketch of the stalls in the chancel. There are no traces of any colouring in any part, except the framing in front. This has, at some later period, been painted over, in imitation of oak. Figs. 2 and 3, specimens of the carvings from the under sides of seats in the stalls; these were centre ornaments. Figs. 4, 5, and 6, side enrichments under seats; Figs. 7 and 8, shields from ditto; Fig. 9, sketch of the under-side of one of the seats, showing the arrangement of the carvings; the remainder are details of these stalls.

Plate VIII. Figures 1 and 6, bosses from the groining of tomb; Figs. 2, 4, 5, 7, 8, and 9, from the groining of the sedilia; Fig. 3, a boss, still remaining against one of the walls of the tower porch, from the groining with which it was anciently furnished; Fig. 10, a specimen of strawberry-leaf enrichment from Wotton's tomb; the flat part of the leaf is gilded, with red edges; Figs. 11 and 12, corbels from Wotton's tomb.

Plate IX. Fig. 1. Elevation of a doorway in a boundary wall of the church-yard, opposite to the western entrance. This door probably gave access to the church from the palace; Fig. 27 is the jamb moulding of the same doorway; Figs. 2 and 28 are the vestry door and jamb; Figs. 3 and 4, door into rood turret and jamb; Fig. 5, jamb of great chancel arch; Figs. 6 and 7, arch mouldings; Fig. 8, section of groining shafts; Figs. 9 and 10, cap and base of pier-shafts; Fig. 11, external cornice of rood turret. The flat hollow shown by this profile was universally adopted when the member was much elevated above the eye, and becomes more open as the altitude from the ground increases; Figs. 12, 13, 14, 15, 16, 17, and 18, details of sedilia and tomb; 19 and 20, stoup and piscina. The bowl of the piscina originally projected beyond the face of the wall, and was probably supported on a small shaft, similar to that mentioned in the description of the piscina lately discovered in the south aisle. Fig. 21, section of one of the beams of the present ceiling of tower porch; Fig. 22, jamb of outer archway of tower; the dotted lines thereon express the moulding of the arch; Figs. 23 and 24, clerestory window and jamb from the nave; Figs. 25 and 26, ditto, from the chancel.

Plate X. Elevation of the oak-screen on the north side of chancel, with the original colouring restored. Sufficient remains to identify the decoration of every part. The stars in the hollow of the canopy were cast in lead and gilded; at the side is a section, showing the construction of the screen.

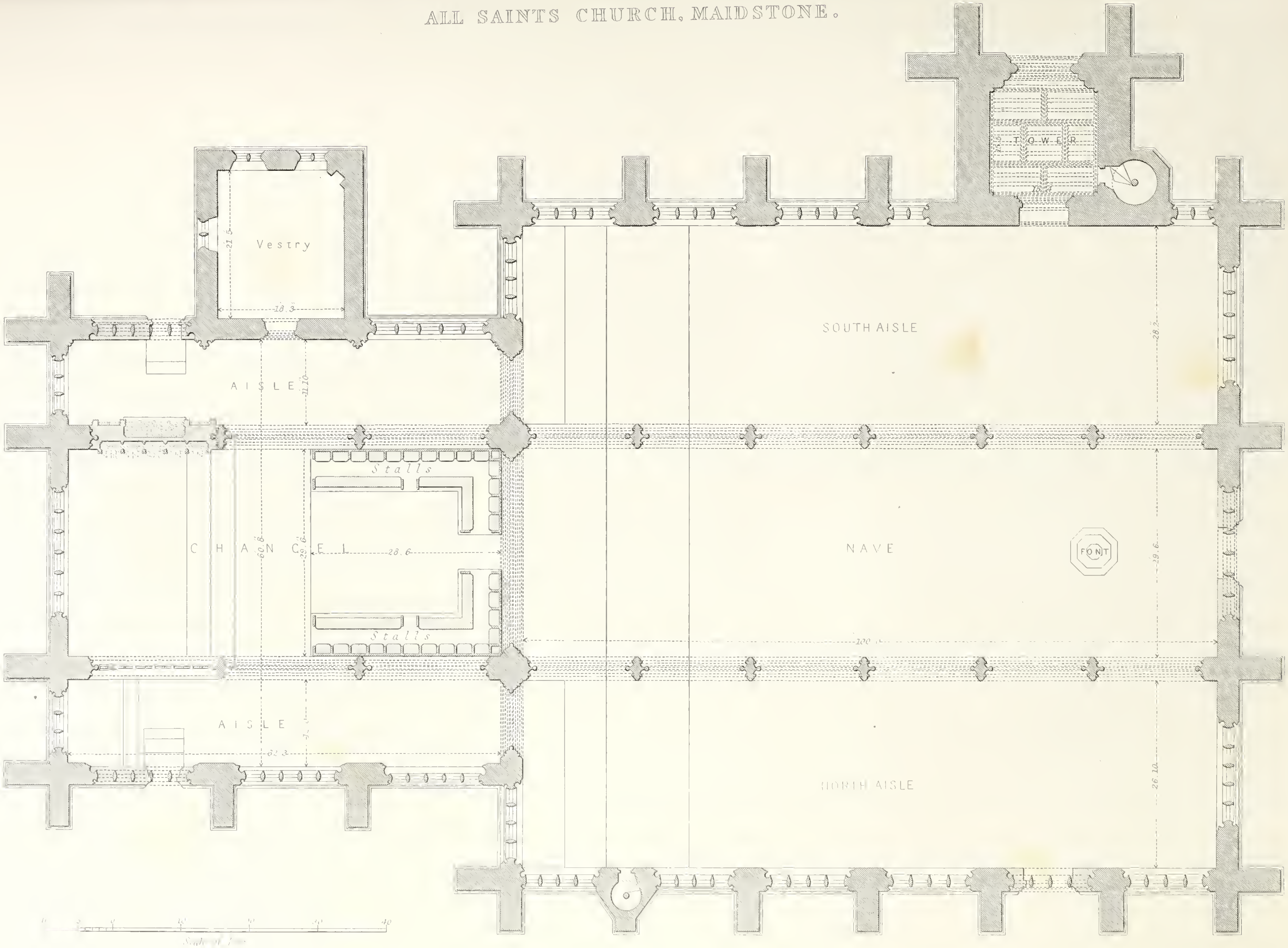
Plate XI. Elevation of Wotton's tomb in the south aisle of the chancel, with the original colouring restored. The painting, though much effaced, can be made out without any doubt.

Plate XII. Painting on the back of the recess of Wotton's tomb. The subject may be considered to refer to the presentation of Wotton to the Virgin, or perhaps to the foundation of this chantry by Archbishop Arundel. The figures are intended to represent the Mother of God, to whom a suppliant, in the attire of a priest, is presented by an angel; behind the Virgin stands St. Catharine, and in the opposite corner is another female figure.

The painting is executed on a thin coat of plaster, and has been wantonly mutilated. The legends on the labels are too much effaced to be decipherable.

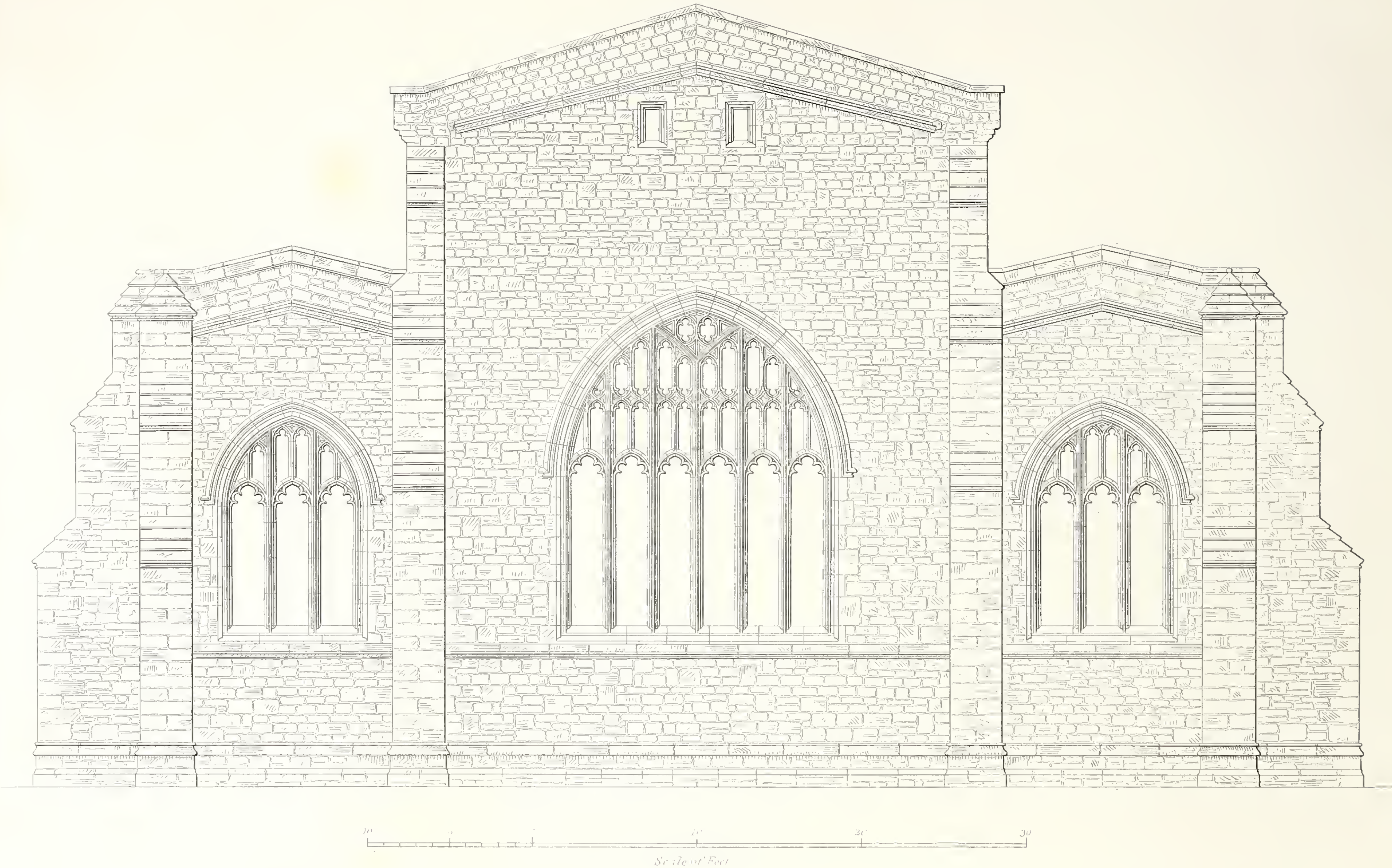
Plate XIII. Portrait of an archbishop, painted at the east end of the recess, conjectured to be intended for Archbishop Chicheley, though it might, with much greater probability, be assigned to Arundel. Over against this subject, at the west end of the recess, is the representation of a bishop; the figures are nearly the size of life. At the side of this Plate, in Figs. 2 and 3, are given the arms of Courtney and Arundel, severally impaled with the see of Canterbury. Fig. 1, the arms of the college, founded by Courtney, at Maidstone; Fig. 4, arms of Christ Church, Canterbury. These, which are taken from the canopies over Wotton's tomb, are again repeated on the sedilia at the other side. All these shields have been repainted in a barbarous manner, but the original colours can be made out. The arms of the college are found again, carved on a stone over the water-gate of that building.

ALL SAINTS CHURCH, MAIDSTONE.



ALL SAINTS CHURCH, MAIDSTONE.

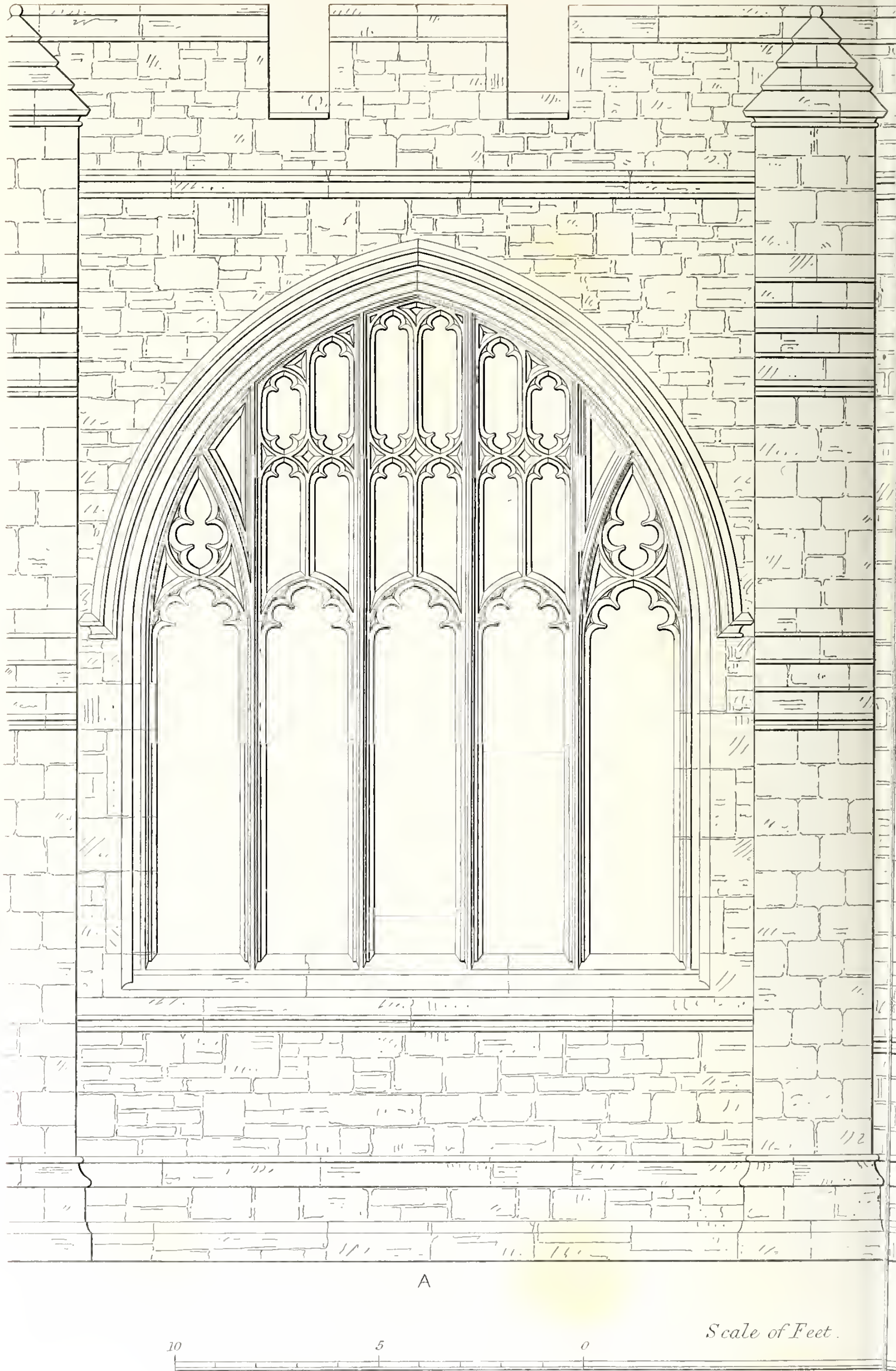
East Elevation



John Weale, Architectural Library, High Holborn

ALL SAINTS CHUR

Elevation of part of Nort



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H, MAIDSTONE.

Aisle of Chancel.

FIG. 2.

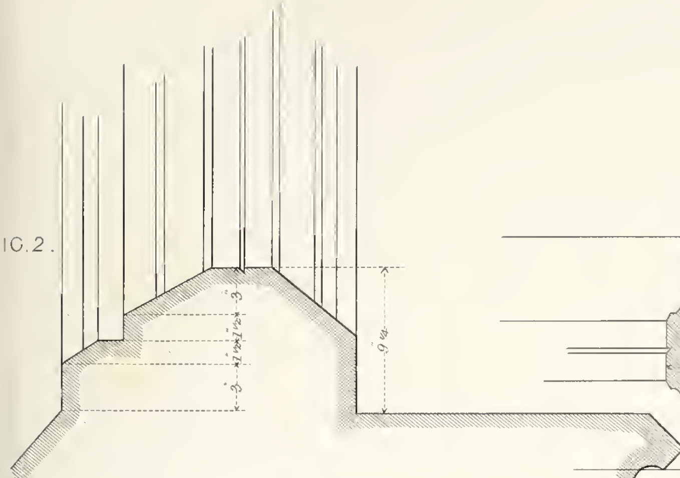
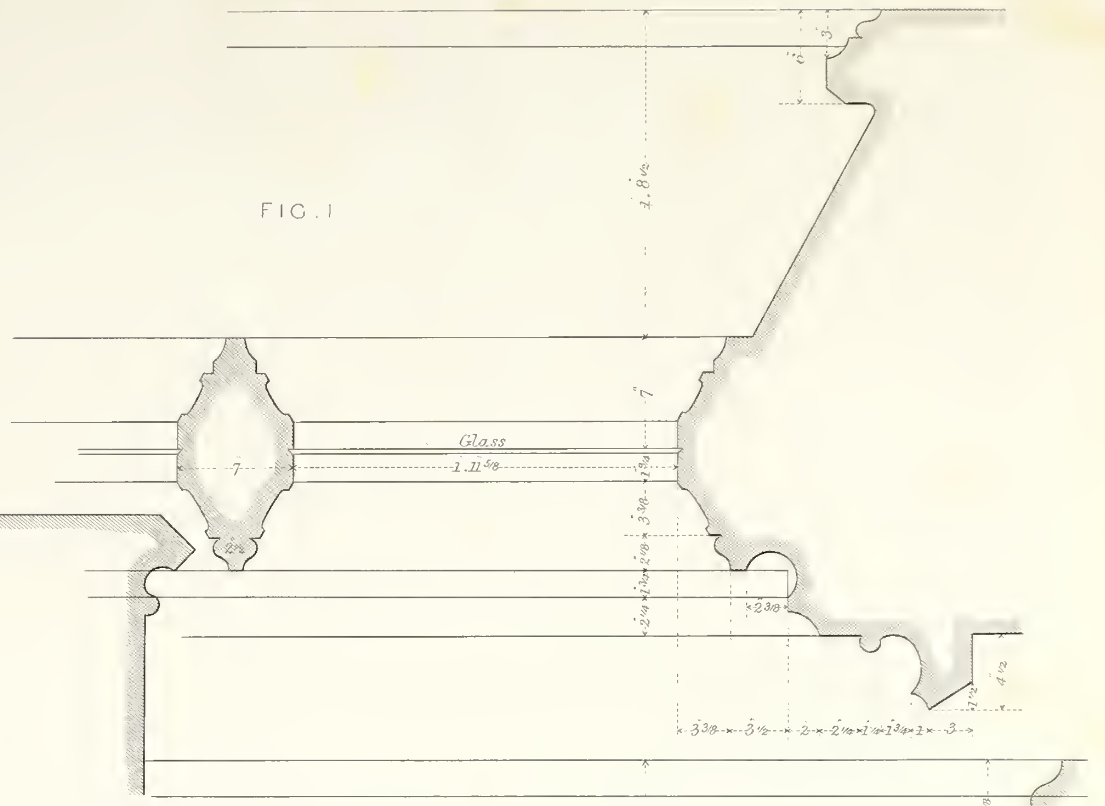
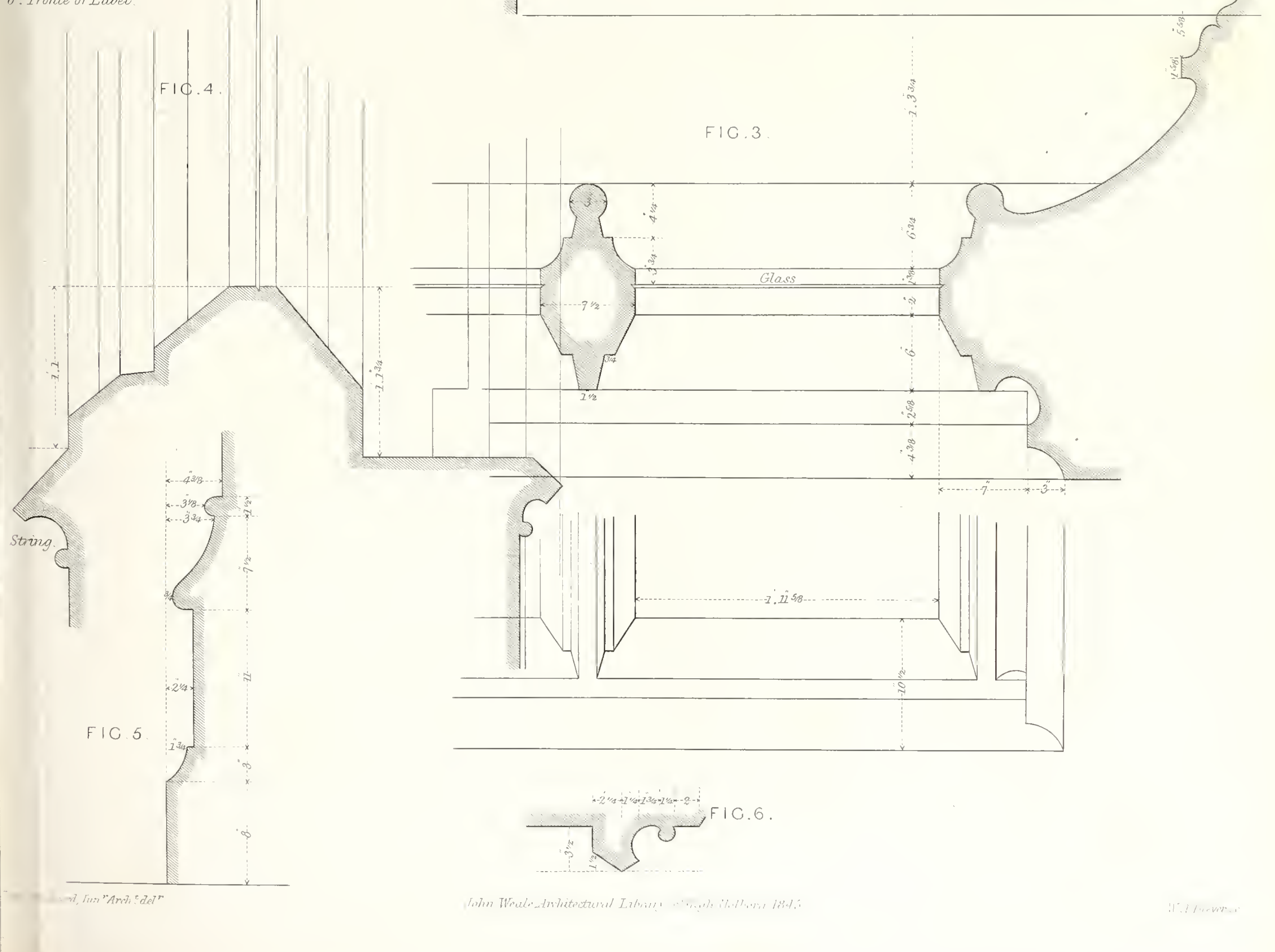


FIG. 1



1. Plan of Mullion, Jaumb & label of Window, marked B on the Elevation.
2. Section thro' Sill.
3. Plan & Elevation of Mullion, Jaumb of Window, marked A. on the Elevation.
4. Section thro' Sill.
5. Profile of Plinth.
6. Profile of Label.

FIG. 4. FIG. 3. FIG. 5. FIG. 6.



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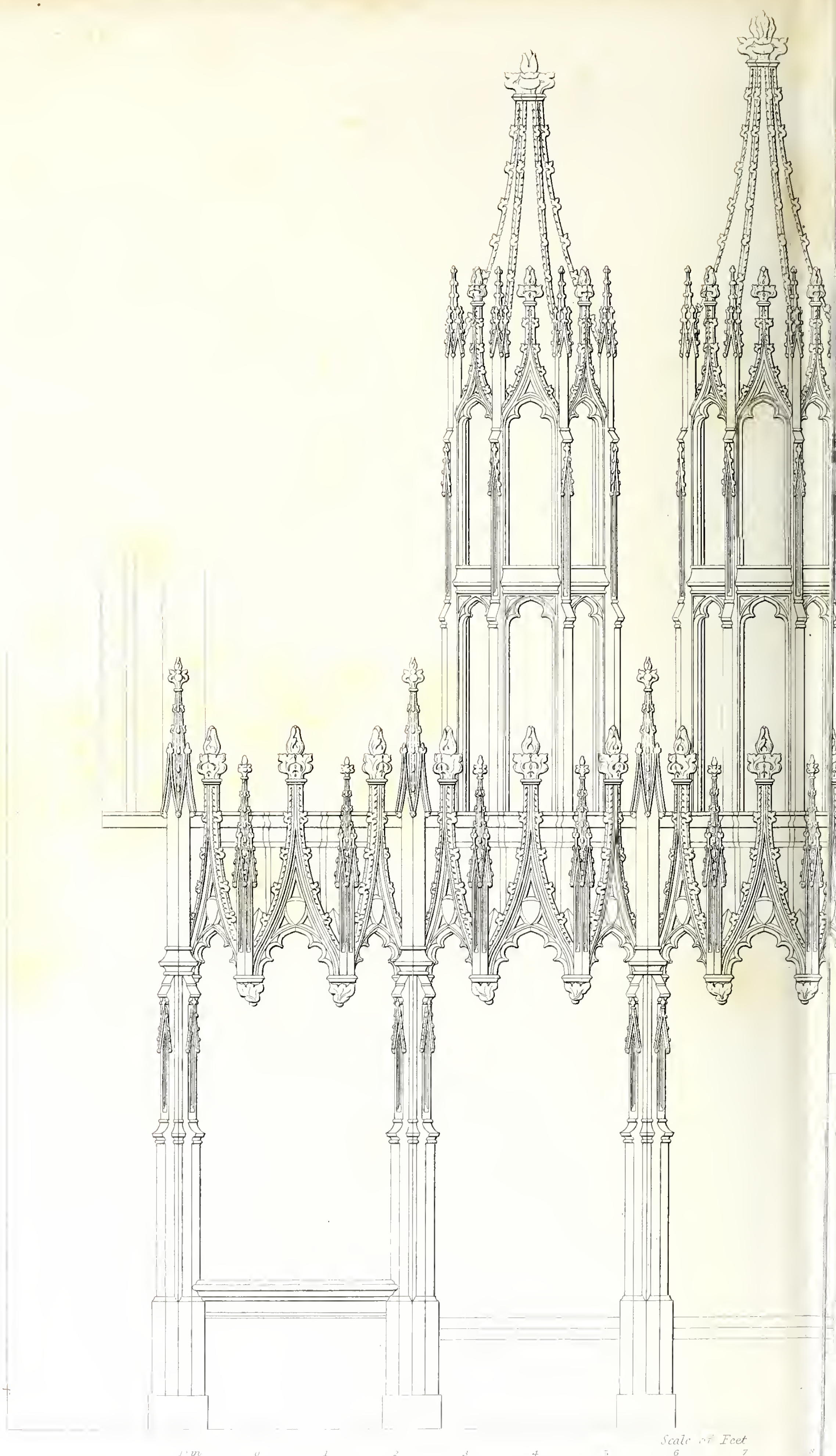

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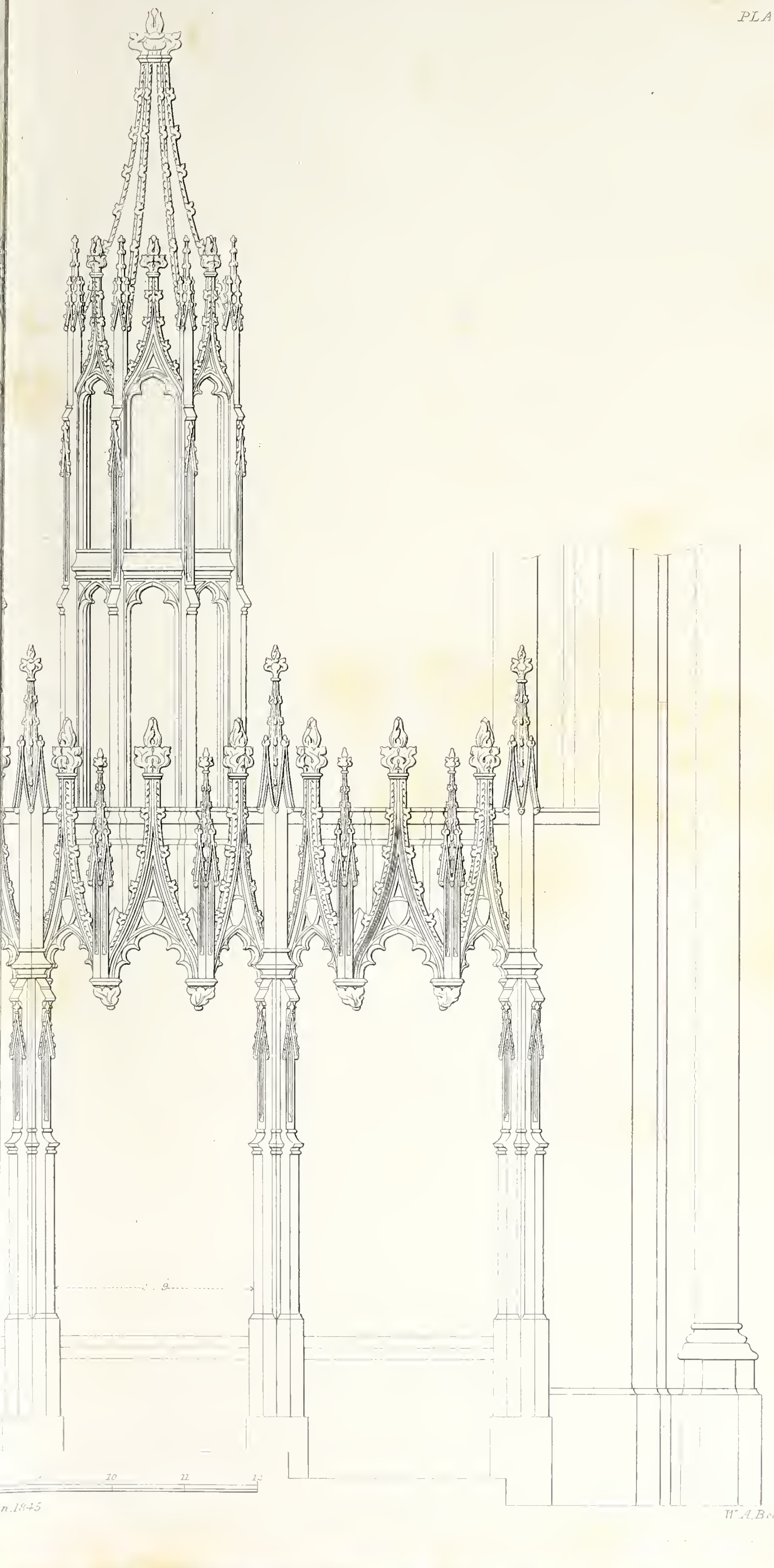

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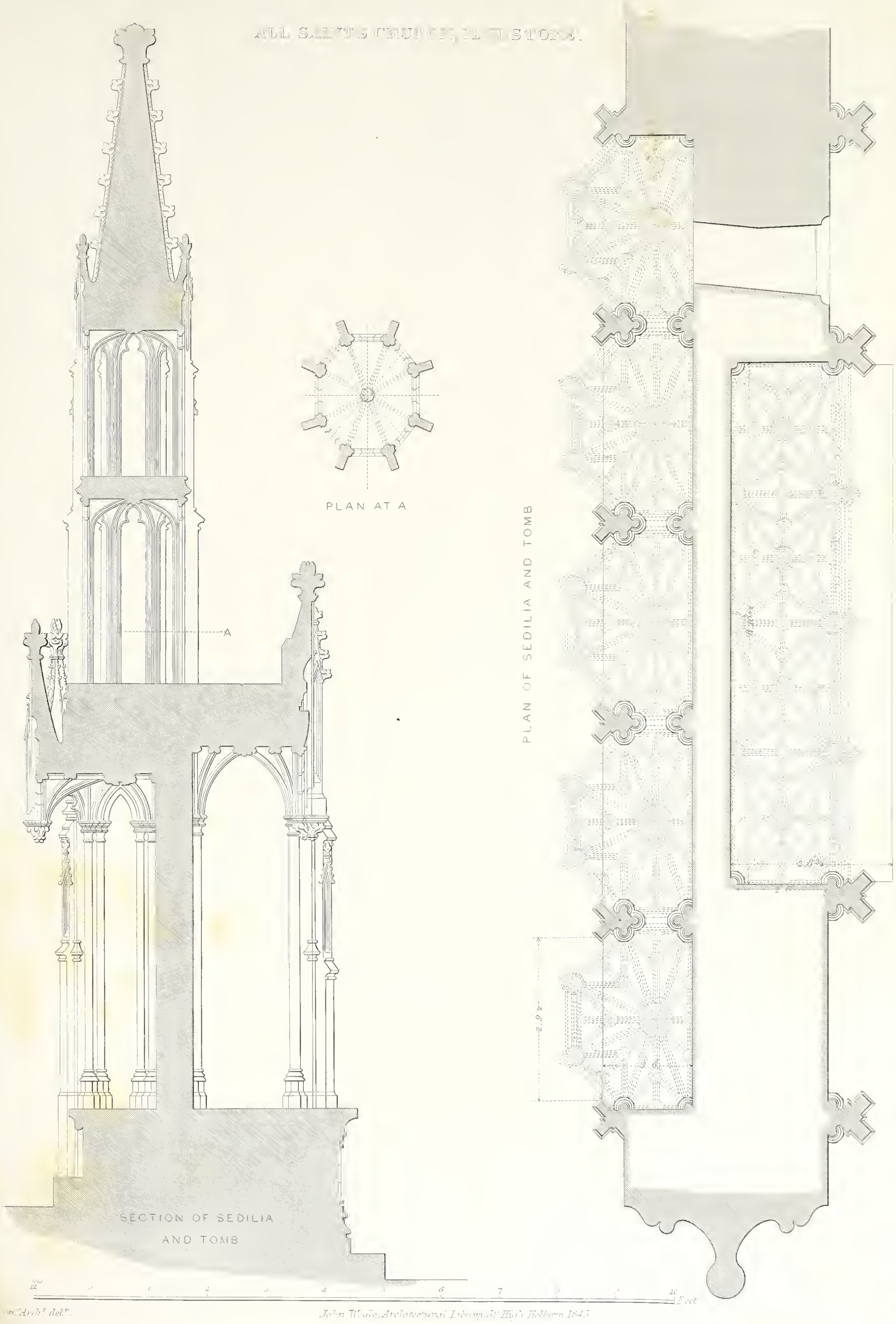
ALL SAINTS CHURCH, IL[illegible]STONE



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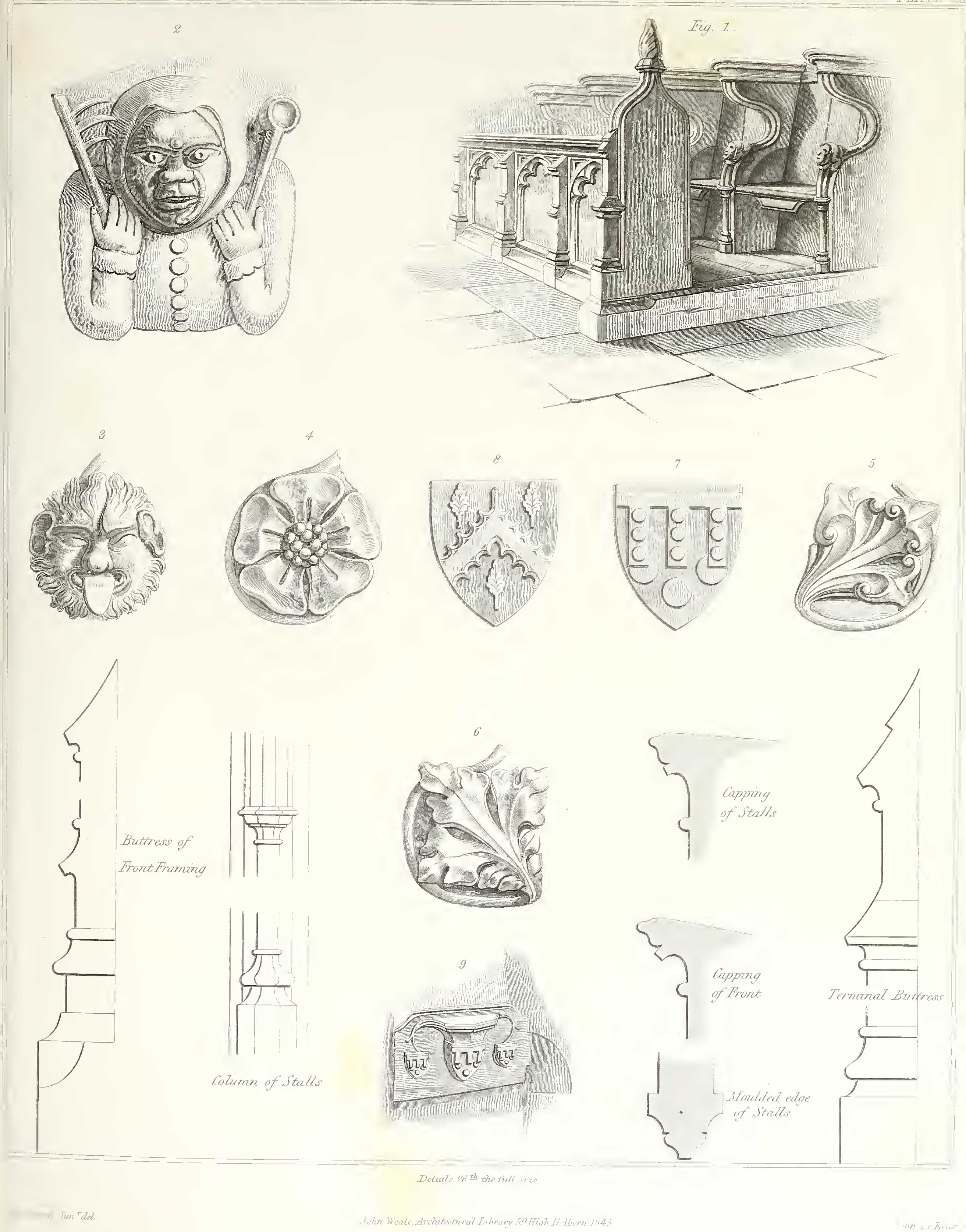

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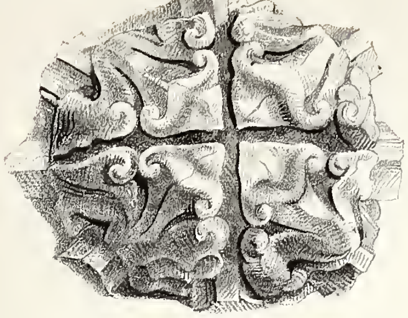

Fig 1.

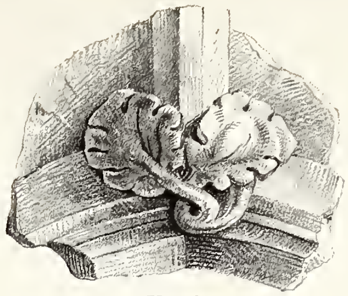

Fig 2.

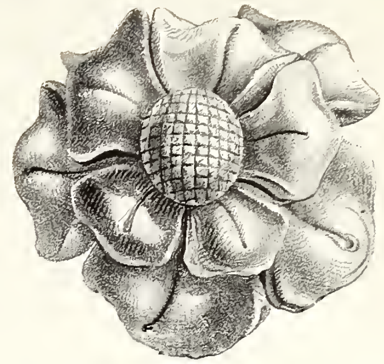

Fig 3.

Fig 4.

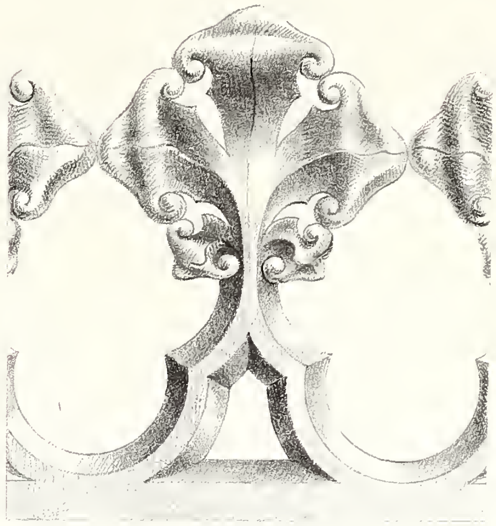

Fig 10

Fig 5.

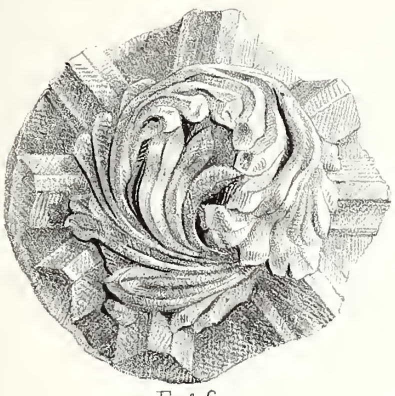

Fig 6.

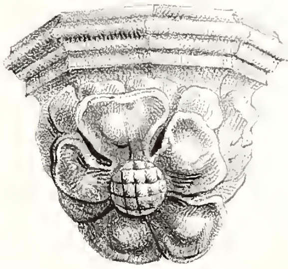

Fig 11

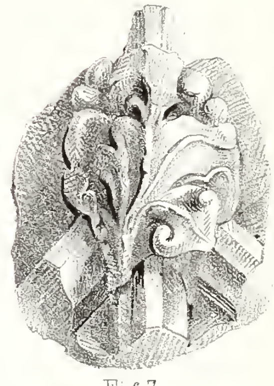

Fig 7.

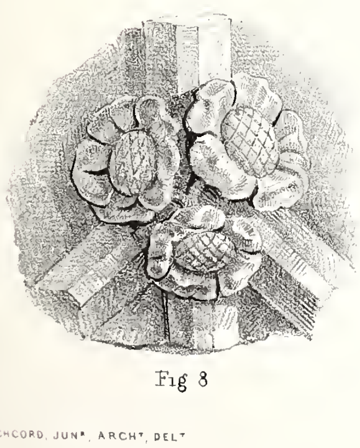

Fig 8

Fig 12.

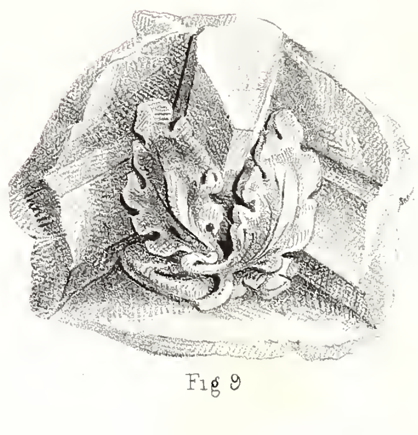

Fig 9

J. WHICHCORD, JUNR. ARCHT. DELT.

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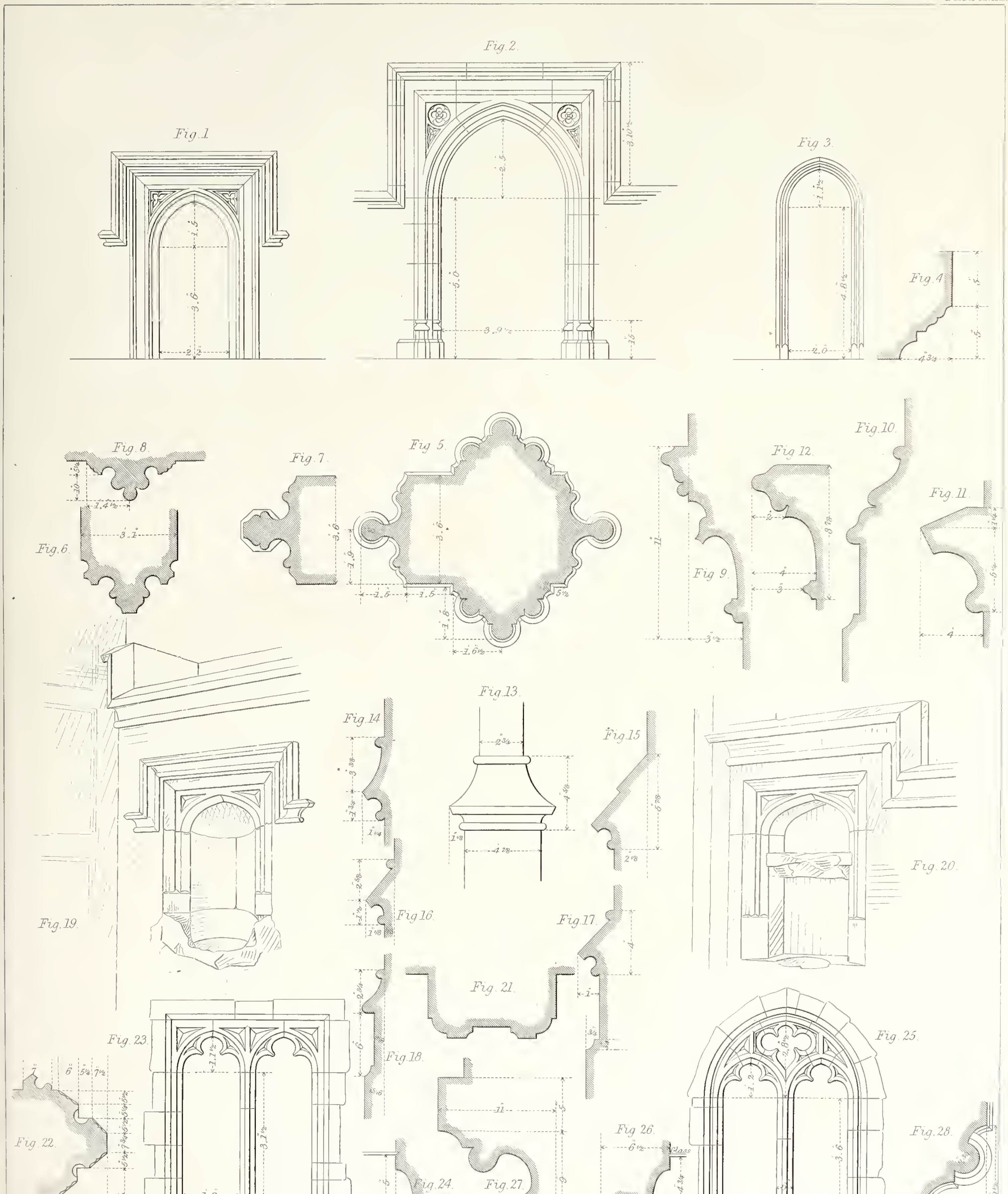
ALL SAINTS CHURCH, MAIDSTONE.

FIGS. 1. TO 9. BOSSES. FIG. 10. STRAWBERRY LEAF ENRICHMENT SURMOUNTING CORNICE OF TOMB

FIGS. 11. & 12. CORBELS



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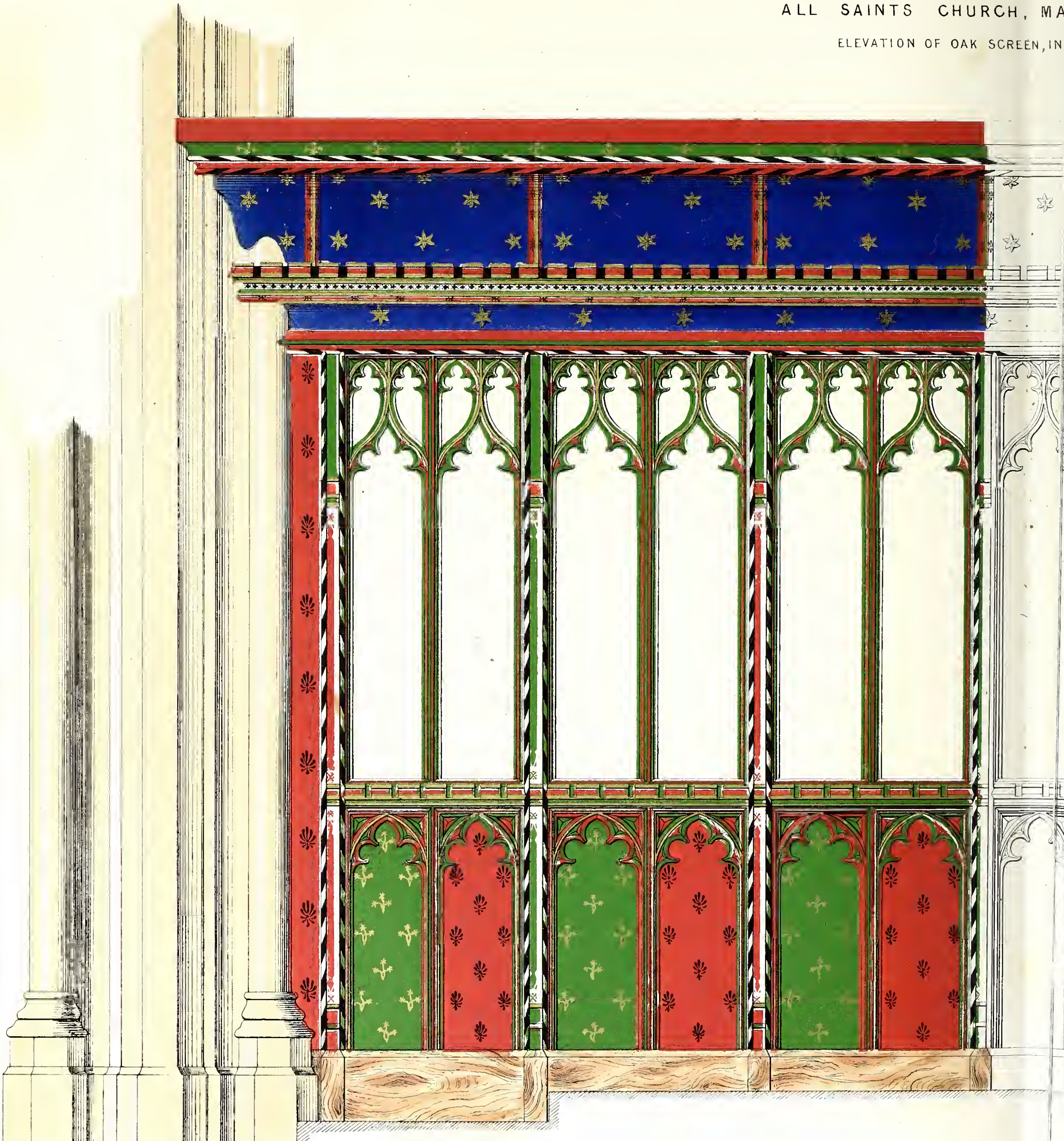
W. A. Beever sc.

John Weale Architectural Library, 59 High Holborn 1845

Plate X.

ALL SAINTS CHURCH, MA

ELEVATION OF OAK SCREEN, IN



SCALE OF 12 6 0 1 2 3 4 5

J. WHICHCORD, JUNR ARCHT DELT

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DSTONE.

HANCEL.

SECTION.

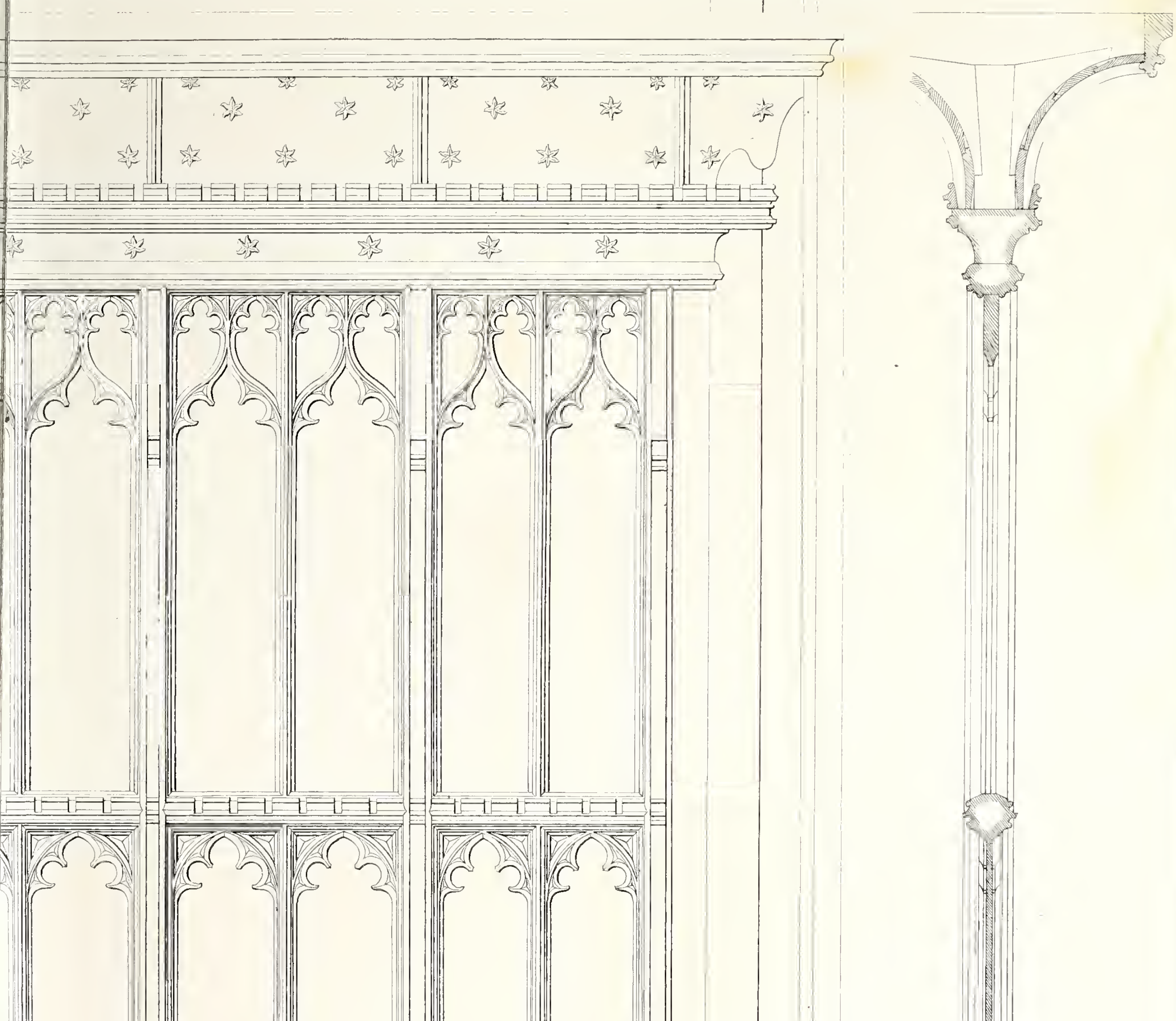

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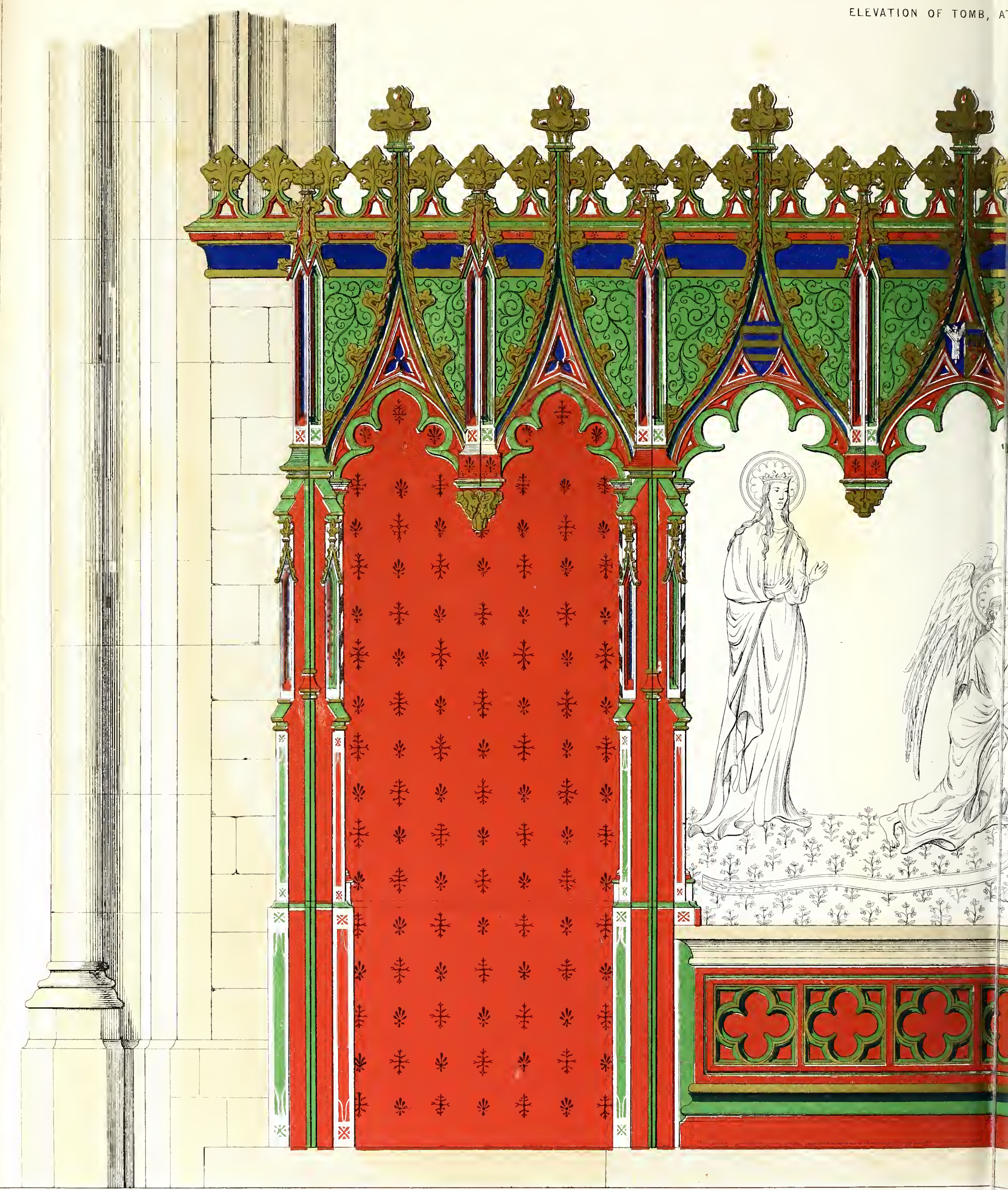
Plate XI

ALL SAINTS CHUR

ELEVATION OF TOMB, A



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H, MAIDSTONE.

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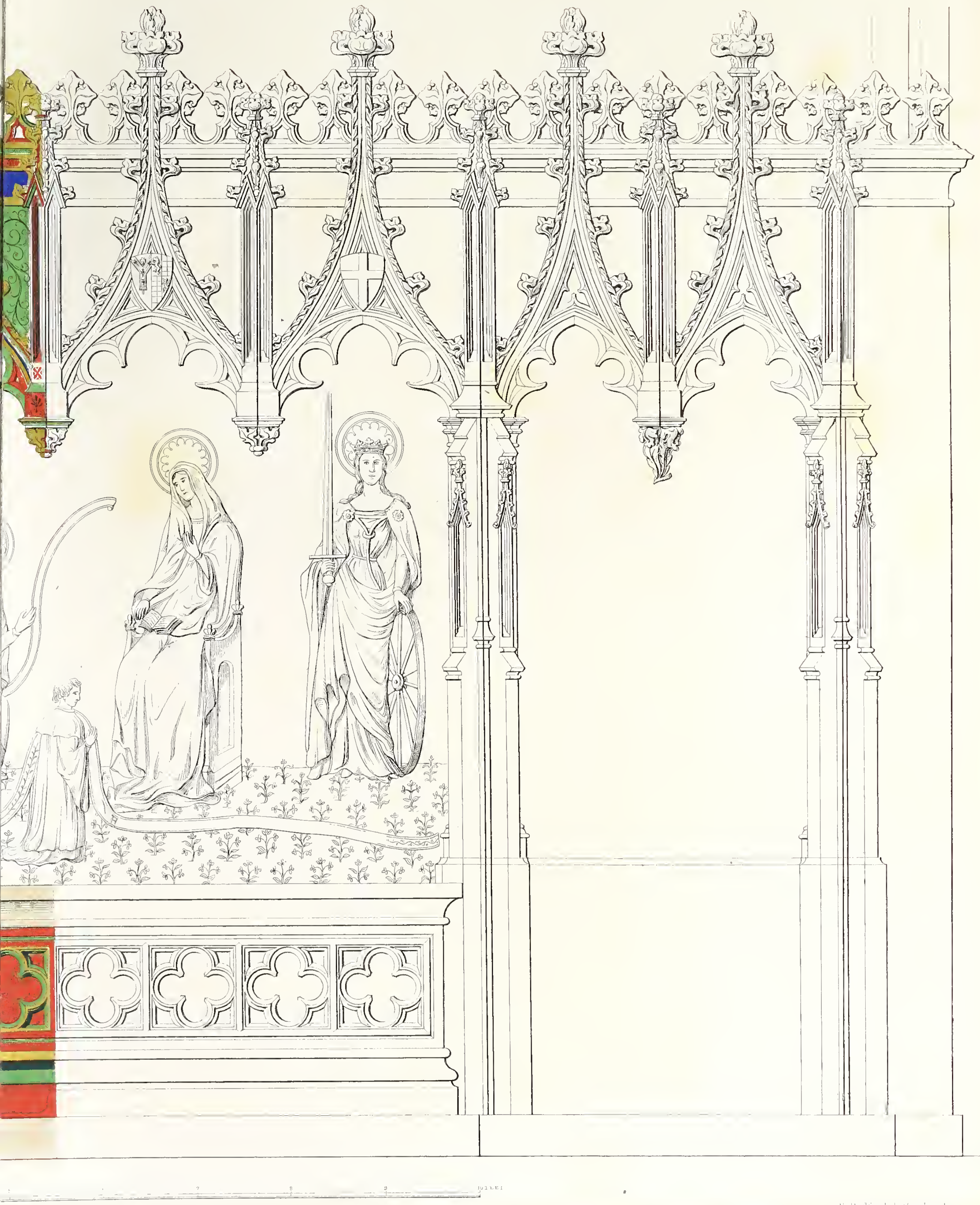

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Plate XII

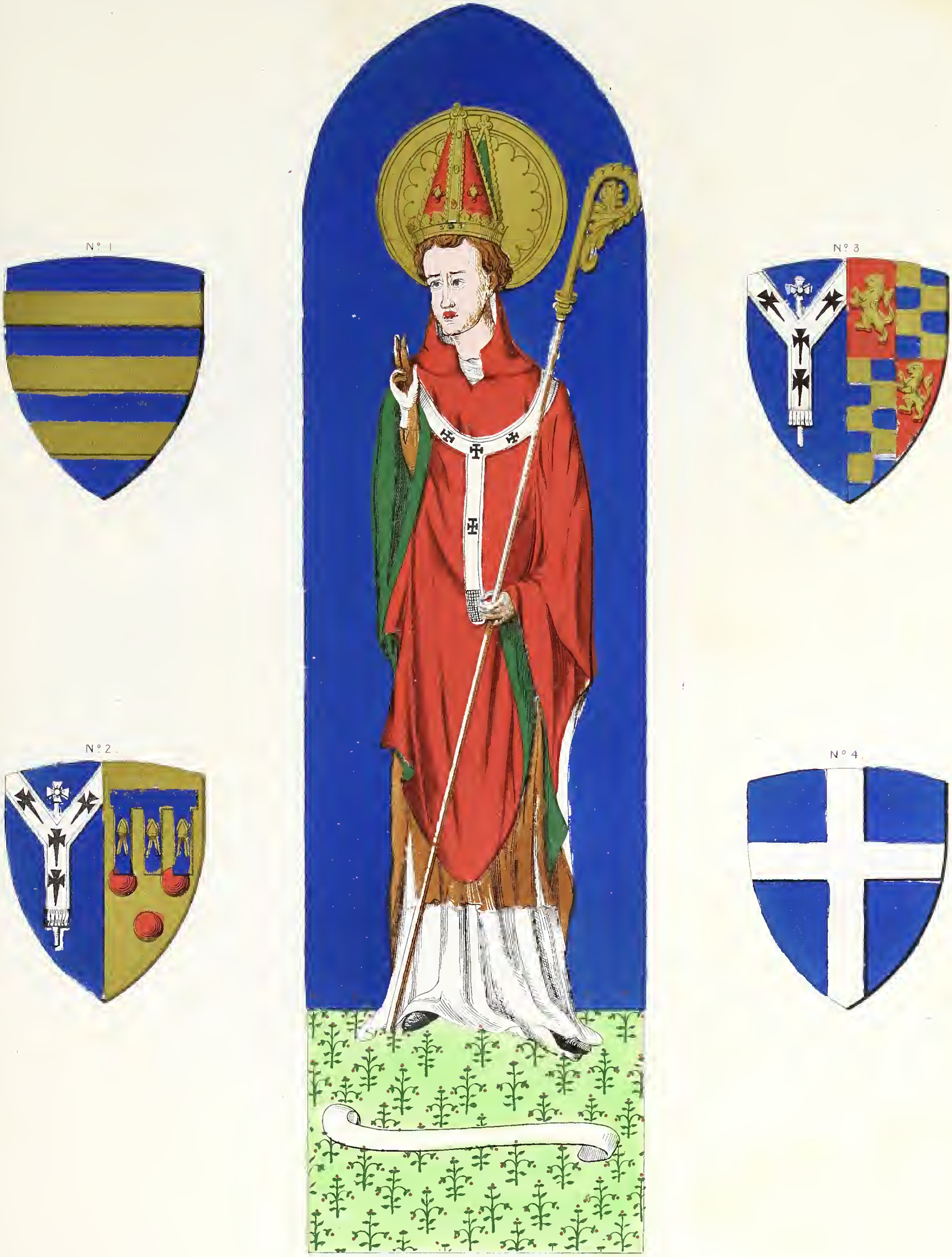
ALL SAINTS CHURCH, MAIDSTONE.

J. WHICHCORD, JUNR ARCHT DELT

PAINTING AT BACK OF RECESS
WOTTON'S TOMB.

Plate XIII

ALL SAINTS CHURCH, MAIDSTONE.



W. [illegible] ORD, JUNR ARCHT DELT

F Bedford, Litho London

PAINTING ON EAST WALL OF RECESS,
WOTTON'S TOMB.

AND FIGS, 1.2.3.4 SHIELDS FROM CANOPIES.

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OBSERVATIONS

ON THE

POLYCHROMATIC DECORATION OF THE MIDDLE AGES.

By JOHN WHICHCORD, Jun., Architect,

ASSOCIATE OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS.

But a few years have elapsed since the theories by which Polychromy was first announced to the world were regarded by the great majority of persons interested in the arts with doubt or apprehension. It was any thing but an agreeable association to the admirers of classic genius, to be told that the exquisite finish of Grecian chiseling was concealed beneath a coat of "villanous ochre," or that the sculptor and architect selected the most costly materials only to daub them with colour, or cover them with stucco; and they resolutely refused to believe that Grecian taste could approve so much coarseness and exaggeration, "or that Ictinus and Callimachus, to say nothing of Phidias or Praxiteles, practised these atrocities."

It was difficult for them to suppose that the same nation which displayed such exquisite skill in architecture and sculpture was guilty of a "barbarous" taste in painting, nor could they reconcile themselves to a custom so foreign to all their preconceived ideas of art.

Yet within these few years so great a change has been wrought in public opinion that suggestions bold in that day seem timid in ours. The advocates of Polychromy have never been led astray by an extravagant imagination; inferences were drawn only from the facts that every succeeding day brought to light; and research, prosecuted simultaneously in different countries and among the monuments of widely varying ages and people, has led to results unanticipated by the first propounders of the new doctrine, and, what is of more object to a practical age, as substantial as they are new.

The architect or antiquary is no longer content with ascertaining the date of a building, and describing it by the combination of its parts, the form of its mouldings, and the character of its plastic decorations ; but in the unnoticed teints that time and change yet permit to remain upon its walls and ornaments, he reads a language long silent and unknown, but now eloquent with beautiful meaning and glorious conceptions :

> " Sit thematis gemina, ac viva expressio juxtà,
> Textum antiquorum, propriis cum tempore formis."

Before the discovery of this practice there was much in " classic " architecture that seemed ineffective or incomprehensible ; very much that when copied in our public edifices only served to disgust the public and blind them to the merits of the style ; yet although we were familiar not only with the existence, but also acknowledged the beauties of Polychromy as applied to the tombs and temples of India and Egypt ; although some such usage seemed connected with the sacred architecture of all nations ; and although with every style that has flourished among any people, Polychromy was born and grew together with it, forming as it were the very soul of the material fabric, yet, with strange perversity, we refused to reason from the analogy, or apply to those forms of architecture that were received among ourselves the same conclusions that were obvious as regards the rest.

It is only now that we can present to the mind all the glories of Grecian art, or realize the picture of an ancient temple, perfect in the simplicity of its conception, grand in the combination of its parts, bold in its continuous lines and unbroken shadows, and harmonious in its brilliant and contrasting colours.

> " Pulchra gradu summo, graphidos stabilita vetustæ,
> Nobilibus signis, sunt grandia dissita pura
> Tersa velut minimè confusa labore ligata
> Partibus ex magnis paucisque efficta, colorum
> Corporibus distincta feris, sed semper amicis."

We acknowledge the very highest grade of art in the Chrysolophantine statues, that ranked among the ancients themselves as the finest productions of the sculptor ; and a consummate judgment in that application of colour, that at once displayed in their sculpture a forcible representation of the actual, and impressed them the more powerfully with the characteristics of the ideal.

In all the arts that minister to society ; in the varied hues that meet us at every turn amid the ruins of Pompeii ; in the brilliant paintings that adorn the walls of each apartment ; in the profusion of ornament that was lavished on the buildings dedicated to pleasure ; in the costly elegance that marked those devoted to the service of religion; in the means of luxury brought within the reach of the humblest; and in the graceful piety that consecrated the choicest offerings to the gods,—we recognise the joyous character of ancient civilization, and the universal and systematic appreciation of art.

It was as though through Polychromy the ancients gave expression to the brighter and more ethereal impulses of the mind; Polychromy was the link connecting the forms of matter with the airy fancies in which classic genius was so rife; it clothed the massive outlines of Egyptian architecture with a life and grace only subordinate to that deep soul of thought that lives in every stone and lurks in every figure: while the eye of the artist is no less delighted with the exquisite management of colour that can unite the heavy masses of its architecture with the burning soil and shadowless sky of that glowing clime. Nor would there be any thing inconsistent in associating similar ideas with our national architecture, adding to the solemnity of our ecclesiastical edifices a winning beauty that should be ever present in the temples of a religion, that allures as much as it commands to the observance of its duties and the participations of its hopes.

Decorative painting has again assumed its place among the fine arts; every new fragment that turns up only adds to the mass of evidence that has convinced those who refused to believe in Grecian Polychromy, and every instance of church restoration proves to those admirers of pointed architecture, who were equally zealous in their detestation of whitewash and love of native stone, that even in the palmy days before the Reformation, walls and stone-work were not only whited or yellow washed, but that the surface of the walls, and even the very shrines and tombs, were diversified with positive and contrasting colours.

Public favour has been gained for Polychromy by that most powerful of all arguments, an appeal to public sympathy; and the practice of it, at first regarded as an experiment, is rapidly spreading as a fashion.

In the preceding paragraphs we have spoken of Polychromy generally, both because in either branch of it there exist the same paucity of written information, and an equal profusion and correspondence of existing illustrations. The principles of Polychromy are recorded only on those works of art it was used to embellish, but throughout all these there is observable a striking analogy.

While every age and country has possessed its own distinctive mode of building, characterized by a spirit embodied under widely differing and incompatible forms, the appliances of colour fall under one law, and the same combinations that impart elegance and harmony to the exquisite contours and open surfaces of Grecian art, are also capable of producing an equally pleasing effect when found in the shadowed projections and intricate shapes of pointed architecture. The art of Polychromy, or practice of painting in positive colours, either on flat surfaces or sculptured forms, has been referred for its origin to other than æsthetic motives; certain existing coincidences in the application of colour, have led to the inference, that teints when applied to sacred subjects acquired a peculiar expression; hence the theory of symbolism of colours. Of the few facts on which this system is based there can be no dispute; but it is very questionable whether any such principles were kept in view in later ages, and under the more perfect forms of the decorative art; and highly improbable that the same symbols could otherwise, than by the most casual accident, be expressive of similar ideas at different times, and under religious systems capable of being referred to no common origin.

The object of Polychromy is to heighten the effect of architectural decorations, either by causing a more just subordination of the various parts than can be obtained by mere chiaro-scuro, or in supplying deficiencies that could not be so well filled up by any other means.

When the details of enrichment are minute or greatly removed from the eye, the use of strongly contrasting colours is necessary to mark the various details and subdivisions which would otherwise be lost; or to connect more elaborate with plainer portions of the same work. It is often also used to attract the eye to the more important portions of a building; and the beautiful effect of the brilliant lines, gilded prominences, and rich surfaces, harmoniously toned with diaper, is known to every admirer of medieval architecture.

It is probable that in the practice of classic antiquity the ornamented colouring on walls and ceilings, and perhaps in general even the detail of the arabesques, was left to the skill and fancy of the workmen. The style of execution in such instances as remain to us, exhibits great facility of production, accompanied by characteristics that distinguished them in a marked manner from the work of an artist. Yet in most cases there exists a certain concordance of parts and unity of effect, that uneducated taste would be unable to attain. Perhaps we should be correct in viewing the various specimens as diversified reproductions of a few types in fashion at the time, with which the workmen would necessarily be familiar, and capable of applying without further assistance than the general direction of the superior artist by whom the higher class of subjects were executed.

The same observations may be understood in a limited sense of Gothic Polychromy. The scientific architects of the middle ages appear to have employed not only the hand but the genius of the craftsman, in the diversified modes of ornament that so peculiarly distinguish Gothic architecture. In the structure, furniture, and enrichments of a great church, we see the aggregate of varying taste and genius. Its decorative paintings, its heraldries, its stained glass, its metal work, and even the different carvings, exhibit, each in its own department, and in some cases almost in every article, the impress of a distinct mind; yet all bent to one harmonious result by the influence of their subject and the fashion of the time.

At the *revival* of the arts, decorative painting, both pictorial, and as consisting in the application of positive colour to objects whose projections and outlines were previously defined by the carver, was found universally subsisting throughout Europe. It does not appear, however, that Polychromy and figure painting were any where cultivated as distinct branches of the art. While Polychromic decorations required for their execution an artisan of superior skill, the general treatment of pictorial representations, the colours employed, the mode of their application, and the very intimate relation found to exist in works of both branches, induce us to believe them to be the work of craftsmen of the same class, and, where found in juxtaposition, of the same hand.

Every degree of merit is found in the works of the middle ages, from the bad copyist of an imperfect school, to the most refined taste in decoration, and intense feeling and truthfulness, if not easy treatment, in pictorial representations.

In point of fact, decorative painting was naturally subject to the same influence of the same external cause that affected art generally, and in the fourteenth and fifteenth centuries had evolved for itself a style essentially distinct both from the classic and revived manner. In Italy the style thus formed not only appears from the first to have had a looser hold, but was earlier abandoned for a style in imitation of the antique; all the productions of that country subsequent to the revival are conceived in a distinct spirit, and executed in a manner rapidly deviating from the practice of Northern Europe; decorative painting in the hands of the Italian school gradually ceased to be Polychromy, and assumed a form subject to all the laws of pictorial composition.

It would be a matter of great difficulty to reduce the practice of Polychromatic decoration to any precise rules: observation, and comparison of remaining examples, will, however, be sufficient for the architect to understand the spirit, and will serve alike as a guide for the restoration of old, or the designing for new works.

In Gothic Polychromy, as in Gothic architecture, notwithstanding the fertility of detail that prevailed, there will be found, during the epoch of any particular style, a vast number of instances in which the ancient architects have imitated themselves; continual repetition of the same idea will frequently be observable in particular districts, or, if differing at all, only in the degree that circumstances or individual taste may have modified the original standard. The skill of the designers was exhibited in the reproduction of certain set forms, and in suiting them to particular localities or requirements, rather than the thirst for novelties which characterize the present day: copies of a few ceilings, strings, shafts, and canopies, with their mouldings and enrichments, and a few examples of diaper, would form an alphabet of Polychromy, which would supply all the knowledge of ancient colour an antiquarian could require.

In churches of almost the earliest date traces of colour may be found, generally applied in a very rude manner, and frequently consisting of nothing more than yellow wash, and red or black bands. This observation holds true of almost all the decorative painting that is supposed to have been executed during the prevalence of the Saxon and Norman styles. Where any pattern has been attempted, it may be immediately recognised by the resemblance it bears to the sculptured enrichments of the period. In the north transept of Winchester Cathedral, there exists a singular relic of early painting. The arches of early Norman date have their massive masonry concealed beneath a coat of plaster, which retains indications of colour. On the side of one of the arches that face eastwards, are a series of radiating lines drawn to represent the arch stones, in a blood-red colour, in each of which are intersecting bands, forming a kind of cross saltire, which bands are dotted with spots of a deeper red. The opposite side of the arch is ornamented with a different design, but of the same colour; and a scroll pattern is also existing running round parallel to the arch. A nearer approach to the manner of a later age, is shown in Bishop Gundulph's work, in the nave of Rochester Cathedral, where the sculptured enrichments that fill the spandril spaces between the double arches of the Triforia, and the large single arch within which they are embraced, are picked out in different colours. In some of these cases the enrichments resemble the flattened tooth ornament, with which the walls of Westminster Abbey are covered. The whole of the Norman work in Rochester Cathedral has been covered with colour. The stones of the shafts and arches were painted alternately red, green, and yellow, the whole face of the stone being filled by the same colour, not distinguishing the mouldings. In the south transept, the date of which is early in the thirteenth century, a similar system has been adopted, where the stones, and not the mouldings, are distinguished. The labels only are treated as distinct features. The tier of windows at the south end have each stone of the labels marked in a contrasting colour to those of the arches. Thus, if an arch stone be green, that portion of the label in contact with it will be red or yellow, and vice versâ. During the former part of what is commonly called the early English period, that is from 1189 to 1216, decorative painting made but little progress; and the extant specimens exhibit a similar mode to that formerly in use. Colours were used in masses, without distinction of detail. A screen of about this date, against the north and south walls of the Lady Chapel, at Winchester, has the centre columns of its tripled shafts painted alternately red and black, the columns on either side of the centre being painted in the contrasting colour. In this case, the colour on the columns extends to the adjacent hollow, without any other relief than a double band of black encircling those columns that are red, at about every foot in height. When painting was only partially introduced, as was the case in simple works, such as churches in rural districts, red was the favourite teint used in the capitals and bases of the columns [a]; and often appearing as a margin to the internal window jamb, if the jamb was without mouldings, of the breadth of two or three inches, sometimes with a narrow black line running beside it on its outer edge [b].

Few traces of colouring of much greater interest will be found prior to the accession of Henry III. The paintings in churches of an early character were often executed at a later period; and this may generally be suspected when the decorations are of an elaborate kind, and when no letters or costumes are represented to determine the precise date: such decorations as we have alluded to, with a few figures on the plaster of the chancel walls, under the east window and on the chancel arch, painted in red or black outline, a few sentences, and a ruder cross or two, are all that the art of the former part of the thirteenth century appears to have been capable of producing.

Henry the Third was an active patron of the arts, and found time amidst all the troubles of his reign to commemorate his taste in works of architecture, sculpture, and painting. The foreign artists whom he employed possessed a juster acquaintance with the principles of art, a more refined taste, and greater practical skill, than can be seen in any previous work of our country. From this date, for several reigns, foreigners were employed in the application of art, and from the encouragement given to the exercise of their talents, a noble emulation seems to have been excited among our native artists; and, together with the history of sculpture, may be traced two separate styles, both essentially distinct in their character, neither imitating the other, and both displaying the very highest qualities of beauty.

The practice of adorning the walls of buildings, hitherto confined principally to sacred edifices, was now employed to the embellishment of rooms and galleries. The following curious orders relating to the art of decoration have been preserved by Mr. Walpole, from the collection of Mr. George Virtue's MSS.

[a] Two foliated capitals, of early English workmanship, supposed to be part of a former church, were recently discovered at West Wickham Church, Kent, built up in a part of the wall erected in the fourteenth century. They were covered entirely with red ochre.

[b] A similar mode of decorating window jambs prevailed to a very late date.

"1228.—Ao. 12 Hen. III. m. f. Rex. thes. et camer. suis salutem, Libertate cuidam pictori 20*s*. ad cameram magni saccarii depingendam.

"1233.—Libertate. Ao. 17 Hen. III. m. b. Mandatum est Vicecomiti Southton: quod cameram regis lambruscatam (wainscoted from the French lambris) de castro Winton: depingi faciat eisdem historiis et picturis quibus fuerat prius depicta. Et custum et computabitur. Teste rege apud Kideministr. iii. die Junii."

These orders clearly demonstrate that pictorial embellishment was in use at this period; in the first one, "cuidam pictor" may be translated as referring to a common house painter, but when we consider that it was not customary to hide the surface of wainscot except with decorative painting, and the amount to be paid for it twenty shillings, (a very large sum at that date,) the inference would be, that it was an order for Polychromatic decoration; but the latter one proves the fact, and a great deal more, not only that pictorial subjects were in use, but of prior antiquity; the directions are that it is to be painted with the same pictures and histories with which it had been adorned before.

In close connexion with historical and imaginative subjects, and forming with them part of the same design, we find a more developed mode of decorative colouring applied both to heighten the effect of sculptured forms, and in the shape of arabesques and diapers, diversifying plain surfaces.

A free and bold style in arabesque prevailed from the time of Henry III., until the close of the reign of Edward III. Bright and lively colours were applied in masses, the grounds covered with compositions of foliage and birds, animals and human figures; sometimes in one teint, sometimes in varied colours. The most beautiful design in use was a pattern of vine leaves, frequently drawn with remarkable freedom and elegance, in which the leaves, the tendrils, and the fruit are represented in red and green teints, with various coloured birds nestling among the leaves; this is found repeated in groinings of this date; beautiful instances exist at Rochester Cathedral, in the groining of the Crypt, and in a piece of wall painting in St. William's chapel in the same Cathedral, and under the canopy of the monument of Aveline, Countess of Lancaster, in the choir of Westminster Abbey. Various figures and devices are found incorporated with foliage, in designs of this description; at some times free and in composition with the foliage; at other times displaying, within coloured medallions, the faces of men and angels, full length figures and emblems. The groined ceiling of Adam de Orlton's chantry in Winchester Cathedral, exhibits on a straw-coloured ground among green foliage, with flowers, green and blue medallions, in which are painted the heads of angels surrounded by a nimbus: the groining ribs have their mouldings marked in various colours, and a running enrichment in a chevron pattern is painted in red and black on the centre moulding; the coloured mouldings of this date are often powdered with rosettes, or similar ornaments in red, black, or gold; and it was not unfrequent to cover with a sculptured diaper even those mouldings that were intended to be painted.

Even at this period, however, when the *tout ensemble* of Gothic edifices was perhaps more gorgeously magnificent than at any other time, the antiquarian will perceive a want of that nicety that distinguishes the work of a succeeding age. To the fifteenth century may be ascribed the perfection of a system of Polychromatic decoration, which, if wanting somewhat in the striking and original character of earlier work, exhibits art acting under the influence of settled laws with greater certainty of effect, a vast improvement in technical skill, and more elaborate variety in the designs [a].

We have as yet no modern restoration that exhibits the full effect of coloured decoration as applied in the fifteenth century. It often happened that throughout the whole interior of a church the materials were no where discernible [b]: the walls were painted over with historical subjects, arabesques, or inscriptions; the ceiling one mass of colour and gilding; the floor paved throughout with encaustic tiles; every window filled with stained glass; the strings, the cornices, with their enrichments; and the capitals of the columns, brought out in red, green, and gold; the very form of the mouldings more clearly marked by their enrichments; and all the teints that were diffused throughout the building concentrated in greater intensity and delicacy on the screens and monuments, only to be surpassed in gorgeousness by the precious ornaments of the altar, rich in drapery, gold, and jewels.

At no time, however, does it appear to have been considered *indispensable* that the whole, or any *particular* part, of a building should be coloured; in fact, as we have before observed, the symbolism of colours, if ever acknowledged, had been forgotten, and the use of decoration in a building was regulated by no other law than the simple canons of taste, the caprice of the artist, or the munificence of a founder; a striking instance of this may be observed in Maidstone church, where the canopied sedilia on the south side of the chancel have never received any other painted decoration than the shields on front of each canopy, although the adjacent walls were

[a] The difference in the modes of painting that prevailed during the decorated and perpendicular periods, shews itself particularly in the forms of the diapers, which, at the later date, are more set, with a frequent use of geometrical patterns and greater minuteness in the colouring.

[b] In Rochester Cathedral, even so far back as in the work of the thirteenth century, the Petworth marble columns have been entirely hid with colour.

covered with diaper, and the oak screen on the opposite side exhibited the most glowing teints[a].

A very curious document is referred to in the Minutes of the Royal Antiquarian Society, under the year 1736:—

"Memorandum.—That Master Cummings hath delivered, the fourth day of July, in the year of our Lord 1470, to Mr. Nicholas Bettes, Vicar of Ratcliffe, Moses Couteryn, Philip Bartholomew, and John Brown, procurators of Ratcliffe beforesaid, a new sepulchre, well gilt, and cover thereto; an image of God Almighty rysing out of the same sepulchre, with all the ordinance that longeth thereto; that is to say:

"A lath made of timber, and ironwork thereto.

"Item. Thereto longeth *Heven*, made of timber and stained cloth.

"Item. *Hell*, made of timber and iron work, with devils, the number thirteen.

"Item. Four knights armed, keeping the sepulchre with their weapons in their hands, that is to say, two spears, two axes, two paves, (a large buckler,) and well painted.

"Item. The Fadre, the crown and visage, the bell with a cross upon it, well gilt with fine gold.

"Item. Four pair of angels' wings, for four angels, made of timber and well painted.

"Item. The Holy Ghost coming out of *Heven* into the sepulchre.

"Item. Longeth to the angels, four chevelers (perukes)."

Two methods of enrichment appear to have been used; in one of which colour was sparingly applied, the fair stone of the groinings, wrought in many an intricate pattern, or the mellow teint of the oak-boarded ceilings, is merely heightened in effect, by gilded bosses on a vermilion ground, the various mouldings picked out in colour, and the walls adorned with monograms, or black and red letter sentences; but in the more common practice of the day, it was usual, where decorative painting was introduced, to cover completely with colour, and to the total concealment of the material, those portions of a building that were thus adorned. When the roofs were of wood their ribs were usually picked out in various colours, plain or relieved, and in early work the same member was often painted in alternate colours, the corbels on which they rested were sometimes, if moulded, decorated as the ribs themselves; if carved in foliage, they were gilded; and if in forms of animal life, bearing shields, they were illuminated in various colours, and the escutcheon charged with the heraldic

[a] Not even the *whole* of a *monument* was always coloured. No portion of the architecture of Prior Rahere's tomb, in St. Bartholomew's Church, Smithfield, retains any traces of colour, though the recumbent effigy of the first Prior, with the kneeling figures, are represented in the usual habits of the order.

devices of the founders. The bosses at the intersection of the ribs, when they are not charged with arms, gilded, and commonly on a red ground. The panels of the ceiling were generally blue, variegated with gilt estoiles, or sometimes having one large radiating star painted therein filling the whole compartment[a]. In late work the boarding is sometimes without ribs, painted in imitation of clouds; in the case of groined ceilings the ribs and bosses follow the same rule, but the spandrils are frequently diapered.

Wall surfaces were generally of a blue or red teint; blue when forming a ground for pictorial compositions, and more commonly red, when unbroken; large surfaces of any colour were invariably diapered, and generally in a deeper shade of the same colour, but the diapering is sometimes omitted when figures are introduced[b]; all enriched work was painted in contrasting colours, the surfaces red or green[c], with blue introduced for relief in hollows, where the object sought was to give depth. Small column shafts or beads were often painted in a spiral curve, or barber's pole fashion, white and black, white and red, red and black, or red and blue; small fillets were often white, and all bosses, crockets, finials, and prominent edges, gilt; and the whole powdered over with star like flowers or sprigs, gold or black if on a red ground, and generally gold over all other colours[d]; the octagonal bases of shafts often had their alternate faces painted of different colours, and the various cap and base mouldings picked out and gilded. Strings usually had their plain surfaces and hollows red or green, the bead often gilt, but the concave parts of cornices, when enriched, were often blue[e]; the favourite arrangement seems to have been red, green,

[a] The soffit of the canopy over Richard II.'s tomb, in the Confessor's chapel in Westminster Abbey, exhibits a gold ground diapered with quatrefoils, &c., each compartment charged with a pictorial subject. In that at the east end were depicted two angels, supporting a shield bearing the arms of Richard II. and his wife, Anne of Bohemia. The two succeeding compartments are embellished with scriptural representations, and the fourth is similar to the first. All the figures, though now much faded, have been painted in bright colours; the ribs between the several compartments are red and gold, and diapered.

[b] So attached were the middle age artists to the use of diaper, that even works in metal, especially effigies, are engraved all over in similar forms to those used on coloured surfaces. Nothing exhibits their abhorrence of unbroken teints more forcibly than the minute delicacy of their works in mosaic and enamel.

[c] Upon the monuments on the north side of the choir of Westminster Abbey a sort of bistre colour is made use of, as a counterchange for red, in the panels round the tomb, in the cornices, and in the series of quatrefoils for the display of arms on Valence and Crouchback's monuments. On Lord Bourchiere's monument, beneath the screen of St. Paul's chapel, green appears in corresponding situations.

[d] On King Sebert's monument the faces of the pyramidal canopies are more plainly coloured, and the faces of the intervening pinnacles have their pilaster faces gilt, relieved by green in the panels.

[e] The very fine effect produced by the use of very few colours may be judged by the screen in Edward the Confessor's chapel. The faces here have a red ground, the soffits blue; and over these universal teints the gilded lace-work of the tracery must have shewn to great advantage.

and gold; but when the series of mouldings, requiring to be distinguished by alternate colours, were deep, it was often customary to give greater variety, by using different shades of the same colours, and which were often placed adjacent to each other. The same means was resorted to, when the very limited number of positive colours, occasionally in the intricacy of Gothic tracery, brought the faces of two members having the same colour into contact with each other.

Diapers were of several kinds; that most commonly met with extends itself over large surfaces in a running pattern, often executed in a deeper shade of the ground colour[a]; a second form, perhaps better understood by the word powdering, scatters over the ground a profusion of small sprigs or flowers, generally black or gold; the diaper of a wall sometimes consists of nothing more than the founder's initials, the monogram I. H. C., or like devices[b], in red, geometrically arranged upon an uncoloured ground, that is, a ground which has no other colour than the prevailing teint of the building[c].

The plain faces of buttresses and pinnacles, and small running bands, are often ornamented with a pattern in two colours; sometimes simple and extending itself over the whole surface, or, if that be very much prolonged, repeated throughout its length. The prevailing teint for this ornament is white and black, or white with the prevailing ground. It seems to have been the aim of the Gothic artists to avoid as much as possible creating spaces of a single colour; for the smallest mouldings are generally powdered with red, black, or gold sprigs.

The use of diaper is to supply the place of middle teints, the introduction of which destroys the brilliancy and interferes with the keeping of Polychromatic painting. A mass of colour, of whatever weight or prominence, may be enriched, and at the same time toned to almost any limit, by a judicious use of diaper.

A great deal of the beauty and freshness of the ancient mode of painting is referable to the pigments that they made use of, and the way in which they were mixed and applied. The colours used in Polychromy were few and simple, but of a

[a] There is a variety of this kind of diaper that may perhaps, with more propriety, be termed arabesque. Such is shewn in the groined canopy over the tomb of Aveline, Countess of Lancaster: here we see an entwining pattern of vine leaves and fruit; the fruit and sprigs red, and the leaves green. The ground shews a straw colour, perhaps originally gilded.

[b] The forms of diapered enrichment are as varied as the fancy of the artist, and not always beautiful. Greater variety than can be found on architectural members are met with in many of the painted effigies, and of great beauty.

[c] A carved diaper, generally of pateræ, was sometimes used to decorate an unpainted wall. This prevails with beautiful effect at Westminster Abbey. A similar object was answered by the wall paneling of Henry VII.'s time, which will seldom be found painted.

substantial and permanent character: the ochres, red lead and vermilion, azure or cobalt, two or three shades of green, (all variously prepared from verdigrise,) with black and white, comprises nearly the whole of their chromatic scale.

In pictorial compositions a wider range was allowed, and compound and neutral teints will frequently be met with.

As far as can be ascertained, very similar menstrua were used to liquefy the pigments employed, both in the classic and middle ages. Painting on plaster was practised at both periods; but it is exceedingly doubtful whether fresco[a], properly so called, was used to any extent in Europe prior to its recorded introduction in Italy.

Wax, with the volatile oils, and resin, appear to have been the general media; and perhaps the paintings executed in wax may so far be called encaustic, as that term applies to bringing out the wax by means of heat after the painting is done[b]. A very considerable portion of the remains of medieval colouring appear to have been executed with turpentine and resin, more particularly those that exhibit, after the lapse of ages, much of their ancient brilliancy, and adhere with tolerable tenacity to the surface painted on. Wax dissolved in gum water may also have been employed, as gum was much used for a similar purpose[c] in the middle ages. Ancient paintings executed with honey and wax possess a high degree of durability; and this method was much in favour among the Grecian artists; but its use in the middle ages is only conjectural.

Many discussions have taken place as to the date of the use of oil in wall painting, many people contending that it was not known until introduced in the fifteenth century by John ab Eyck; but it is evident that this opinion is incorrect, and that it was known as early as 1239, as the order below testifies. But it does not appear to have been generally used until the fifteenth century: it might have been considered an experiment, which the medieval artists were cautious of trying, knowing by experience the completeness of their old system. The order is dated in the 23rd of Henry III.

"Rex thesaurio et camerariis suis salutem. Libertate de thesauro nostro odoni aurifabro et Edwardo filio suo, centum et septemdecem solidos, et decem denarios pro *oleo*, vernici, et coloribus emptis, et picturis factis in camerâ reginæ nostræ apud

[a] Fresco is the art of painting in size colour, upon a fresh plaster ground. The name is derived from the Italians, who call it dipengere in frescó, in contradistinction to the dipengere in secco "Merrimée."

[b] In the south aisle of the choir at Westminster, the walls of the recess known as King Sebert's monument appear to have been painted in wax.

[c] Illuminating MSS.

Westm. ab octavis Sanctæ Trinitatis anno regni nostri xxiii. usque ad festum sancti Barnabæ apostoli eodem anno scilicet per xv. dies."

In the fifteenth century, however, oil seems to have predominated[a], and about this time came into general estimation among artists. Although scarcely capable of the same fixity of teints as the older compositions, oil has been found to possess many qualities that render it superior in handling, combining more readily with the various pigments and flowing freely. The modes of preparing oil for colouring, however, appear to have been different to those now in use: few ancient specimens will be found that have received more than a single coat of paint; whereas, on the modern system, the work must be painted over several times before an even surface or an equal intensity of teint can be produced. These repeated coats are destructive of all nicety and finish.

When any extent of wall surface was proposed to be painted, it was usual to cover the stone work with a thin coat of plaster or whiting, for the purpose of concealing the joints and affording a better ground[b]. The ground thus gained was, in works of importance, very carefully prepared with size, of thin glue or of gum-arabic dissolved in water, with the addition of a little dry white lead or sheep-skin size, to prevent the too great absorption of colour[c]. For gilding, sizes similar to those now or lately in use were adopted, and laid as a second coat over the previous ground. The gilding of middle-age works will generally be found to have been performed in a superior manner, and to have stood well.

In appearance these paintings most nearly resemble flatted work varnished: the colours have in general more force than is usually attained by modern oil—glossy, yet free from glaze, and possessing considerable body. They are not absorbed by wood

[a] There are instances of the use of oil in the *late* part of the fourteenth century; and most of the monuments in the choir of Westminster Abbey are painted entirely in oil. In those cases, however, where it is possible to ascertain the original teints, they appear inferior in brilliancy, and certainly in surface, to the other work of the same date. Oil also was used for the pictorial decoration of St. Stephen's Chapel, Westminster, of which we read that Hugh de St. Albans and John Cotton were employed as principal painters, on wages of one shilling per day. (See Britton's Architectural Antiquities.)

[b] No variation appears to have been made in this practice, even when oil was intended to be used. The oil paintings on what is termed King Sebert's monument, in Westminster Abbey, may be mentioned as executed on a thin coat of plaster, although both the assigned antiquity of these subjects and the probability of their being the production of a native artist may be doubted.

[c] Merimée gives various recipes, of a more modern date, for the preparing of grounds for wall painting. He appears to recommend saturating the cement that forms the ceruse with drying oil and wax (in preference to boiled oil).

or stone, nor do they adhere very tenaciously. Though easily separable from the ground, they are not liable to crack.

Distemper paintings are very common, and do not differ materially from the appearance of such work in the present day. In buildings of small importance, simple earths dissolved in water were often the only colouring media applied, and continued to be used in our village churches down to a very recent date[a].

It will be observed, in the course of these investigations, that decorative painting is in no case applied with the object of concealing inferior materials or workmanship: the most elaborate care has been bestowed on the details which are painted, perhaps to a greater degree than in other parts of the same building which may not be ornamented with colour. The materials are oak and the finest stone, such as we should expect to find in the richest part of an important building. Yet, in modern structures, it seems by no means incumbent on us, in such cases, to make use of the costly materials our ancestors employed: without departing from the spirit of antiquity, the architect may adopt, for works intended to be painted, any substantial material capable of being readily wrought or moulded. We ought to bear in mind that the colouring of ancient carved work was very frequently an afterthought, and sometimes distinctly of a later date than the work itself; and, in addition to this explanation, we may take into consideration the circumstance that our predecessors, in the selection of their materials, chose such as were familiar to them, leaving us a hint to do the same by such as are commonly employed among ourselves, and reserve the more costly kinds to situations that display their peculiar qualities.

An examination of the colouring of ancient edifices will lead to the following conclusions:—

1st. That differences exist in point of style and materials in the works of distinct periods.

2ndly. That these distinctions exhibit themselves in a marked manner, at periods corresponding to our usually received architectural chronology.

3rdly. That the decorative art attained its greatest perfection subsequently to the middle of the fifteenth century, following in its development the advances of architectural taste.

[a] The only recipe for this description of painting I have been able to find is the following:—"Quia autem metuebant ne muri scissurus diffinderentur, hinc eosdem linteo, prius glutine mediante, induxerunt, desuperque, applicito gypso, postmodo demum picturas suas effigurarunt, qui modus dici solet, alla tempera, id est temperaturæ aquariæ. Hanc autem temperaturam ita preparabant effracto prius ovo gallinaceo, in ejusdem liquore frondem teneram ficulneam de ficu juniore discutiebant: ubi è lacte istius frondis, equè vitello illa nascebatur temperatura: qua mediante postmodum loco aquæ vel gummi, vel tragacanthæ, colores suos subigebant, quibus dehinc opera sua perficerent." (Sandrart, Academ. Pictur., p. 15, A.D. 1648.)

MODERN ENGLISH GOTHIC ARCHITECTURE.

(CONTINUED.)

By GEORGE WIGHTWICK, Architect.

We little imagined, while we were writing our late article on "Modern English Gothic Architecture," in opposition to the proclaimed views of the Camden Society, that the continued existence of that body was, in the least degree, threatened, either by hostile decisions without, or civil dissensions within. It would appear, however, that at least a *change* in its spirit and operations is to take place; so that if it survive its present attack, it will be to regenerate itself under principles more accordant with some particular motive either of Antiquarianism or Art. To the one or the other of these distinct purposes it should unquestionably address its future efforts; or, if it undertake the active promotion of both, it should be by the co-operation of the Antiquarian, with his industrious research on the one hand, and of the Artist, with his inventive ingenuity on the other. The former is necessarily unimaginative. He has to do with old forms and old feelings, and habitually shrinks from the contemplation of those ever existing principles which, although the same, promote change with the change of time. The latter is as necessarily creative. He has to do with modern forms and modern feelings, and to produce fresh combinations under the guidance of those unchanged, but change prompting, principles to which we have just alluded. If, however, the Society is to be any thing besides antiquarian, it should change its name; for we are not aware that Camden ever considered the subject of architecture in any other light than as an historical language which spoke of the condition of his country in preceding ages.

In allusion to the probable character of the future Society, which we apprehend will arise on the foundation of the present falling one, we would venture a few suggestions which we trust will be accepted in a favourable spirit by those, at least, who having been, or still continuing, attached to it, have yet lamented the injudicious conduct of certain of its members. We desire, then, to see it securely based on such catholic principles of art as may make it *nationally academical;* and that, to this end, it will make use of all retrospective operation, only as the means of prospective improvement. We would wish it to emulate the taste and skill with which Sir Christopher Wren met the requirements of his own day, by perfectly adapting to them the materials of preceding times. As he applied to the then erecting churches the revived style of Heathen Italy, so would we apply to our future churches the revived Gothic styles of Christian Europe. What St. Stephen's, Walbrook, is to the Pantheon, such, we conceive, should be the new Protestant Church to the Abbey of Westminster. We will suppose a case:—

Given:—The regulations enforced by "her Majesty's Church Building Commissioners," and those of the "Incorporated Church Building Society," and the Norman style of design.

Required:—A church not to exceed a certain outlay, and to contain a certain amount of accommodation. This might be replied to, either by architects competing, or by any particular architect, who, from circumstances, might at once be engaged. In the event of competition, the Society would decide on the selection of some one of the plans; that selection being governed, not less by the strict adherence of the design, to the conditions of the invitation, than by its superior merits as a work of art and construction. Of course, any subsequent material alteration of the chosen design, would involve an injustice to the other competitors, who, being permitted to remodel, might produce an ultimate result superior to that of the selected, but corrected design. On the other hand, the appointment of a particular architect would authorize such a continued interchange of suggestion and modification as might produce a result which would be especially creditable both to the fame of the architect and the influence of his co-operators.

Again,—as it regards the published Transactions of such a society:—

Infinite good might be effected by a careful systemization of the leading and characteristic details and general forms of the various Gothic styles, from the Norman to the Tudor periods: forming, as it were, a series of GOTHIC ORDERS, not so much imperative and fixed, as suggestive and controlling. Thus, an entire external and internal *compartment* of each variety of nave or choir might be given: a gable end, including all the principal details of its period; and a tower or spire respectively conforming with its corresponding compartment and gable. These, of course, would include each suitable variety of buttress, pinnacle, window, door, vault, porch, &c.

What Sir Wm. Chambers accomplished, in giving us a grammar of Greco-Roman Architecture, might be afforded by the Cambridge Society in respect to the required modern Anglo-Gothic. There is much less occasion for any addition to our published stores of Gothic material, than for their systematic arrangement in a regularly combined and consecutive form. The present extremely mixed and miscellaneous character of our Gothic Museum as a whole, renders it not less perplexing than instructive to the student, though we are by no means insensible to the merits of Britton's "Chronological History," and Parker's "Glossaries" and "Companion." The chronological arrangement is, however, in our estimation, far preferable to the alphabetical; and we think it now time to set forth a magazine of model examples, *imitated* from the old specimens, rather than literally *copied.* There is scarcely any particular ancient example (speaking with reference to its entire combination, and not in allusion to its details) which may not be much improved by some omission, addition, or altered proportion; such modification being warranted—not by our own unaided opinion, but by precedent the most authoritative. Thus, in some of our most celebrated Norman towers and façades, we see the arched ranges carried quite to the angles of the masonry, as in the towers of Exeter, and the front of Wells cathedrals. In others, as in the towers of Winchester, and the front of Castle Rising Church, we observe the much better effect of leaving the angular abutments plain. The little tower of Than Church, in Normandy, is almost beyond improvement; but the body of that building requires to be associated with the tower by corresponding character and beauty. The tower of Iffley Church, in Oxfordshire, is (as far as the original part goes) a genuine piece of Norman design; but the west front, though containing details of exquisite beauty, requires an alteration in the position of its windows, and greater harmony with the tower. It would be a good movement on the part of such a society as we are contemplating, to offer slight premiums or complimentary medals for the best modification of certain ancient examples, (as the church of Iffley, for instance,) stating any particular features which were to be retained in all their integrity. Take the nave of Durham, and the tower and transepts of Winchester, and compose therefrom a Norman cathedral, giving to the Winchester tower the additional height which it unquestionably requires. Complete the three towers of Wells, and compose a west front to associate more correctly with the more simple character of the main body of the edifice. Complete the central tower of York, or design a central tower for Exeter, and give a dignity to the west front of the latter, worthy of the magnificence of its interior.

Such might be some of the exercises which the Society would have in its power to promote and reward. A series of critical essays pointing out the merits and defects of our cathedrals and larger churches, might assuredly be published with the greatest benefit to all rising architects, and to the promotion of the public taste. We have ourselves endeavoured, in former papers, to give the statistics of general form and proportion, and to deduce therefrom some governing rules for future guidance in criticism and church building; and we feel assured, that if such efforts were to be made by better essayists, under the encouragement of such authority as a national architectural society would give them, they would speedily prevent the recurrence of any thing below a respectable mediocrity at the least. In this we refer, of course, to such buildings as might be constructed without the immediate supervision of the society, which could never expect to obtain a universally avowed homage. Though all parties might not choose actually to move in its "sphere," there would be many of them either secretly or unconsciously instructed by its "collateral light," and we shall be at all events in a state of gentle progress towards the time which may exhibit a Catholicity of taste, and produce such ultimately refined models of perfection, as may allow the Society to dissolve itself into the "broad and general air" of pervading intelligence.

As a slight example of our own ideas in respect to the adaptation of old material to new uses, we gave in our last paper a design for a Protestant Cathedral, and we now submit a sketch of much less pretension, though of more practical likelihood.

The annexed design is for a Church, to contain between six and seven hundred sittings, in which we adhere to the cruciform plan, as a symbol not to be dispensed with, and to our determination of avoiding as much as possible the objectionable impediments which internal pillars continue to form in the eyes of Protestant congregations. Our aim has been to preserve at the same time that arcaded ordinance which will ever be pleasing to the lover of the picturesque, and to employ galleries without any very detrimental effect to the main perspective of the interior. We also, virtually, obtain an actual width without that expanse of main roof whose required pitch would give it objectionable height, and the breadth of which would militate against that expression of length which is essential to the impressive effect of a church interior. It will be observed that a series of side pews or stalls is obtained in the recesses of the arches supporting the clerestory, the backs of these recesses being formed by a continuous wall supporting a small lean-to roof. This disposition also affords a constructive advantage, which the adopted Norman style would not otherwise have allowed. The Norman buttress is of very slight projection, and against it (the walls being not thicker than is necessary for vertical strength) the pressure of our roof would have been too great. The solid masonry, therefore, which in our model backs each pillar, and receives the abutting foot of the roof, is, in fact, a large and most effective buttress. A single pillar carries the arched walling across each transept, so that the main roof continues uninterrupted along the entire length. Within the transepts are galleries, and, if required, a third gallery might be placed to the depth of one arch at the west end. The north and south galleries are approached by staircases forming apses against the transepts. The western gallery would be approachable by stairs in the tower. The principal light would be afforded by the clerestory, a method which is always greatly conducive to that solemn effect which a church interior should as much as possible exhibit. In very large churches without a clerestory, (as in our design for a cathedral,) the mere proportions of the building will elevate the window to a sufficient height above the heads of the congregation; and were it wished to raise the lower line of light still higher, the under portion of the windows, from the sill to the first transom might be blank; but in small churches the clerestory is well adapted to give at once sufficient light, and to preserve at the same time that feeling of seclusion, of holy separation from the world, which is conducive to the suitable abstraction of the mind of the worshipper. If lights be required for the recessed stalls they would be obtained from a single small window in the back wall of each, and, unquestionably, if filled with coloured glass, they would greatly conduce to the beauty and solemnity of the interior. The communion table would have railings along the sides as well as front; and the vestry, at the back of, and below the east window, would be approached between the side rail and the stalls. Corresponding would be a door for the private entrance of the priest.

We would finally observe, that this design was made, in the first instance, without regard to any particular style. The Norman is adopted, not only because the *most* fitting, but on account of its being the *only* fitting style. The lancet window was inadmissible on account of its great proportional height; the other pointed varieties were prohibited, by reason of their requiring a greater expanse of openings. The style chosen is self suggested. Had there been no precedent for it, something of the same kind must have been practised. The varied character of Gothic architecture, is, however, such as to leave us at no loss under any circumstances of requirement. It is as comprehensive as the volume of Shakespeare, and affords matter, illustration, expression, and quotation, for all our necessities.

We trust that, in time, we shall be rightly understood. The anger excited in certain parties by our presuming to call in question the *artistical* feelings of the

Camden and other Church-Architecture Societies, will be, we hope, allayed in the growing assurance that we have been merely attempting to correct a too headlong and inconsiderate devotion, a too unqualified and indiscriminating adherence to the ancient models; "headlong," because violent—"inconsiderate," because rejecting the co-operation of those who, by long professional study, are competent to assist,—"unqualified," because disbelieving in the possibility of "bettering example,"—and "indiscriminating," because blind to the very varied degrees of merit which example exhibits. We repeat, what we have repeated before, that ART has been too much confounded with ANTIQUARIANISM; that a too prolonged research among old *things* has dulled the capacity for entertaining new *ideas;* that the mind and motive which generated things once *new* have been entirely overlooked in the admiration of those things merely because they are now *old;* and that a slavish obedience to *past* periods has tended to extinguish the chance of that respect which we should desire *future* periods to have for *us.*

It would seem, indeed, that we are pretty much in the same condition with the modern painters of Rome, whose minds are under the "blighting influence of that patriarchal excellence which, properly understood, would serve for a guide and example." "In no city of Europe," says the Oxford graduate, in his admirable work, on the ancient and modern landscape painters, "is painting in so hopeless a state of degradation as in Rome; because there, among all students, the authority of their predecessors in art is supreme, and without appeal, and the mindless copyist studies Raffaelle, but not what Raffaelle studied. It thus becomes the duty of every one, capable of demonstrating any definite points of superiority in modern art, to encounter without hesitation whatever opprobrium may fall upon him from the necessary prejudice even of the most candid minds, and from the far more virulent opposition of those who have no hope of maintaining their own reputation for discernment, but in the support of that kind of consecrated merit which may be applauded without an inconvenient necessity for reasons."

Now we do not mean to ascribe to our modern Gothic architects any "definite point of superiority" above the masters of old, but we hesitate not to say that the measures which have been taken by the late Camden critics are calculated to prevent the perception of such a "superiority," even if it really should exist. They would have us mindlessly study the old models, but not what the old modellers studied; nor can we believe that, in their midway resting-place as self-proclaimed copyists, they have any thing like the same amount of enthusiastic admiration for the old Roman Catholic temples, which we ourselves entertain. The petty particularities of their criticisms, and the sleepy character of their rhapsodies, fall but with a disturbing influence upon the enlarged and fervid susceptibilities of him, who, with a more honest regard to the exclusive merits of our Romish predecessors, gazes upon the glorious pile of Westminster or York

> " till the place
> Becomes religion, and the heart runs o'er
> With silent worship of the great of old !"

GEO. WIGHTWICK.

Plymouth, March, 1845.

DESIGN FOR A PROTESTANT CHURCH IN THE ANGLO NORMAN STYLE.

Fig. 3.

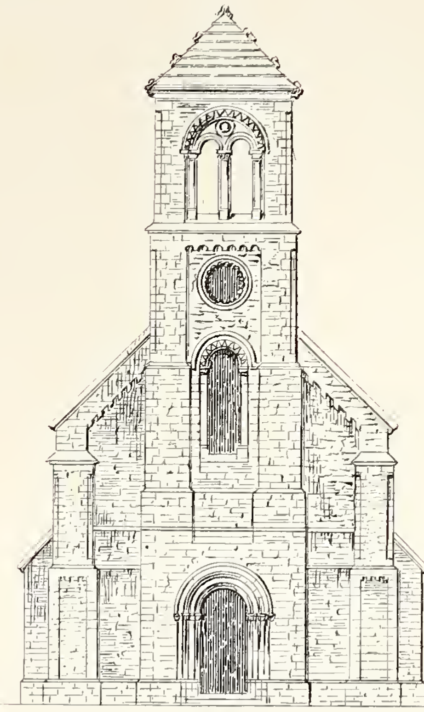
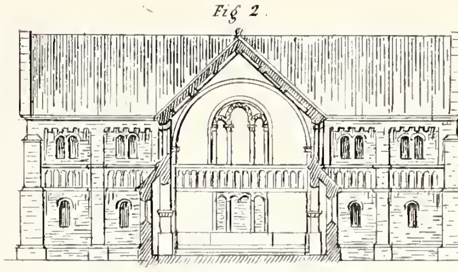


Fig. 2.



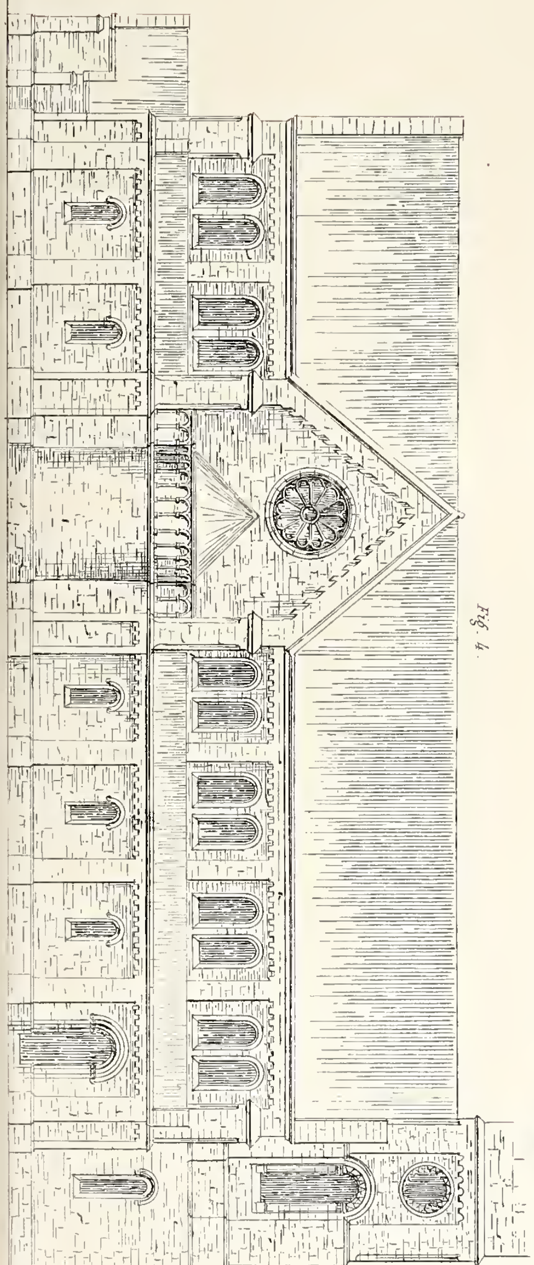


Fig. 4.

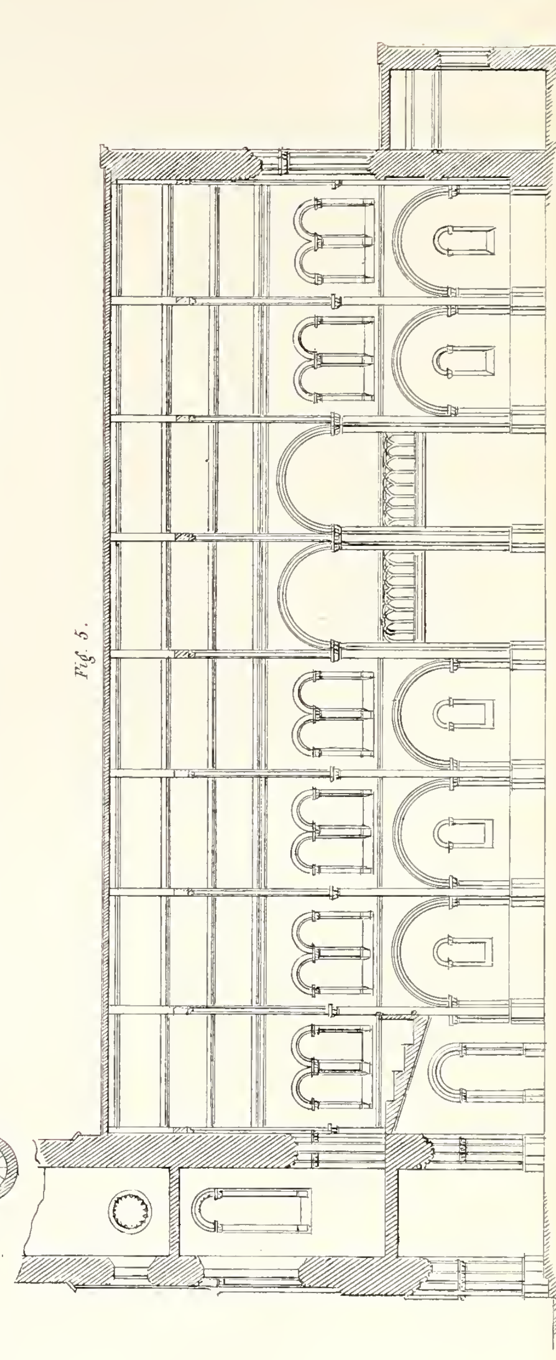


Fig. 5.

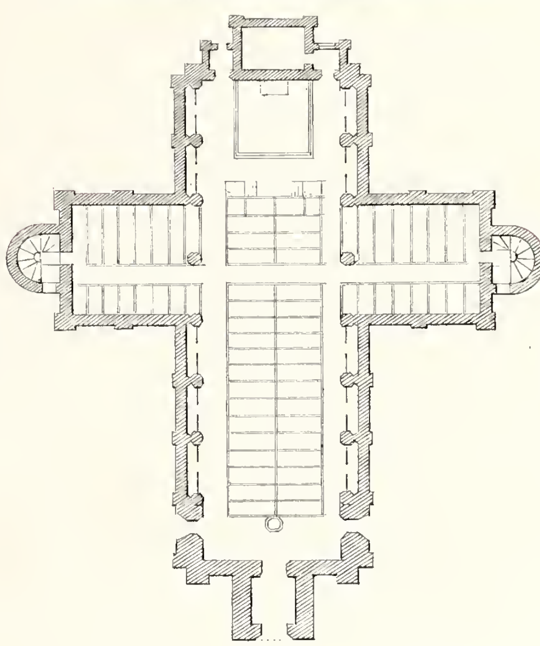


Fig. 1.

Geo. Wightwick, Architect

Scale to Fig. 3. 4 and 5

Scale to Fig. 1 and 2.

London, John Weale. 59 High Holborn, April 1st 1845.

REVIEW.

PUBLICATIONS OF THE OXFORD ARCHITECTURAL SOCIETY.

In this age, when everybody must meddle with his neighbour's business, and fancies he knows it much better than the man does himself; no set of persons have suffered more, from the interference and dictation of their neighbours, than the architects. It seems first of all to be considered that they know nothing at all of that which has been the study of their lives: and secondly, that any body who has read Rickman, or Aunt Elinor, is qualified to criticise and dictate to them. A man who cannot draw a line, who knows not a single principle of composition, to whom design is Hebrew, and construction Syriac, infallibly considers he knows all about architecture, and great airs he gives himself, and deep and severe are his criticisms, whenever he has an opportunity. Give him but a smattering of a few technical terms, and place him on a committee, or should he be ignorant of every thing, even the common phrases of the art, and have no concern with the matter, still he must judge, and most probably will condemn every thing he sees.

The architecture of the middle ages is the chief field in which these men disport themselves. Classic architecture is beyond them, the due appreciation of its beauties requires an elevated mind and cultivated taste. None but men of classic feeling can appreciate classic architecture. Accordingly it is decried by our modern cognoscenti; and the architecture of the primitive *Christians* is universally called *pagan*. The truth is, they know nothing, nor do they feel any thing of what they cant about. They have no idea of the picturesque beauties and bold construction of our forefathers, but merely talk about Gothic as *a matter of fashion*, just as in Sir William Chambers's time nothing would go down but *Chinese*. There were Chinese pagodas, and Chinese bridges, and flying dragons, and all sorts of monstrosities, which were very delightful indeed till the fashion changed. Just so, a little while back, Norman was the fashion, then was early English, poor and thin; afterwards early English came in, and woe to the unhappy architect who praised King's College Chapel, and did not call William of Wykeham "debased." It has become a regular cant, a most absurd and unmeaning nomenclature prevails, a species of "flash" which every one must learn "to patter." Gentle reader, if you would be thought to be very knowing indeed in architectural matters, talk a great deal about "*late early* English," and "*plain decorated*:" that is the phrase of the day, and will be, it is probable, for some three-fourths of a year more: for as nine days are the limit of private wonder, so are nine months that of public admiration. How much all this resembles Mr. Poole's "Man of Fashion at Sea." He learned, in a short time, he says, to "abaft the binnacle," to "athwart the hawse," and to "shiver the taffrail" as well as any man in her Majesty's service; he buys a *box coat* in case the Captain should ask him to go out with him in the ship's *gig;* and he says "it was now *post meridiem*, which you know, my dear Augustus, is the nautical term for half-past four." All honour to your good-humoured wit, thou historian of Little Pedlington!—would we could read such an article on the modern pseudo-ecclesiologists as that thou hast written upon the pseudo-nauticals.

But there has been a worse feature than this. Some folks, not content with talking as familiarly of Gargoyles and Lychnoscopes, Perpeyn Walls, and Window Soyles, "as maids of thirteen talk of puppy dogs;" have fallen, like Bottom the weaver, into "'Ercles' vein," "a part to rend a cat in, and make all split." Their criticism has been not only gall but positively libel; and while they have indulged in the το φοβερον in virulent attacks upon such men as Barry and Poynter, they have melted into the το ερασμιον in the most fulsome panegyrics of "our architect" and "our carver." But let them pass; if they don't go out in the socket first, we may have a word or two with them some day or other.

At present it is somewhat refreshing to turn to a society, not professional it is true, nor practical, but at any rate respectable, who have put forth sundry works to the world in a modest tone, the greater part of which have value, "be the same more or less," (we must leave our readers to judge of the plus and minus of the case,) who do not treat other people with arrogance, nor presume on their position as men whom every one with any feeling of religion must forbear, however ill they may use him. If they have failed at all, it must arise naturally from the fact that they are an architectural society, without being architects. But if they have rendered themselves amenable to criticism, we are half disarmed, and half defrauded of our quarry, first, by the modest tone which pervades their works, and secondly, by the well-intentioned direction they have followed.

The great error in designing churches for some time past, has undoubtedly been the attempt to make them "little cathedrals." Now if any man should make a fowling-piece of the reduced shape of a sixty-four pounder battery gun; or fabricate a one-horse chaise in the diminished proportions of an omnibus; or build a Thames wherry like a man-of-war, of some ten thousand times her bulk, we opine this man would commit an analogous absurdity to him who would build a little district church on the proportions of a mighty cathedral. A little cathedral would be like a little potentate; encumbered by little externals, too small to be of any use to him, and too mean and poverty-struck to command any sort of respect from other people.

This error the Oxford Society have avoided; but there is another, and that is the indiscriminate selection of the models laid before the public for imitation. There is no doubt that things were much as they are now; the great architect was employed on the vast and costly edifice, the lesser on the lesser, and it is very probable that many of the little country churches were built by "Dan Absolon" [a] the village builder, cobbled up by following in a bungling manner some better example he had seen at the market or borough town. It is well to take parish churches as models for parish churches, and cathedrals as models for cathedrals; but let us in both instances *select* our models, and not give the beautiful and the ugly; the good and bad; the original design and the clumsy copy, both in one work.

We fear, however, we are wearying our readers by these remarks. Let us proceed at once to the volumes before us. The first thing that strikes us is, that they are of different sizes, some folios, some octavos, and these last of different paper and type; small matter it is true to the architect, but very annoying to the subscriber who is choice in his books, and loves uniformity in his binding, and to see them "range." However, we suppose the subscribers ought to look to this; our business is rather with the insides. Let us open the first that has been sent us, it is "A Guide to the Architectural Antiquities in the Neighbourhood of Oxford," and is divided into deaneries. If this work is intended to contain an account of all the churches in the deanery, good and bad, it may be very well to fill a volume with an account of modern additions, or debased originals; but we think it not very likely "to promote the study of Gothic Architecture," to compel a reader to wade through a minute account of every door, window, label, and string course to some scores of little churches without (confessedly) either architectural merit or picturesque beauty to recommend them; and if it be so intended, the illustrations are lamentably deficient: one church is illustrated by a drawing of a pinnacle, another of a very common piscina, two or three have only the sedilia; so that the society seem to be like the old story in the classic Joe Miller—Hierocles, where the pedant having a house to sell, carries a brick about with him in his pocket as a sample, and produces it when asked what sort of a house it is. In the letter press descriptions we also regret to find the absurd phraseology of the Cam-

[a] The Village Carpenter in Chaucer.

bridge Camden Society is used; "late early English," and "plain decorated" are in every page, and the striking difference of style marked by the introduction of the four-centred arch is unnoticed, and the style of the Tudors is called "perpendicular," when, as any one may see in Henry the Seventh's Chapel and St. George's, Windsor, the tracery of the windows was as often flowing as it was perpendicular. Again the fact, that one style frequently runs into or dovetails on to another, is wholly lost sight of; so we have the window head described as of one period, the dripstone of another, and the corbel heads of the third; just as if we should say that a man's head was forty years old, his body thirty, and his hands fifty. Besides this, we think due consideration has not been given to the fact, that there is a transition in mouldings as well as in tracery. Nay, after all, that certain mouldings may be *prevalent* in a style, that are not exclusively *peculiar* to it alone. We remember well taking the sections of the dripstone, in a church in Kent, built in 1260, that were exactly what we are told are perpendicular, and these were worked on the arch stones. Similar remarks are also applicable to battlements. The archæological parts of this work are good, but are compiled from Kennett's Parochial History, and other topographical works. The wood-cuts that are given have much artistic merit, and in truth we should have preferred less letter-press description, and more of illustration. We miss one thing, though sorely, as architects, and that is a scale to the details; it would have been of the greatest use, and, except here and there to a plan, we get none at all.

We have next to notice the Fotheringay Church; this is a re-publication from Dugdale, of the agreement for rebuilding the nave: the contract and specification in fact. This little book is made out of Bonney's History, as it honestly professes to be; the wood-cuts are very clever, by Jewitt, and they illustrate clearly the meaning of many technical terms used in the fifteenth century. The book has its use to those who understand the matter; and to the sciolists it is a perfect godsend; they can amaze the weak minds of the hearers with "ground tables, window soles, botrasses clen-hewyn, perpeyn walls, asheler, (by the way the word 'squinches' does not occur throughout the whole contract,) 'respounds,'" &c., &c., till they are in the seventh heaven of self-approbation:

> For "ekes" and "algates" only deign to seek,
> And live upon a "whilome" for a week.

For ourselves, we can only say it is a useful, nicely got up work: *oh! si sic omnia.*

The next thing which presents itself to our notice, is "Remarks on Wayside

Chapels," and very good archæological remarks they are. We do not quite agree with *all* the author (or rather authors, for there are two) have said; nor would we venture to suggest that in the pious, disinterested, and enlightened middle ages, the good monks may not have occupied bridge chapels for the double purpose of meditation and collecting the toll: a sort of mixture of the hermitage and "the 'pike;" no! we are architects, not antiquaries, (at least for the nonce,) and we can, therefore, only complain of the meagre food offered to the student in architecture. There is a tolerable flank view, but the main elevation is only a vignette. We could cover with half a crown the whole of the gorgeously enriched front. Detail there is none; and the principal wood-cuts are from some frescos; one contains half a female figure, and the hand and the knee of a second: and this of course to the exclusion of what would really be valuable.

We now come to the folios. The first is a design for a decorated church, with specification, &c. We scarcely know how to treat this. It appears to us very like an attempt to publish a sort of "Every Man his own Architectural Physician," a commonplace form whereby churches may be prescribed, and compounded, and forced down patients' throats without the aid of an architect. We do not sit in judgment on this point, nor do we do more than hint that this does not appear to be very professional on the part of the society's pounder; but as the drug is not very likely to be taken, firstly because we apprehend it will not be found to be strong enough, and secondly because we opine it will come to more than the *estimated* thirteen pence halfpenny including the stamp, it will, perhaps, be waste of words to say any more about it.

It now gives us much pleasure to pass to the next folio, "Shottesbrooke Church." This is a building really worth the attention of an architect, though small, and comparatively plain. The notices are taken from Tanner, and from an article in the Gentleman's Magazine; the only part of the letter-press description to which we object is the absurd quotation from Rickman, that it is a "beautiful *miniature cathedral.*" Now we have already given our opinion on this notion that *dwarf giants* are beautiful, and we confess we cannot imagine a cathedral at the very least without aisles. The writer, however, of the preface, may justly reply to us, "non meus hic sermo." We are aware of it, and we gladly give our unqualified praise to what he has done. We think the same material might, perhaps, have been supplied at much less expense; but this is a matter between the publisher and the subscribers, if they are satisfied, *quid refert nobis.*

But if we give unqualified praise to Shottesbrooke, what must be said to such book-making as "St. Bartholomew's, near Oxford," and "St. Peter's, Wilcote?" Each an ugly, tasteless, very small barn, nay! *barn* is too extensive a term for places sixteen feet wide; without the least pretensions to architectural beauty, or without the slightest historical reminiscences that would give them an interest. These two little hovels are given to the subscribers in *fifteen folio steel plates*. The perspective views are wisely confined to little vignettes, which might be covered by one's thumb, and the detail—let any one but turn to plate 2, of Wilcote: there is a "grand misrepresentation," as Matthews used to say, of a rubble wall—every stone carefully delineated; a slated roof—every slate a faithful portrait; (though here the architect gets the better of us, and hypercritically suggests that a little shadow to show that the roof slopes backwards would be an improvement: at present it looks like an upright *stone* wall with an upright *slated* wall on the top of it; but never mind,) one little window, one little door, and one little porch, and there! you have a grand steel plate. Perhaps, you may say if the subscribers are satisfied and pull forth their five shillings without grumbling, what is it to you? Why this it is, if we gave *our* subscribers no more for their crown piece than the Society does, we know very well that we should be bitterly attacked, nay, perhaps, libelled by a certain set of critics we shall not name. *Tumet jecur*. Why are architects the only set of men who are to be stuck up to throw mud at? Why are they to be subjected to treatment every other profession escapes; why is all sort of gentlemanly courtesy forgotten when they are assailed? It is because, from their peculiar situation, few can, and fewer dare retaliate. It is because they are attacked individually, and by name, while their adversaries crouch behind the dead wall of a society to pelt them. It is because they fear the private spite that has been sometimes directed against a man's practice, and which blights the rising hopes of one struggling with this hard world. It is because they have visions of ledgers with long blank pages, and domestic hearths with pale, sad, silent faces. However, the day of retaliation may come. These arrogant critics may find others "as cunning in fence" as themselves: there are vulnerable points even in the crocodile's hide.

We now take our leave for the present of the Oxford Architectural Society, with this advice, to select their examples with more care, to give more detail, and always to supply a scale to every sketch; to remember that "the grotesque" and "peculiar" is not necessarily "the beautiful," and that there is as much difference in point of taste and artistic handling in Gothic churches, as there is in classic examples. If they do this and still keep their former unassuming tone, we bid them "God-speed," and wish them every success; and we believe every true architect will do the same.

EXAMPLES

OF

ECCLESIASTICAL PERPENDICULAR ROOFS.

By HENRY CLUTTON, Architect.

The accompanying sketches, which represent some of the forms of perpendicular roofs, from the commencement to the decline of the style, are the result of a tour through several of the English counties. At the time they were made, no intention was entertained of publishing them; but without any pretensions to accuracy in point of dimensions, it has been thought that, as perspective delineations, they might afford some interest, and with this view they have found a place in the Quarterly Papers.

Although perpendicular roofs are less rare than those of earlier periods, and are frequently to be met with, it is seldom that the enquirer after this branch of art will alight upon any specimen in which modern notions of cleanliness, or injudicious repairs, have not obliterated all traces of colour and changed the character of the details.

The churches of the more remote and thinly inhabited villages of Norfolk have very generally escaped without much damage from the hands of the "improver" so called; and not only have the roofs, in many instances, been preserved entire, but the rood screens and chancels, and the various fittings required by the ritual of the unreformed church, remain in their original richness of colouring and elaborateness of detail. It would seem, therefore, to be highly advantageous to the architectural student if the contents of these beautiful churches, now unhappily, from the effects of time, fast hurrying to decay, were rescued from oblivion by the publication of a series of careful and accurate drawings, and it is hoped that the present hasty notice may invite some competent hand to the task.

It is desirable that the attention of the various architectural societies should be called to the state of these churches—not so much with a view to their restoration, as to recommend the taking of some judicious steps to prevent the further decay of the woodwork contained in them, in order to preserve to posterity genuine examples of that beautiful branch of Gothic art.

REFERENCE TO THE PLATES.

No. 1. This roof is from the chancel of the church at Wells, in Norfolk: it is very simple in construction, and in span measures twenty-one feet. From the form, this roof might be taken for one of earlier date, but the details are obviously of perpendicular character.

No. 2. is from the church of Trunch in the same county, and is early in the style.

The form of this roof resembles so much that of larger and better known examples, that a reference to them, and especially to the roof of Westminster Hall, and the able dissertations published thereon, would convey a much more comprehensive and satisfactory solution of the principles of construction, than any description applied to the present illustration. The span of this roof measures twenty-eight feet.

No. 3. is from South Creek, in Norfolk, and is later in the style than the two preceding examples; but in principle of construction resembles the latter. The span of this roof measures twenty-eight feet, and some remains of colour are still visible.

No. 4. is an aisle roof from New Walsingham Church, with the remains of some very beautiful pannelling between the principals.

No. 5. is a singular roof from Knapton Church in Norfolk. It is very bold in construction, having to sustain itself by means of a series of corbelling, which successively conducts the pressure to the walls. The span of this roof measures thirty-two feet, and nearly the whole of the coloured decorations remain.

No. 6. is from the chancel of Worstead Church in Norfolk; twenty-four feet span, and very simple in design.

No. 7. is a roof from Hatherop Church, Gloucestershire; and is here introduced to continue the series. It is late in the style, and measures in span eighteen feet.

No. 8. is a singular roof from Old Basing Church, Hampshire; it measures twenty-two feet in span, and concludes the present series.

Before closing this paper, it will not be out of place to advert to the probable motives which urged the Gothic architects to emulate in their timber roofs the boldness of construction of stone vaultings, and to achieve with a different material the same results.

In the fourteenth century, and previous to the introduction of the four-centered arch, the span and height of stone vaulting had attained the utmost limit of practical dimensions, and no larger space could be covered with stone without the assistance of pillars.

All palatial halls prior to this time were erected in this manner; but a desire to avoid the encumbrance of pillars, no doubt, induced the architect of Westminster Hall to cover the span with a wooden roof, as affording greater convenience, and being more suitable for the entertainments contemplated to be given therein by Richard the Second.

The system of double-framed roofs did not become general until this time.

The position of the principal trusses of these roofs corresponds to that of the main arch ribs of stone vaulting in relation to external buttresses, to which points, in either case, the pressure is conveyed; after securing adequate abutments to resist the weight and consequent spreading of the roof, the Gothic carpenters relied entirely upon the sizes and tenacity of the timbers to resist the strains upon the beams, which, although constructed of oak or chesnut, have in most cases sagged.

In reviewing old buildings and speculating upon the boldness and success of their construction, some astonishment must be felt at the temerity of modern architects, who, in their eagerness to copy old forms, apply roofs of the form of which we are speaking to thin walls, and in a material inferior to either oak or chesnut. The success of these attempts must be attributed chiefly to the skill of modern carpentry and the extensive use of iron; and if to these agencies were added that of duly ascertaining the bearings of each truss by weighting it previously to fixing it on the walls, fewer instances would be recorded of failures of this modern application of old roofs. It is also to be recommended, before covering new roofs, to tie the walls together by means of a wrought iron bar fixed and screwed to the wall plates, and to remain in that position until the whole of the work has settled, and the timbers of the roof attained their proper bearings.

The old system of boarding the roofs was excellent as effecting a general distribution of pressure over the whole surface, and thereby modifying those partial strains which often arise from inferior material or workmanship.

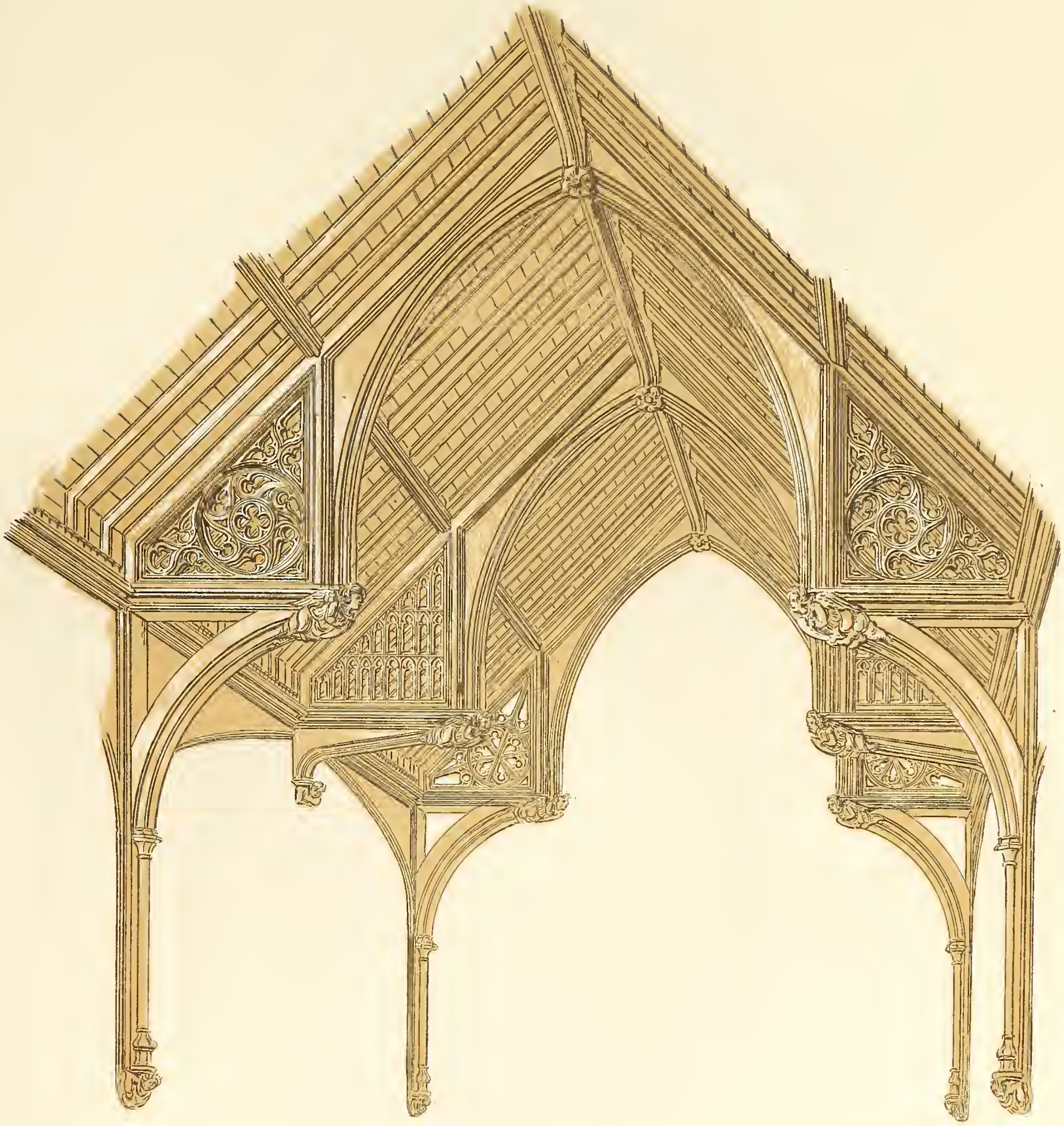
The strength of a ship depends greatly upon the planking.

No. 1

Printed at 70 St. Martin's Lane

CHANCEL OF WELLS CHURCH, NORFOLK.

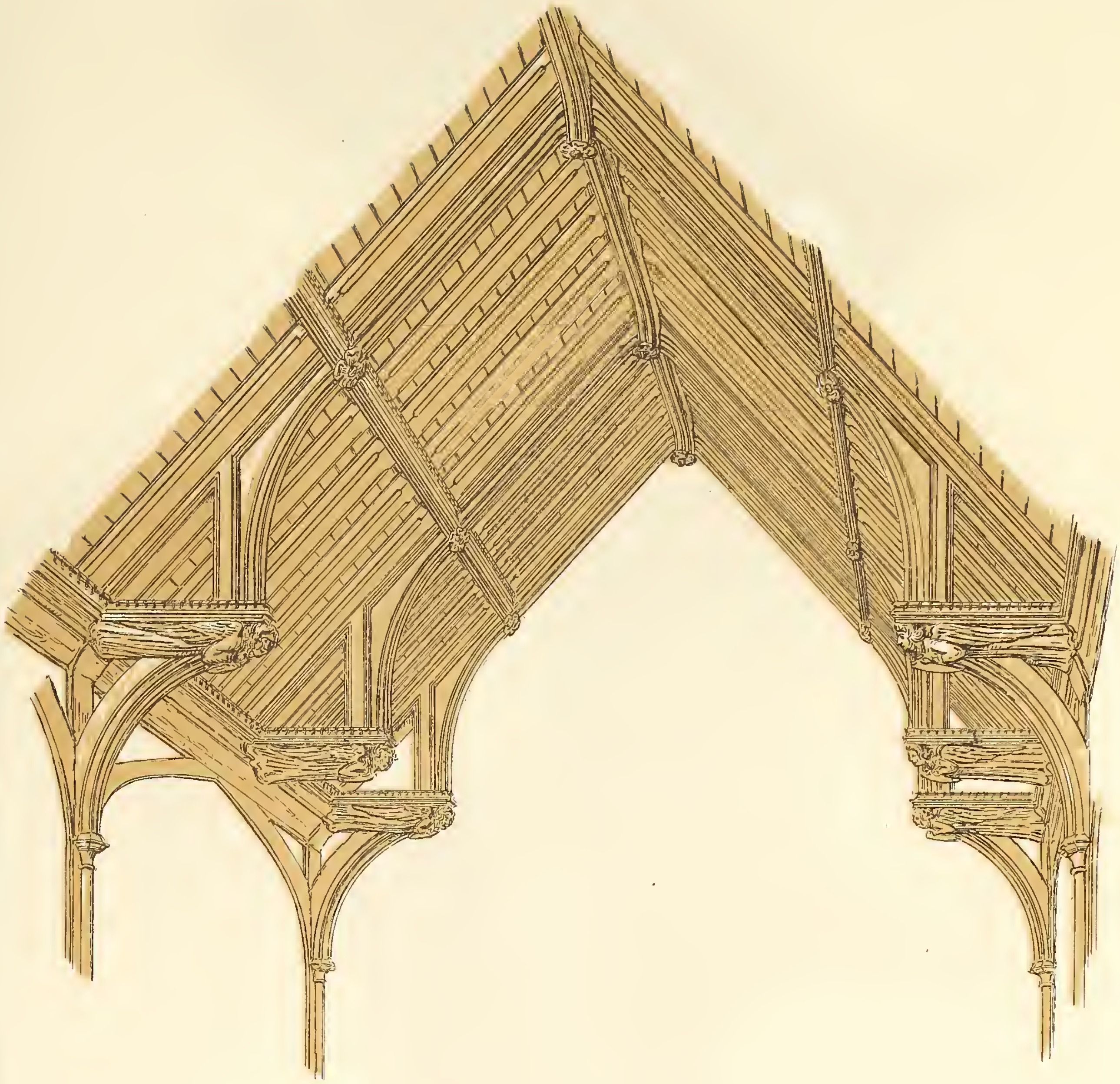
London, Published by John Weale at his Architectural Library, 59, High Holborn July 1 1845.



Printed at 70 St Martin's Lane

TREMIH CHURCH, NORFOLK.

London Published by John Weale at his Architectural Library 59 High Holborn, July 1 1845.

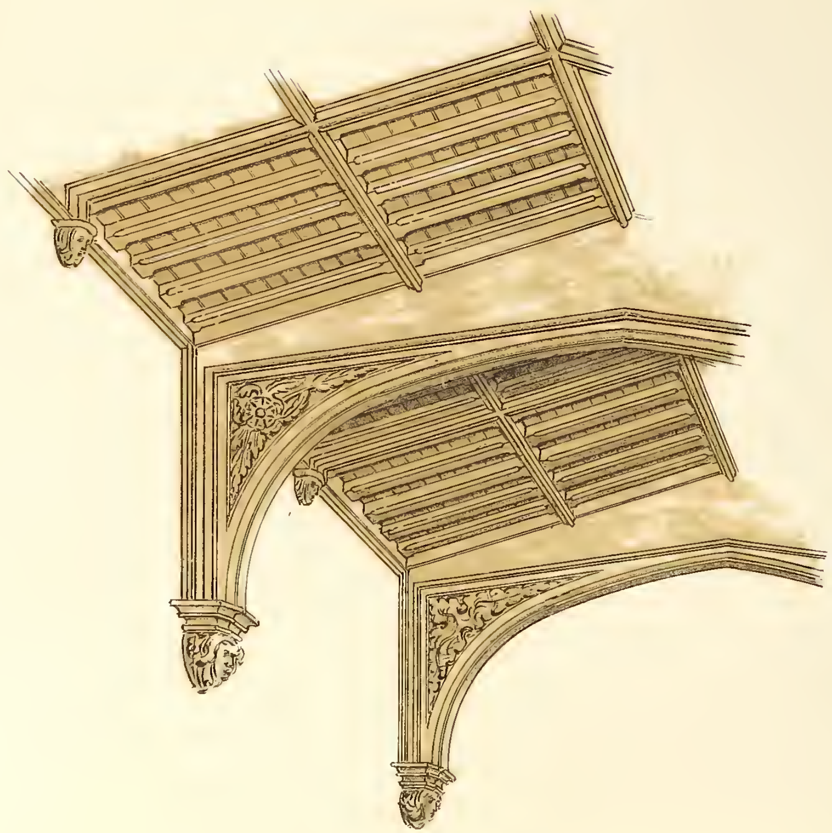


Printed at 70 St Martin's Lane.

SOUTH CREEK CHURCH, NORFOLK.

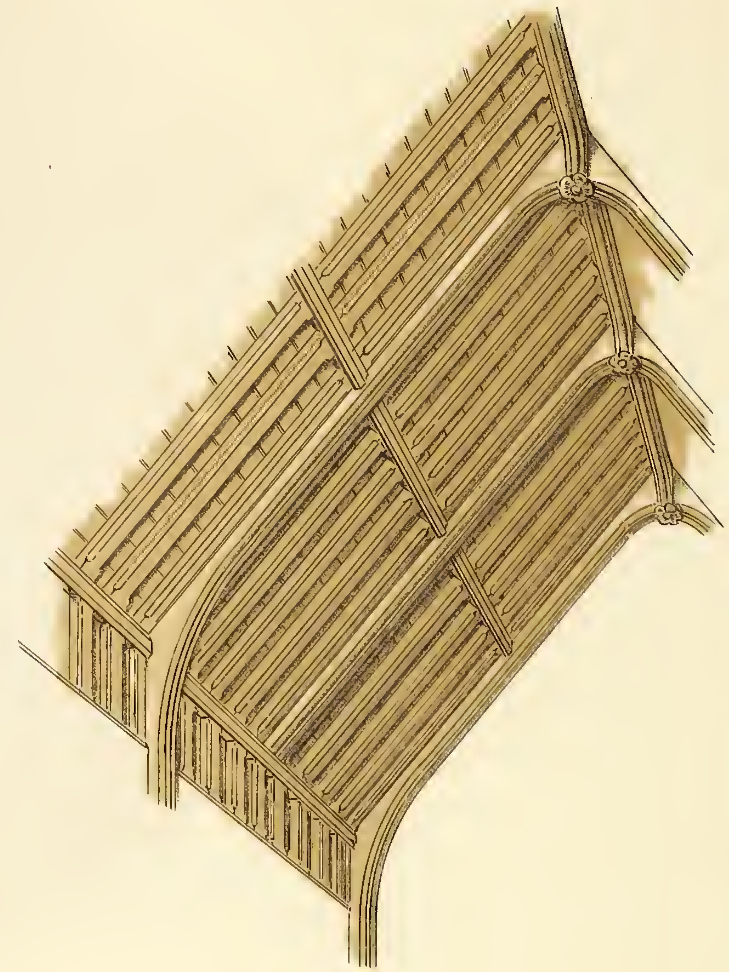
London, Published by John Weale at his Architectural Library 59 High Holborn July 1 1845.

N°7.



ROOF OF HATHEROP CHURCH, GLOUCESTERSHIRE.

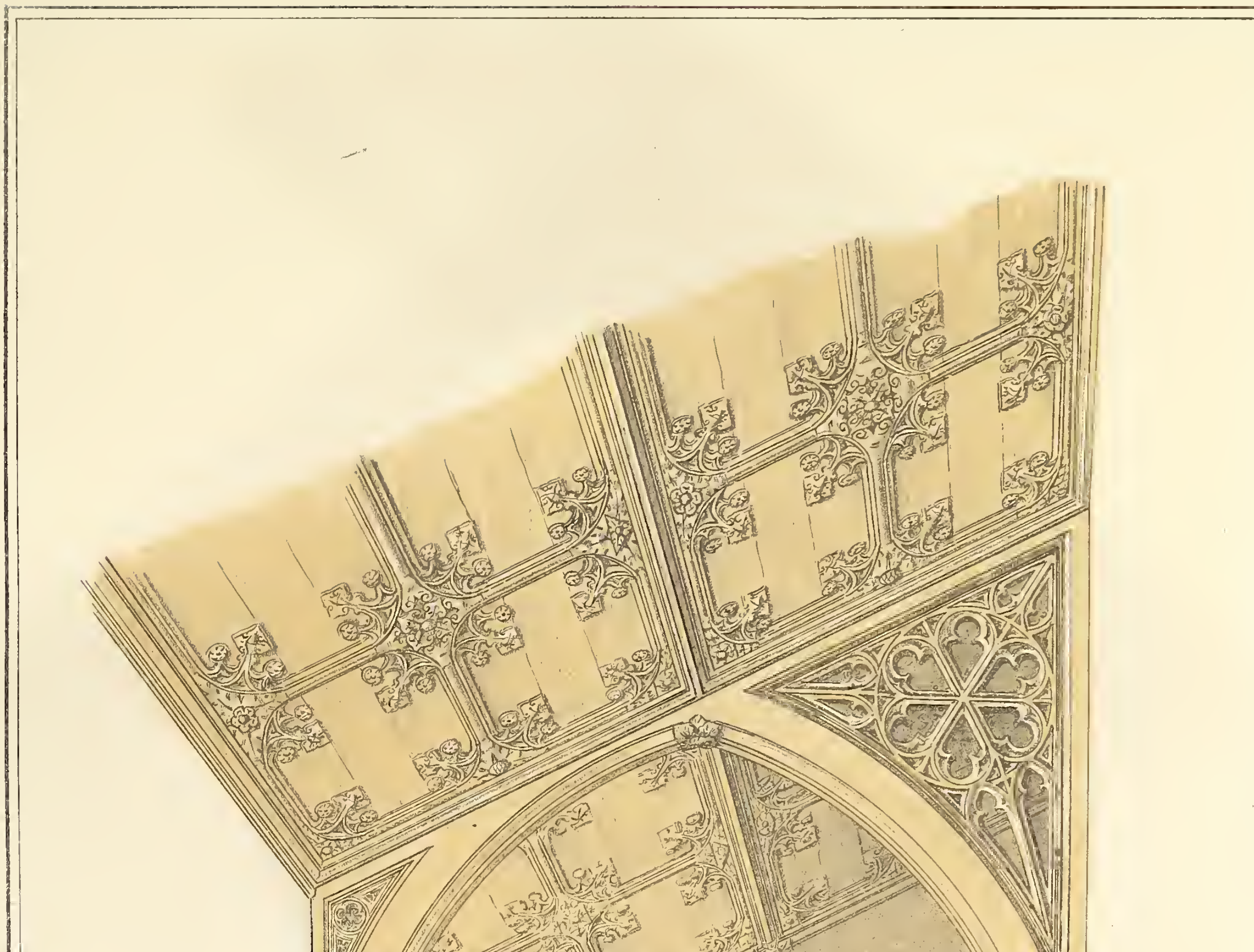
N°4



CHANCEL ROOF OF WORSTEAD CHURCH, NORFOLK.

Printed at 70 St Martin's Lane

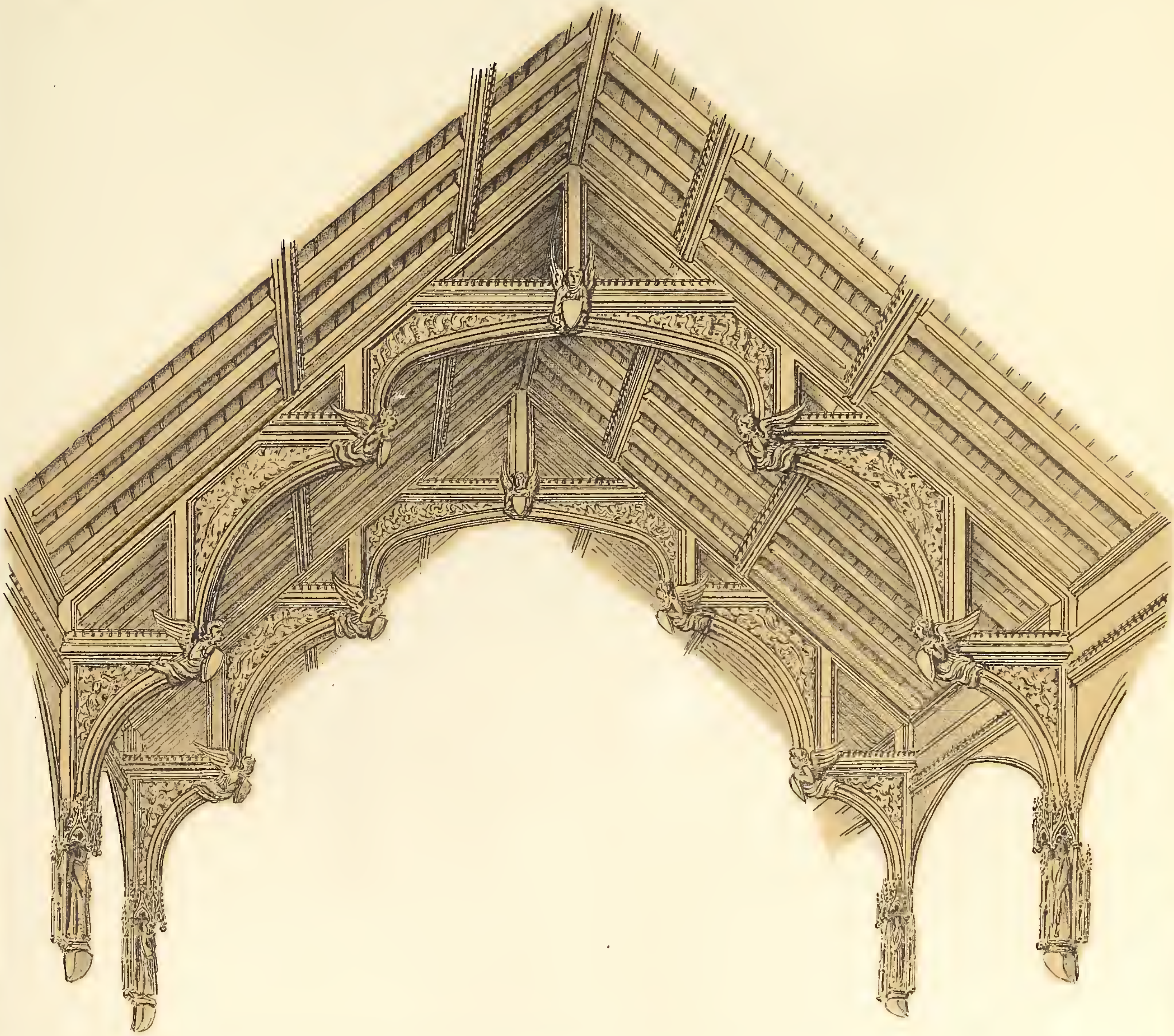
London, Published by John Weale, at his Architectural Library, 59, High Holborn, July 1, 1845.



Printed at 70, St. Martin's Lane

AISLE ROOF, NEW WALSINGHAM CHURCH, NORFOLK.

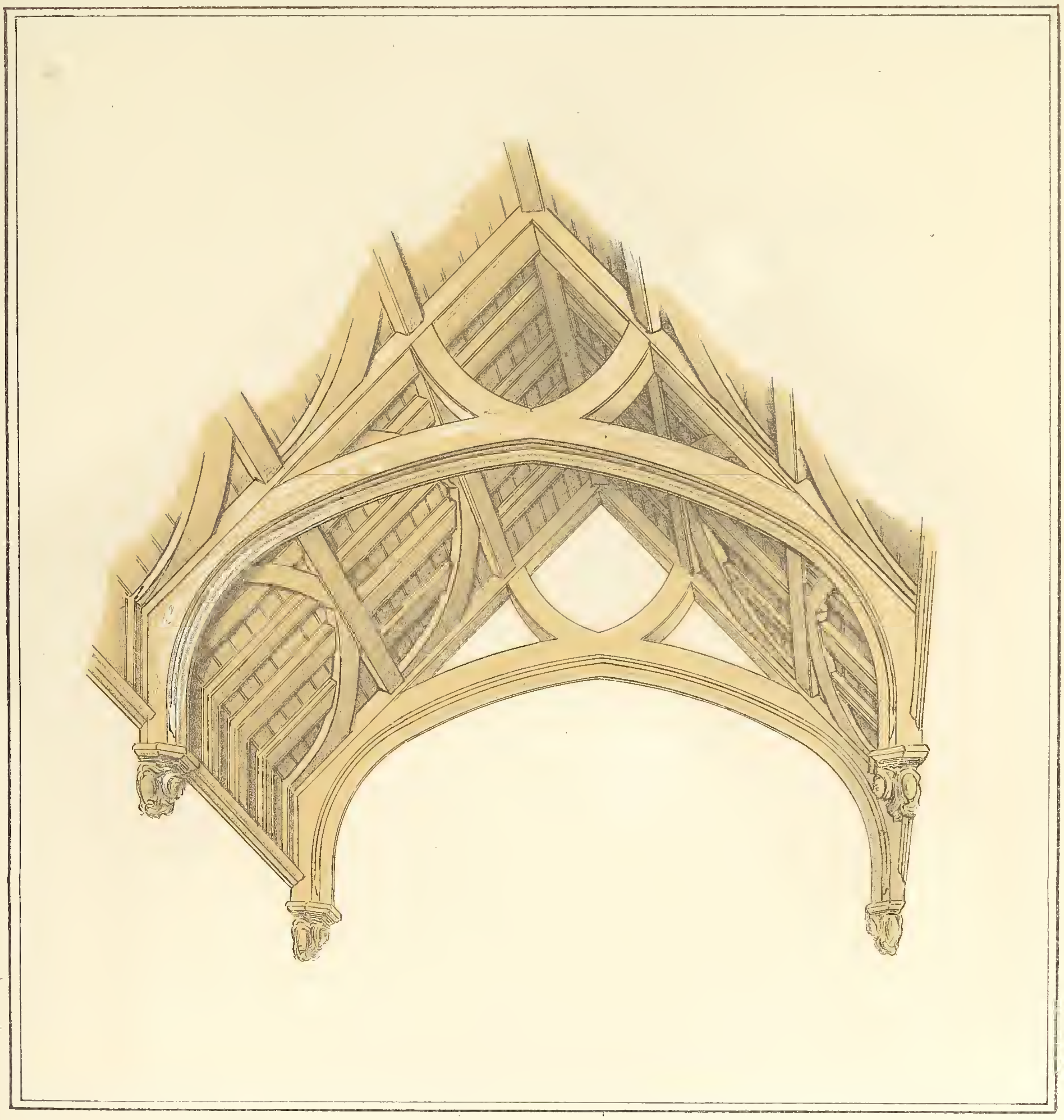
London, Published by John Weale, at his Architectural Library, 59 High Holborn, July 1 1845



Printed at 10 St Martin's Lane

KNAPTON CHURCH, NORFOLK.

London, Published by John Weale at his Architectural Library, 59 High Holborn July 1 1845.



Printed at 70, St. Martin's Lane

OLD BASING CHURCH, HAMPSHIRE.

London, Published by John Weale at his Architectural Library, 59, High Holborn. July 1, 1845.

CHURCH OF THE HOLY CROSS,

BINSTEAD, ISLE OF WIGHT.

FROM DRAWINGS AND ADMEASUREMENTS

BY R. J. WITHERS, ARCHITECT.

About a mile and a half to the westward of Ryde, and bordering on the coast of the Solent Sea, is situate the beautiful and picturesque village church of Binstead, and which the accompanying Plates are intended to represent in detail. The surrounding scenery is well calculated for privacy and devotion, the church being encompassed with tall and stately trees, rearing their heads as if to protect the small and humble house of God from all harm and irreverence. On taking an exterior view we perceive that the foundation and other parts of walls clearly indicate the primary structure to be Norman, and one small circular head light 12½ inches wide and 4′ 2″ to the springing under a segmental arch inside, and coeval with the original building, remains in the N.E. corner of nave, the remaining windows being modern innovations, with the exception of the E. and S.E. of chancel, which appear to have been inserted towards the latter end of the thirteenth century; that on the N.E. is a pretended copy by a country mason of the present century of the beautiful two-light window opposite, but as coarse and incorrect in detail as possible. It is evident that the roof of chancel, as well as the cross upon the east gable and coping, were added about the same time as the windows. A low segmental chancel arch, erected at the time the Norman church was built, remained until some few years ago, when it was destroyed, and a common pointed one substituted; the imposts of the original arch remain, which are given in Plate 5. The old bell remains in the wooden bell cot with a more modern one, the inscription on the former being in early character, "*Sancta Maria ora pro nobis.*"

No ancient records remain which would enable us to throw any light upon the erection or subsequent alteration of this little village church, but it is undoubtedly dedicated to the Holy Cross, from its being mentioned as such by various antiquarian writers, and from another still more striking certainty, that of its *orientation*, it being built pointing exactly 5′ 30″ north of east, being about the point the sun rises on the 14th of September, the day of the exaltation of the Holy Cross or Holy Rood.

Plate 1. By this the general character of the church may be formed, which when this sketch was taken was in a very deplorable state, but has lately been nearly rebuilt and perfectly restored, and much to the credit of those engaged. A square trefoil-headed "*lychnoscope*" (Cam. Cam. Soc.) remains blocked up in the s.w. corner of chancel.

Plate 2. This beautiful early example of stained glass dates undoubtedly with the window to which it belongs, and from its extreme simplicity deserves particular attention. The plan is as usual, nave and chancel, the latter being very well proportioned. No traces on the outside wall on north side of chancel remain to show whether there ever existed a sacristy to account for the recess in the wall, as it appears to have been a locker for some purpose, and is therefore open to conjecture.

Plate 3. An elegant specimen of an early decorated window, and symbolical in every respect of the Holy and Undivided Trinity, it being divided into *three* lights and *three* circles, these subdivided into *three* trefoils, each trefoil having *three* spandrils, the whole comprised under *one* arch. It will also be seen that the *same* radius that describes the underside of outside arch, is the *same* that describes the underside of the inside arch, thereby making it equal, but still spreading more inside for the better admission of light. The label is the same to the interior and exterior of this and the two-light window next given.

Plate 4. This window is coeval with the one just mentioned, and equally beautiful, although not so strikingly symbolical; the interior arch immediately over the window is the same as the outside one, it being brought through, and thus gives a greater variety of lines than if it were absent.

Plate 5. Fig. 1 represents the roof of chancel, and undoubtedly of early decorated character; this was a common example in former days, and beautiful it must have appeared where there was a long and unbroken line, because *every* rafter was thus trussed and placed about 18 inches apart; but we rarely or ever see such a specimen now. Better times being in store, we may therefore look forward with hope to

an amendment in such things. Figs. 2 and 3 are the quaint and original imposts on the N. and S. sides of chancel, and once supported a beautiful segmental Norman arch. Fig. 4. This was also discovered during the recent repairs, and has been placed over one of the west lancets. Fig. 5. This symbol of eternity was originally the key-stone to the porch door, and is now placed over the other west lancet. Fig. 6. The cross on east gable, and apparently of the same date as the roof, but rather mutilated; this has also been restored. Fig. 7. The piscina in the sill of the S.E. chancel window, and of very uncommon design. Fig. 8. The Holy Dove with the nimbus; this was found during the recent alterations, and has been very properly placed over the entrance door of the new porch, in which place many examples occur.

Before concluding these remarks, a few words may not be amiss upon the late beautiful restorations which have been undertaken since these drawings were made; the nave has been entirely rebuilt in the early English style; a bell turret with spire and a new and beautiful open oak roof added, the whole being seated throughout with oak benches, with standards and poppy heads beautifully carved, a stone pulpit and elaborately carved reading stall, and a font of exquisite workmanship, representing the fall and redemption of man in eight compartments.

The chancel windows glow with beautifully painted glass of superior design and execution, the east window being a memorial, as stated by a brass in the sill, to a deceased father by his children; and what can be more suitable for a gift to commemorate one departed in the faith, and whom we loved, and at the same time enrich our beautiful Gothic churches? The altar table and railing are formed from old carvings purchased for that purpose, and exceedingly chaste and elegant: indeed sufficient cannot be said to form the least idea of this now beautiful house of God, and a visit would amply repay any one fond of ecclesiastical architecture. The details are beautifully correct, the whole being designed and carried out by Mr. Thomas Hellyer, of Ryde, Isle of Wight.

Would that others would follow the example of the worthy rector of Binstead, the Rev. P. Hewett, by whose exertions, aided by a few subscribing friends, this hitherto degraded house of prayer has been rendered one worthy of the Most High, and, when complete, will be an everlasting monument of the piety and generosity of those engaged.

R. J. WITHERS.

No. 1.

Church of the Holy Cross.
Binstead,
I. of W.

South East View of Church.

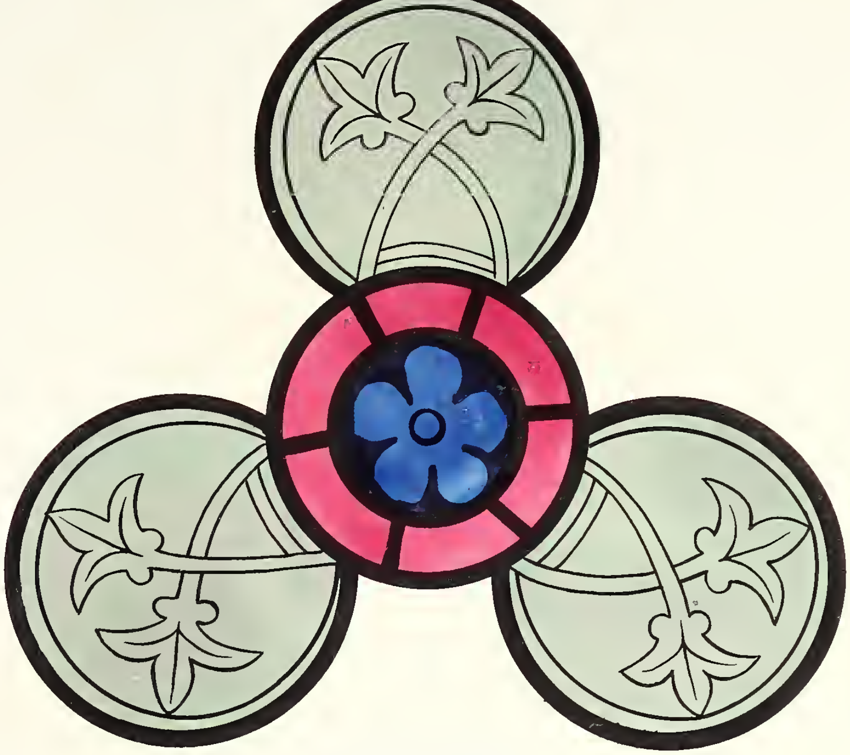
R. J. WITHERS RYDE I. W.

J. Bedford, Litho London

London, John Weale, 184
Printed by Standidge & Co

N° 2.

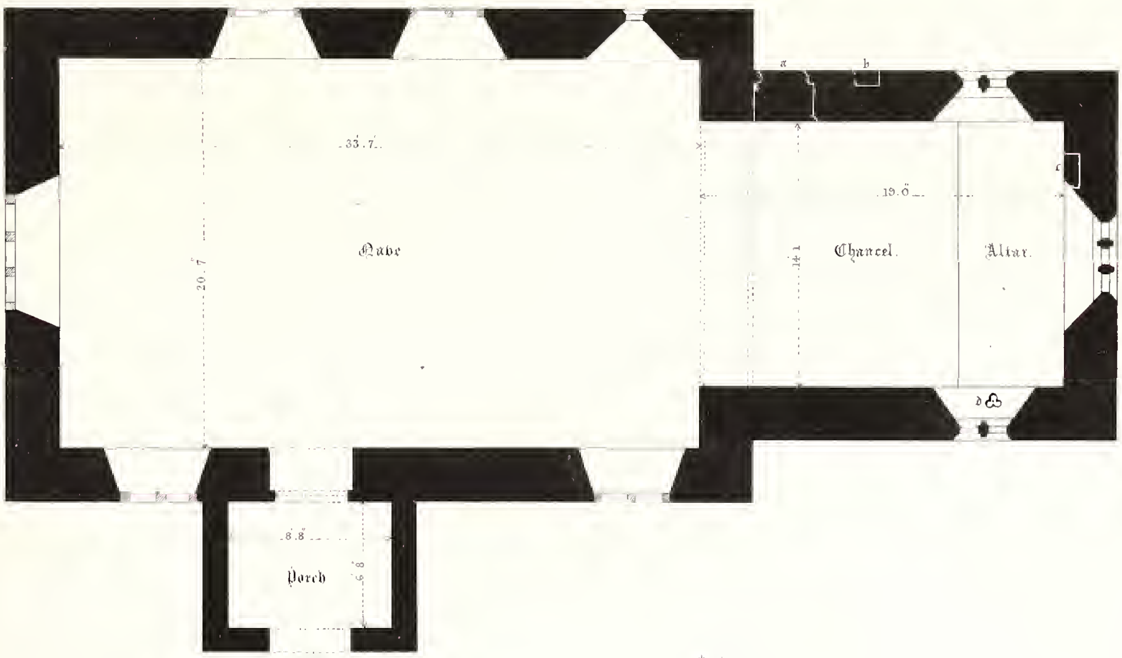
Church of the Holy Cross. Binstead. I. of W.



Stained or Painted Glass.

small Trefoil East Window

½ real size.



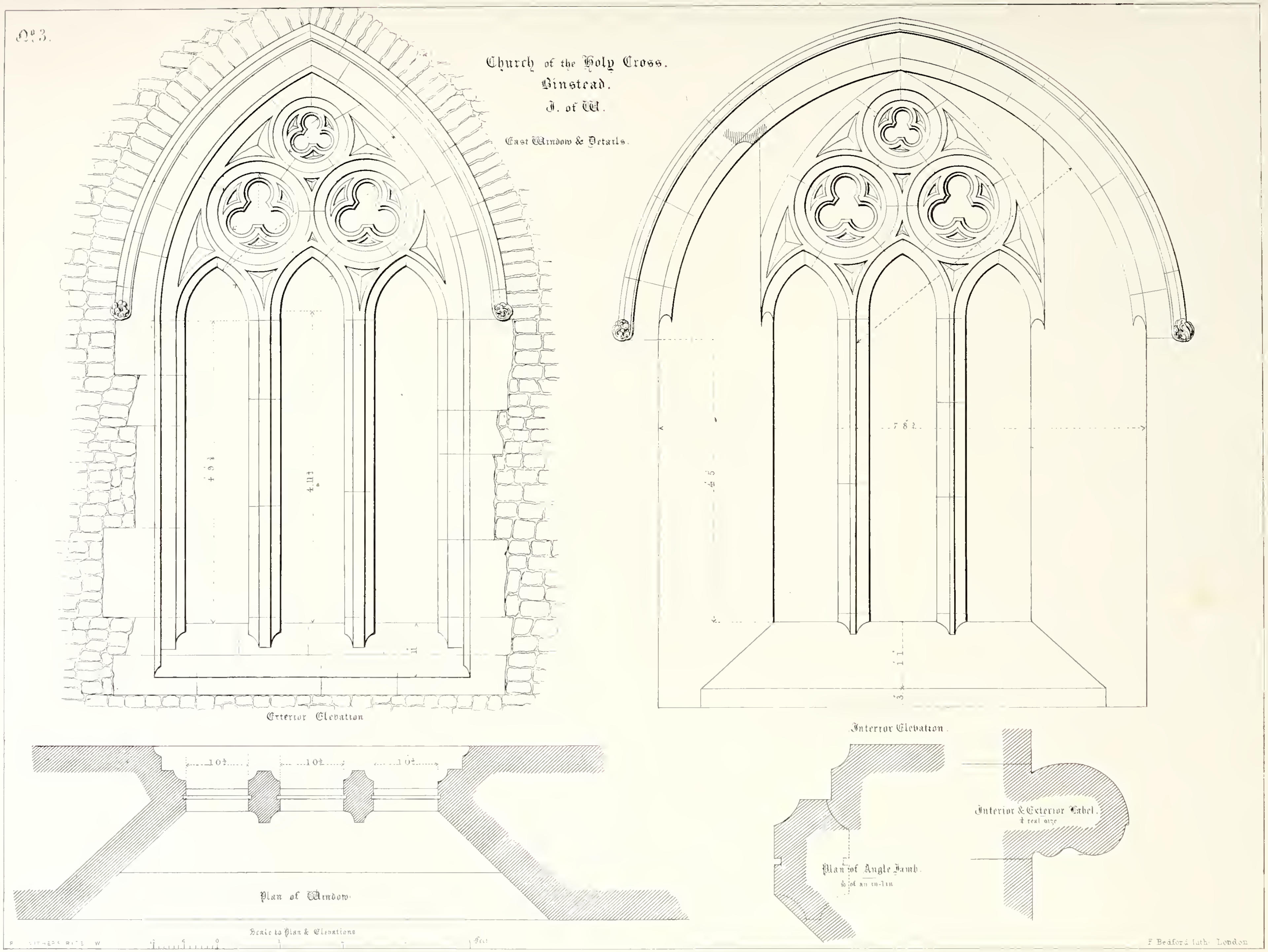
Reference

a Priests Door, now stopped up
b Recess in outside Wall
c Aumbrye or Locker
d Piscina.

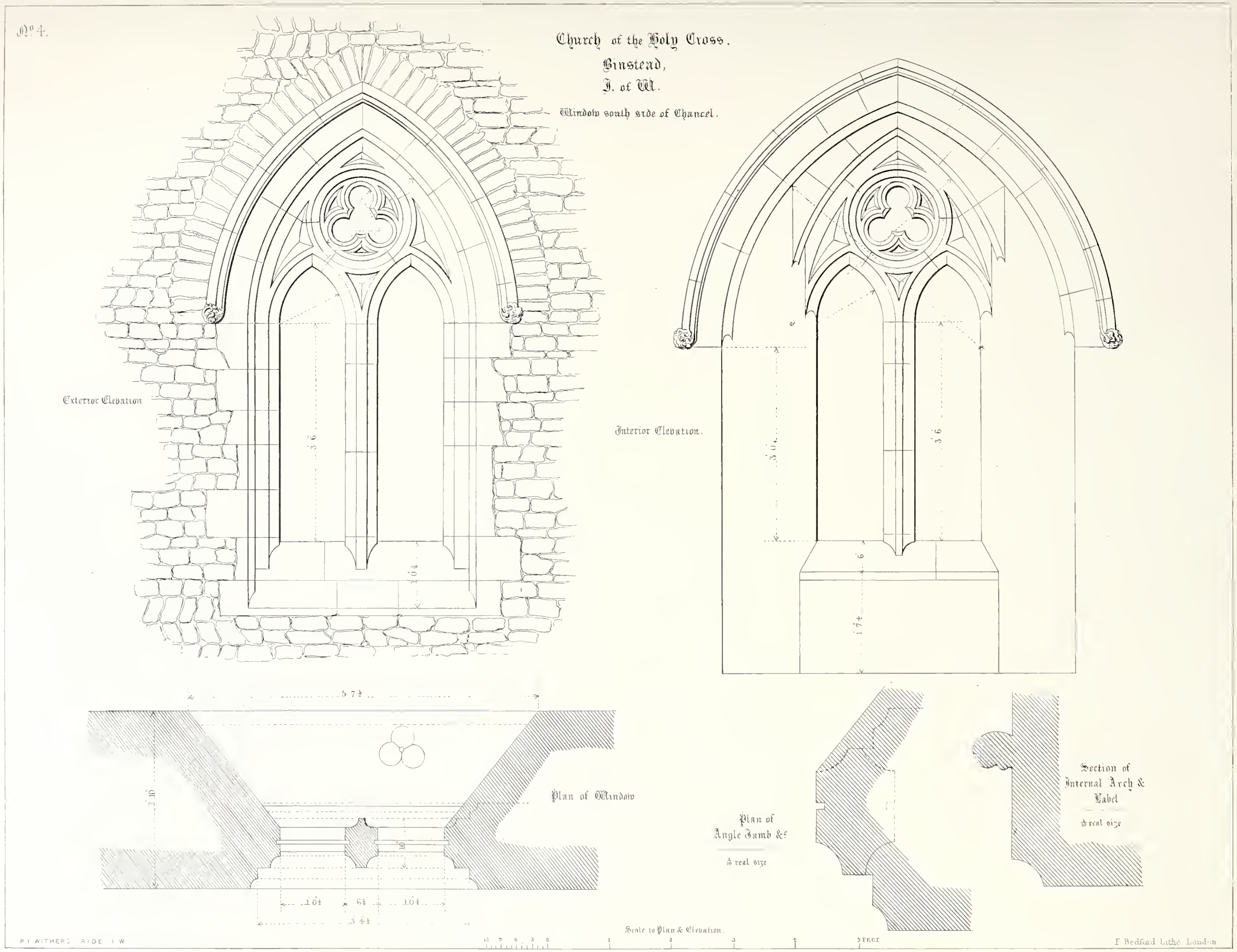
R. J. WITHERS, RYDE I. W.

Bedford, Lithog London

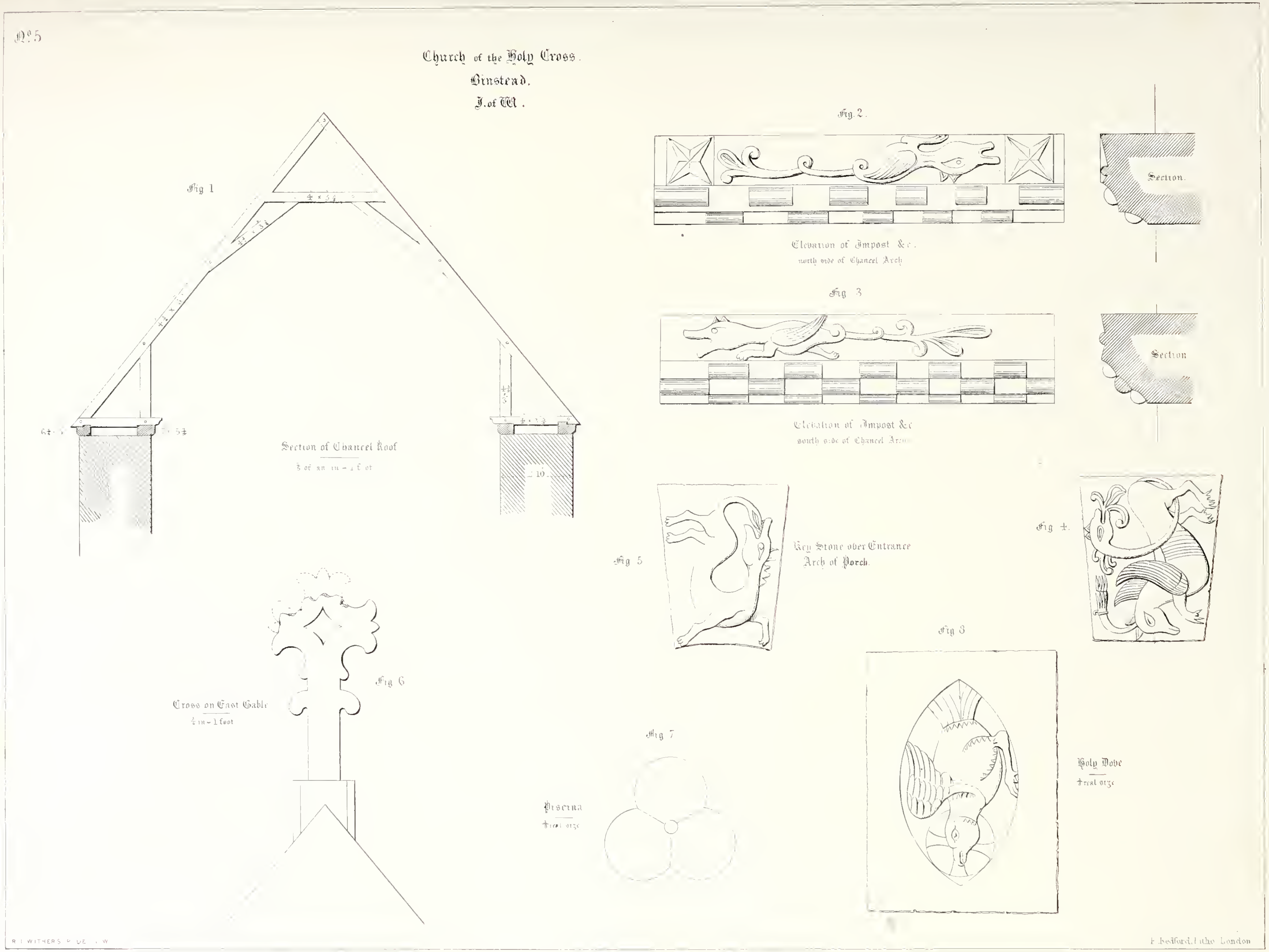
London, John Weale, 1845
Printed by Standidge & C°



London, John Weale, 1845
Printed by Standidge & Co.

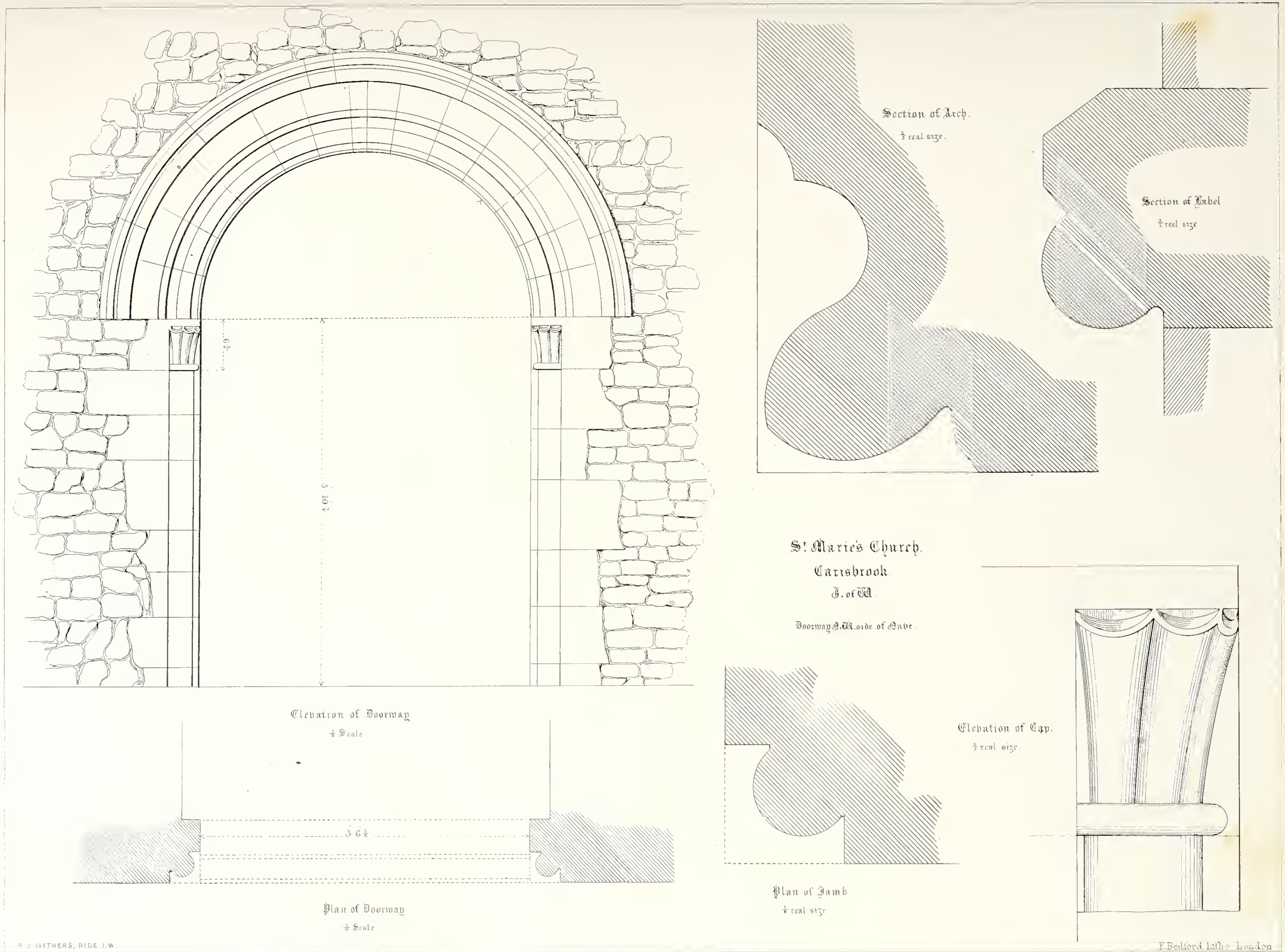


London John Weale 184
Printed by Standidge & Co.



No. 5
Church of the Holy Cross.
Binstead.
I. of W.
Fig 1
Section of Chancel Roof
Fig. 2.
Section.
Elevation of Impost &c.
north side of Chancel Arch
Fig 3
Section
Elevation of Impost &c
south side of Chancel Arch
Fig 4.
Fig 5
Key Stone over Entrance
Arch of Porch.
Fig 6
Cross on East Gable
¼ in = 1 foot
Fig 7
Piscina
Fig 8
Holy Dove
F. Bedford, Litho London

Weale



London, John Weale, 1845
Printed by Standidge & Co.

AN INTRODUCTORY ESSAY

ON THE

ART OF PAINTING ON GLASS,

BY EMANUEL OTTO FROMBERG.

TRANSLATED FROM THE GERMAN,

BY HENRY JAMES CLARKE.

AN INTRODUCTORY ESSAY.

Painted windows are allowed to be the richest and most magnificent application of art to the interior decoration of monumental buildings. The brilliancy and liveliness of the colours, of which glass is susceptible on account of its transparency, will always secure to this kind of painting a distinguished rank among the arts. The dazzling combination of colours, which fills the observer with astonishment, on account of their brilliancy, as well as on account of their variety, gives a peculiar character to painted windows, which prevents them from falling into oblivion, even should they be neglected for a time. If we go back to the elementary condition of the art, the symmetrical arrangement of pieces of glass of various forms and colours, combined with more or less skill, they are by no means entitled to engage our attention in a higher degree than the lustre of gold, and the most lively colours of the richest decoration. Yet with what magical charm must they not attract our observation and excite our admiration, when painting invests form with these beautiful colours, and breathes life and soul into them?

Painting on glass seems to have made a fresh start within the last few years. The favour with which the productions of this art have been universally received, promises it soon a new and brilliant career. But how has it happened that this species of painting, whose magical effects have been so justly appreciated, has been neglected for so long a time, after having for several centuries exercised the genius of artists, and been cultivated by them to the exclusion of almost every other?

Painting on glass has, in fact, experienced a remarkable fate. In the periods of barbarism, when war and devastation had smothered the taste for the arts, it came into existence, and was never more flourishing than in those centuries of ignorance. At the period of the regeneration of science and the arts, when good taste, and the love of what is beautiful and true to nature had begun to spread through Europe, its splendour seemed on the wane, and in process of time it became almost entirely extinct.

What, then, are the causes of so remarkable a decay? In the twelfth century, this art, which had been for a long time still in its infancy, seemed encouraged by the piety of the monks, (among whom alone the wrecks of the sciences and of the secret arts were yet to be found,) to make a vigorous attempt to release itself from the state of oppression into which it had fallen. But while the spirit was active and ready to soar, the means were wanting, and much time was spent in the choice of the proper mode of carrying it into practice. Many kinds of painting would have to be tried; and, at a time when taste had not yet been refined by long practice, and especially by the study of classical models, the preference would naturally be given to that kind of painting which was most capable of seducing the eye by the brilliancy of its colours. The combination of colours was the sole charm that painting could lay claim to; the merit of a beautiful outline, on the contrary, one which exhibited grace, purity, and correctness of form, was utterly neglected.

Hence the splendour of painted glass, and the almost universal admiration paid to it by those who felt themselves compelled to do so by the guardian genius of the art.

But in the succeeding centuries taste was cultivated. Art had less of the material, and found other facilities and other means of producing effect. She strove after effects of a much higher kind; and as genius endures with impatience the bridle of a difficult execution, the obstacles which the painting on glass presents to the expansion of thought, would considerably diminish the favour that it had enjoyed in consequence of the liveliness of its colours. Oil-painting was soon called into existence by Jean de Bruges. This new form of the art, the imitation of nature, gained the victory over the one which had preceded it, and painting on glass was driven from its throne.

The consequent decline of the art was not, however, sudden and precipitate. The revolution which in the sixteenth century took place in the arts, was also not without its influence upon the progress of painting on glass. Its most beautiful works were produced at that time. The most celebrated men did not disdain to support it by their talent; and never at any time was it more deserving of honour. It had, however, attained the summit of its greatness, and was soon to become a spectacle of the most complete decay.

Many causes undoubtedly conspired against its further prosperity. To these, among others, belong the religious disturbances and the wars which followed the reign of Francis I., and the calamities that were brought on by subsequent discords. But, above all, we must take into consideration the very strong prepossession in favour of oil-painting, awakened by the brilliant successes of its productions; and, moreover, the favour with which the art of engraving on copper, as well as all those arts which have drawing for their basis, were received. These arts shared among themselves the consideration that had been formerly given exclusively to painting on glass. Finally, we must bear in mind the singular patronage bestowed on oil-painting by those in power.

The various phases of the art of glass-painting clearly ascertain the mighty influences to which it must have yielded. The study of them offers to the inquirer matter for the most serious consideration. In the twelfth and thirteenth centuries, in the shadow of barbarism, if I may be allowed the expression, we see it making considerable progress. In the fourteenth and fifteenth centuries it bears unlimited sway over the arts. In the sixteenth century it becomes a rival to oil-painting, and, after an obstinate struggle, sinks into oblivion. All the old painted windows have something characteristic of the period to which they belong. The modifications which successively appeared in them, offer to the archæologist points of the deepest interest for observation and comparison, while they are at the same time the seals of their respective eras. These distinctive marks exist not merely in the painting, but also in the general conception of the entire work. We have only to cast our eyes upon a window of the twelfth and thirteenth centuries, and we shall discover, in a truly remarkable manner, the whole spirit of the Gothic monuments of that period. This kind of architecture, so rich in its ever alternating details, yet without any confusion, and regular in its monotony, successively presents that remarkable feature which we recognise alike in the entire structure and in each of its parts; and the reason of this lies in the fact, that the observer, before he can comprehend the numerous details, gradually perceives that they form an essentially harmonious whole. This peculiarity prevails in Gothic church-windows to an extraordinary degree. When viewed at a certain distance, they present a magnificent decoration of the most lively colours, distributed in a manner worthy of the most skilful workers in mosaic. It is a rich carpet, whose simple but graceful pattern is illuminated in alternate gradations of colours admirably combined. Upon a closer inspection, we obtain a complete view of the forms of the various ornaments, which contribute to the general effect, the naïveté of which makes us feel less regret at the imperfection of the execution.

Gothic painting borders on the mosaic, and we may go so far as to say that to this it owes its origin. Like the mosaic, its art was primarily limited almost exclusively to the symmetrical arrangement of pieces of glass of various colours. The art of drawing played here only a subordinate part; but, like the latter, it afterwards borrowed its forms from nature. In proportion as the taste for correct drawing was carried to perfection, the simple arrangement of glass lost its importance, and was finally eclipsed by the art of painting.

In the sixteenth and seventeenth centuries, correct delineation completely gained the ascendancy in painted windows, and we find in these neither the effects of symmetry nor of the mosaic. It underwent a change in every particular, to an historical kind of painting, of a much higher and more elaborate style, but which was no longer so rich and so brilliant: the sentiments of the soul gained at the expense of the impressions of the senses.

In the intervening centuries a transition took place from the one extreme to the other. At first we see the ground diversified with a thousand brilliant colours, on which, however, larger figures, drawn with greater skill, and after a pattern more or less understood, are occasionally to be met with, and occur as exceptions. In process of time, these figures are surrounded with splendid borders or friezes, which are finally obliged to give way to architectural backgrounds, and the imitation of the antique. These are the various forms under which the art of painting on glass was cultivated during a period of more than 600 years. In the eighteenth century it seemed to be completely lost.

But is it destined to lie neglected, because the reign of oil-painting will endure? Painting on glass cannot, for a moment, contend for the approbation of artists as the rival of the latter. The difficulty which attends the practice of it, and the necessity for the co-operation of chemistry in the productions of this kind of painting, leave its resources ever insufficient to enable it to vie with oil-painting, to which, on that account, it must unquestionably yield the pre-eminence. But if the artist who devotes himself to glass-painting is content to avail himself only of the legitimate resources of his art, if he does not strive after effect, nor endeavour to pursue the path of oil-painting, we have not the slightest hesitation in asserting, that painting on glass, considered as a monumental style of painting, constitutes an art, inimitable in itself, capable of being executed with great spirit, and worthy of engaging the most distinguished talents.

But then the painter on glass must refrain from attempting to imitate oil-painting. On the contrary, he must acquire the conviction, that, although these two arts have unquestionably a point of contact, they, nevertheless, possess sides extremely dissimilar. To these belong, in the first place, the proper modes of practising them respectively; lastly, the different conditions under which their effects are produced.

Thus, for example, painting on glass, on account of the distance at which the picture is placed from the spectator, requires to be treated in a perfectly distinct manner. It excludes detail, which, on an opaque surface, is susceptible of great effect, but which, through the transparency of the glass, is lost, even should not a defect in the burning have done injustice to the talent of the painter. But if, after all, the artist be bent upon giving to his performance all the harmony of an oil-painting, he must sacrifice the transparency, and the liveliness of the colours, which constitute the most beautiful feature of this kind of painting. Besides, the presence of the leading and the iron bars, which unite the various portions of a painted window, and which it is in vain to attempt to conceal entirely in the shadows of the picture, must ever prove the stumbling-block on which the claim of the artist to imitate oil-painting is sure to founder.

There is a fact, which observation itself has demonstrated to an inexperienced artist, and which must lead us to deliberate upon the method of proceeding in practising the art of painting on glass. It is this, viz., that in the colouring of a very elaborate cartoon, the half-tints, which have been diversified in gradations of colours delicately and harmoniously blended together, always run together into one colour, producing the same effect in every part, as soon as they are viewed at a distance. It is not our intention to account for this remarkable phenomenon, but we content ourselves with merely calling the attention of the glass-painter to the fact, in order that he may join with us in drawing the following conclusion from it.

A painted window, of very elaborate execution, which is designed to adorn a building dedicated to the worship of God, and consequently must be viewed at a certain distance, not only loses the fineness of the details, but is also obscured by the blending of the half-tints, and therefore becomes heavy, dry, and hard.

The art of painting on glass, for the purposes of decoration, is founded solely and entirely upon the observation of the above-mentioned fact. This species of painting, in fact, owes its origin to the necessity which the artist is under of conforming his work to the conditions imposed upon him by the distance at which the spectator must view the painting. What would be said of an artist who thought of treating decorative painting exactly as he would miniature painting? If we insist strongly upon this truth, it is for the purpose of applying it to painting on glass, which is indisputably a decorative kind of painting, and must be cultivated in this acceptation, except, perhaps, in the case of small cabinet windows, similar to those which are known under the name of Swiss-painted glass. If these rare exceptions be not taken into account, the painted glass in church-windows is at such a distance from the spectator, that it would be more prejudicial than useless to attempt perfection and elaborateness of detail, as it is practised in the case of an oil-painting. A pure and correct style of drawing, united to a simple and vigorous copying, are the qualities which the painter on glass must, before all things, endeavour to attain.

Unfortunately the assumption of superiority which has impelled mankind in all ages to outdo their predecessors, has also misled those who, in modern times, have attempted to revive the art of painting on glass. It is seldom that we avail ourselves of the experience of the former, and we attribute to their impotency that which is in reality the result of mature consideration, which, however, we are utterly incapable of appreciating. Thus, too, it has been taken for granted, that the last painters of the sixteenth and seventeenth centuries were not in a condition to make further advances in their art. Their performances were criticised, at the same time that they were compared with the contemporaneous productions of oil-painting. The recognition of this principle would, in our opinion, have been more modest, as well as more reasonable; viz., that the glass-painters of former times preserved their art free from all imitation; that a long experience taught them to be content with borrowing spirited ideas from oil-painting, and not to aim at producing the same effects by means differing so widely from one another, so that in the end they made painting on glass an isolated art, unlike any other in its effects as well as in its means, and one which is subject to peculiar conditions.

But, on the other hand, it has been said, that the ancients did not understand the art of painting on glass; and, under this impression, an attempt was made to execute what *they* had never been able to perform. This kind of emulation is undoubtedly noble and honourable; but it is to be regretted that such praiseworthy exertions have been misdirected; for, instead of continuing the progress begun by the ancients, when it was so easy to do so, artists consume their emulation in impotent attempts, until a personal experience induces them to resume the labours of the ancients, at the point where the latter have left off.

We must, however, do justice to him who rescued from oblivion an art that had been so long neglected. For this our thanks are due to the learned superintendent of the royal porcelain manufactory at Sèvres, Herr Brongniart, who has contributed much to its revival.

We believe we have now satisfactorily defined what we understand by the art of painting on glass. In our opinion there is still a future for this art, if its votaries do but follow the paths marked out for them. With respect to the kind of composition best adapted to it, we shall content ourselves with merely remarking, that the good taste of the artist alone must preside over his conceptions. As, however, some have given their opinion in favour of the Gothic style exclusively, others in favour of the style at the period of the revival of the art, according to the several directions which their studies have taken, we cannot forbear expressing our opinion upon this subject. We have no thought of enlisting followers for either party; but, without the smallest intention of drawing a comparison in this controversy, we may be permitted merely to hint, that the artist should not allow himself to be taken up with these discussions, and that in the conditions of his art alone he has to seek for the spirit that must direct the suggestions of his imagination. He should avail himself of all the resources afforded him by the nature of the things on which he has to exercise his talents. Ought he, for example, to forego the powerful effects which a skilful arrangement of colours enables him to produce? Should he disdain to derive advantage from the lively colouring of the glass, because it is the most goodly dowry of the Gothic style of the art? We think, not; but we are far from advising him, on the other hand, to sacrifice to such endeavours all the resources of painting which the revival-style is capable of affording him, provided that he uses all these means with moderation; and, we repeat it, keeps within the conditions of his art. We submit this opinion to the intelligent artist, who does not allow his ardent spirit to be carried away by his ideas; but we have no hope of convincing those who, in the wanderings of their fancy, as well as in the right path, have become the slaves of their imagination.

A very natural question presents itself to the mind, with regard to the erroneous belief which universally prevails, that the secrets of the art which were known to the ancients are lost. Are we capable, if not of surpassing, at least of resuming and continuing, the labours of the ancients? When we compare the glass of the old church-windows, of any period whatever, with the glass of our manufactories, we cannot for a moment doubt that our system of manufacturing it produces far more perfect results, certainly as far as regards its transparency, whiteness, and clearness, and generally with respect to all those qualities which are peculiar to glass. Besides, it is allowed that the methods of working have been considerably improved. And if, on the other hand, we compare fragments of old painted glass with that which we manufacture at the present day, it will appear in the most convincing manner, that our painted glass is not in the slightest degree inferior in point of colour to that of the ancients. There was a time when the manufacture of coloured glass was discontinued, because in consequence of the decline of the art of painting on glass this article was of no further use; but none of the secrets of the colouring were lost. Persons who were little aware of these circumstances, and mistook the effect for the cause, maintained that the reason why the art yielded nothing more, was, that the painters on glass no longer understood how to produce the ruby of the ancients.

But this assertion was very soon shown to be false; for as soon as ever the determination to restore painted windows manifested itself, the glass-house of Choisy in France, among others, proved by the most successful results, that the art of manufacturing coloured glass was in no way lost, but was only asleep. In fact, we possess a multitude of receipts of the ancients, according to which coloured glass was produced in former times. Moreover, in pigments we are much richer than the ancients; our pigments, too, are much better, more adhesively enamelled, in consequence of the improvements which have been introduced into the system of burning in the colours in modern times.

From what has been premised, we may conclude that our artists are in no respect in want of the material elements; on the contrary, they are far better aided by resources and means which await their disposal than the ancients were; and if their works attain no remarkable superiority, the reason of it must be sought for in the fact, that the best means and modes of execution in the arts are unfruitful, when they are not employed with sufficient taste and spirit.

Glass-painting has, in our time, risen into life again, surrounded by the fairest hopes; and what we know of the artists who are already practising it, leaves us not the slightest reason to doubt that it will soon be cultivated with a success worthy of the present age. We would gladly contribute in some degree to draw it forth from the state of oblivion in which it has been for a long time buried. For this purpose we shall now communicate a number of practical observations which lie in the sphere of glass-painting. We believe that we cannot contribute more effectually to the diffusion of the art, than by clearly laying down the methods employed in its practice. We shall advert to those both of the ancients and of the moderns, and compare them with one another, in order to show the improvements that have taken place in our time. At the present day, when artists as well as amateurs are most zealously engaged in glass-painting, we flatter ourselves that this information will not be uninteresting to many. Little has yet been written about it, and the majority of the publications that have appeared on the subject, treat more of the history than of the practice of the art.

The art of painting on glass by no means consists in the mere application of the colouring materials to the surface of the glass, by methods similar to those employed in oil-painting. The colours used are of a peculiar kind, and possess the power of vitrifying at a high temperature, and of fixing themselves unchangeably upon the glass. Consequently the glass, after the paint has been applied, must be exposed to a certain heat in a furnace adapted to this purpose. Appropriate means must also be employed in the application of vitrifiable colours.

A painting on glass,—as for example, a church-window,—always consists of a great number of pieces of coloured glass, whose various hues illuminate an ornamental pattern or an historical subject. These pieces of glass are either symmetrical or irregular, so as to agree with the sentiment exhibited in the composition itself. After they have been arranged in their proper places, they are encased in lead, and united so as to form one complete piece. These pieces are united by an iron frame-work, called the *arming*[a].

After the brief explanation we have just given of the conditions to which glass-painting is subject, we have to determine its connexion with other arts. In the first place, it is evident that the science of the chemist must be united to the talent of the painter, and that the glazier himself must lend his assistance. We have therefore divided this little work into several sections, in which the various branches of the art will be successively treated of. We have circumstantially discussed the following particulars :—

1. The quality of the pigments, their composition, their preparation, and lastly, all the chemical operations which are necessary previous to the painting ;

2. The means used in laying on the colours ; the various methods employed for this purpose, and every thing which has reference to the proper art of glass-painting ;

3. The manner in which the vitrifiable colours are burnt in ; and fourthly,

4. That part of the glazier's art that is concerned in the putting together painted windows in churches. Finally, we have given an account of the various mixtures with which the glass is coloured *en masse*.

Glass-painting, as it is practised at the present day, has scarcely any thing in common with that of the ancients, as far as regards the colours. When this art, which had been entirely neglected for a whole century, was rescued from oblivion, the improvements in the manufacture of glass had so materially changed the quality of this substance, that the ancient methods employed in the painting were no longer applicable. Towards the middle of the eighteenth century, glass was still composed almost exclusively of flint and potash or soda. This simple silicate was deficient in fusibility, and preserved an extraordinary tenacity even at the highest temperature ; it was difficult to purify, occasioned an enormous expense in fuel, and was not capable of being worked well. In the year 1760, Bosc d'Antic tried a mixture of lime in the form of carbonate of lime, which Kunckel had before proposed. A striking improvement in glass was thus obtained. When combined with silica, and with soda or potash, it forms a bisilicate, which is much more fusible than the simple silicates.

[a] Germ. *Armirung*.

The proportions of these substances were, however, for a long time badly determined, and it was not till lately that the makers were enabled to impart that fusibility to glass which renders it so easy to work, and so cheap to manufacture.

It is obvious that the pigments of the ancients, which were prepared for a hard kind of glass, could not have fusibility enough for the glass which is now manufactured. Other ingredients had to be sought for. But if the ancient methods of painting were no longer in accordance with the quality of the glass, still less were we acquainted with them. Moreover, the knowledge of enamel colours for metals, as well as for various kinds of earthenware, afforded easily applicable principles, according to which a series of properly fusible colours could be composed. The vast conquests of chemistry within the last fifty years, promised besides, to this manufacture, a very certain success. Modern glass-painting is thus almost entirely of late origin; and, with the exception of the process of burning in, has experienced modifications in every particular in a very remarkable manner. If we believe the testimony of the authors as far back as the period at which Levieil wrote, the glass-painters at that time burnt in their colours in iron boxes, in which the glass was arranged in layers with calcined and pulverized lime strewed between the strata of glass. But towards the year 1758, an English artist made known a new method of burning in, which he employed himself, and which, with some trifling modifications, has remained in use since that time. We shall describe this method more particularly in its proper place. The superiority of this new method of burning in the colour over the ancient method, and especially over that of Levieil, is incontestable. According to the method of the latter, the melted pigments were placed in contact with powdered lime: a portion of this powder adhered to the colours, and injured the transparency. If this was not always the case, the reason was, that the pigments, on account of their slight fusibility, merely adhered to the surface of the glass, and then again its transparency was impaired. The painted windows of the Levieil family furnish a proof of this, and in particular that in the chapel at Versailles, the blues of which are so obscured, that they appear black; and among others Pierre Levieil himself, in his work, admits the fact.

What we have said about the process of burning in, as far back as the time of Levieil, is founded upon the testimony of the writers who have left us some very interesting notices of the state of glass-painting at that period. To these, among others, belong Kunckel, Haudicquer de Blancourt, Levieil, &c. We have not, however, received their opinion upon this matter without due reflection. For how could it be supposed, that in the sixteenth century, when both glass-painting and enamel-painting were so generally honoured and cultivated, it should never have occurred to any of the artists, who were frequently skilled in both arts, to subject the process of burning in to those conditions which are indispensable in enamelling, namely, a contrivance for heating the plates of glass, isolated and entirely removed from contact with any other body which can adhere to the colours when in a state of fusion, soil their surface, and deprive them of their transparency? This fact may easily be explained with regard to the former centuries, in which the Gothic style only was cultivated in glass-painting. Because, as this kind of painting is limited to a mere outline upon a ground of glass, coloured *en masse*, little depended upon the smoothness and briliancy of the colours which were applied in the painting; on the contrary, a complete opacity was indispensable. But in the age of a Pinaigrier, or a Jean Cousin, when the use of pigments for painting almost entirely superseded that of coloured glass, it is hardly to be supposed that the glass-painters were unacquainted with a method of burning in similar to that which is now employed. And this is the less credible, inasmuch as the works of this period prove that pigments could be prepared of great clearness, free from all impurity, and just as good as the enamel-painters could produce. It may well be supposed that the traditions of the Levieil family have not informed us what the process was before their time. The progenitor of this family lived somewhere about the end of the seventeenth century. Glass-painting, which was gradually declining, was at that time only cultivated by a few artists. The Pinaigriers, and those of their school, had carried all the secrets of their art with them into the grave; and this was the case at that time with all who practised an art which was enveloped in mystery. Even the very writers who furnished the public with information upon the arts, always reserved that which was most useful for themselves. Cassius did so, according to his own confession, and Levieil made it a subject of complaint against Kunckel and Taunai. Before Guillaume Levieil but one artist, Jacques de Paroi, had written about glass-painting, and from this common source several authors who followed him, as well as the painters who in the most modern times devoted themselves to glass-painting, seem to have drawn. To the former belong Felibien, Florent le Comte, and Haudicquer de Blancourt; and to the latter the Levieils and the brothers Recollet. This is proved by their receipts, which they have transmitted to us, which are for the most part like one another, and are many of them completely identical.

It may be easily supposed that the Levieil family were unacquainted with the method of their ancestors, who kept it a secret, when it is certain that Pierre Levieil himself, in spite of his profound erudition, was ignorant of what was anterior to his time, although it had been made known. Fifteen years after the appearance of the English work which we spoke of, and actually at the time when he was writing, he still continued to adhere to the manifestly antiquated traditions of his family. However it may be in other respects, we have certainly, in the present state of our knowledge, no reason to envy the ancient glass-painters in regard to their methods of operation. Consequently, we have nothing to hope for from pretended discoveries of the secrets of the ancient artists, which were at times so pompously announced, because, as we have before stated, the improvements which took place in the arts in consequence of the progress of science, have placed us in an entirely new situation, which makes the methods of operation that were in vogue at a period far distant from the present time appear utterly useless.

PART I.

CHAPTER I.

OF THE QUALITY AND COMPOSITION OF THE PIGMENTS.

By the pigments necessary for painting on glass are understood vitrified or vitrifiable substances of various colours, which are applied to the surface of the glass, and fixed by being exposed to a temperature which brings them into a state of fusion.

Several qualities are indispensable to the pigments :—

1, fusibility at a given temperature ;
2, the power of adhering firmly to the glass and completely uniting with it ;
3, a peculiar transparency, or an opacity ;
4, a glassy appearance after fusion ;
5, a sufficient hardness to resist entirely the friction of solid bodies ;
6, insolubility in water ;
7, the being unchanged by the action of the air, moisture, and the gases, which are ordinarily diffused through the atmosphere ; lastly,
8, an expansibility equal to that of the pieces of glass that are to be painted with them.

The fusibility of the pigments must always be greater than that of the glass. As the latter becomes soft at a red heat of some intensity, it is necessary that the pigment should be in a state of fusion and become fixed to the glass, before it reach the temperature at which it would be spoilt by bending, from being at the point of fusion.

The pigments are almost always more or less transparent, and only a few must be opaque. In contradistinction to the other enamel-paintings, which convey to the eye merely reflected rays of light, a painting on glass receives it colour from transmitted rays. We can understand, therefore, that transparency is a quality very frequently necessary to the pigments. It is not always indispensable, that this transparency should be perfect and possess the clearness of glass ; on the contrary, it is often an advantage, when the objects which are behind the window cannot be distinguished. A half-transparency is usually sufficient, provided that it admits of a rich and magnificent colouring; but there are cases in which the painting requires perfectly opaque pigments.

The hardness of the pigments varies according to their composition. They must always possess a degree of hardness sufficient to enable them to resist easily the friction of hard bodies; but since the causes which operate mechanically upon painted windows, to the destruction of the pigments that lie on the surface of the glass, are exceedingly rare, the artist need not always exclude those pigments that are even of moderate hardness.

The resistance of the pigments to the chemical action of bodies must be such, that they cannot be affected by any of those agents to the influence of which they are ordinarily exposed, e. g. the action of the air, water, sulphuretted hydrogen [a], and other gases diffused in the atmosphere; but it matters little whether the pigments are capable of being acted upon by bodies with which they only accidentally come in contact, or not.

The unchangeableness of the pigments is as conditional as that of the glass, and is usually in proportion to their hardness.

Expansibility is one of the physical qualities of which the pigments must possess a precise and accurate amount. In the frequent changes of temperature which the painted plates of glass undergo, during and after the burning, the expansibility of the pigment must be in exact proportion to that of the glass. Were it otherwise, the expansion and contraction taking place irregularly in both bodies, would produce movements in the glass in opposite directions, which must occasion numerous fractures. These are in fact the accidents produced by pigments whose expansibility is ill suited to the glass. Pigments of this kind crack and split, and soon peel off the surface of the glass in the form of scales, while the glass itself, which on account of its thickness possesses firmness and a greater power of resistance, remains uninjured.

The pigments are composed:—1, of colouring materials [b], which in most cases belong to the class of metallic oxides; 2, of fluxes [c] or vehicles for colour, which are vitreous or vitrifiable compounds, through the medium of which the colouring matter is fixed upon the glass. These fluxes are generally silicic, boracic, or borosilicic salts, in which the acids are combined with the bases in certain proportions, and whose state of neutralization varies according to the several indications of which we shall afterwards have occassion to peak.

[a] Or, hydrosulphuric acid,—schwefelwasserstoffsäure.

[b] Farbestoffen. [c] Fluszmitteln.

In order to colour the pigments, the colour which a substance in its uncombined state affords is sometimes employed, sometimes that afforded by its combination with another substance which usually forms a part of the flux. In either case the colouring matter is always mixed with the pigments. This observation admits of a very nice distinction between them, so that we have divided them into two classes.

The first class comprehends those pigments in which the colouring matter is uncombined with the flux, and is in a state of simple mixture, as, e. g., in the case of oil-painting the colour is mixed with the oil. We shall call them *pigments coloured by mixture* [a].

The second class comprehends those whose colouring matter is in combination with the flux, has become a constituent part of it, and forms with it an entire vitrified mass, possessing all the properties of glass itself. We shall call them *pigments coloured by combination* [b].

This classification of the pigments has not been invented merely for the purpose of systematical arrangement, but is grounded rather upon practical considerations of the greatest importance.

The composition of the fluxes is not arbitrary. Independently of the peculiar qualities which they must possess in order to be really unchangeable, it is also necessary, since they are the medium through which the union between the vitreous and the colouring matter is effected, that they should be adapted to the nature of the former, to ensure their adhesion to it for a long period, and that they should also accord with the qualities of the colouring materials which they have to unite with the glass. The necessity there is for the fluxes being accommodated to all the requirements of the colouring materials, is the principal reason why a much larger quantity of this vehicle must be employed, as we shall show hereafter. We shall first consider the composition of the fluxes in the several relations they bear to the colouring matter.

In the pigments of the first class it is necessary that the flux be of such a quality that it will preserve the colouring matter in the isolated state upon which the obtaining the requisite colour depends, and that it contain nothing that can effect a change in the properties of the colouring matter. In the fused colours [c] of the second class, on the contrary, it is indispensable that the flux should exhibit a powerful action upon the colouring matter, by which action the combination from which the colour is to be obtained is effected. We shall now make a few observations, from which we shall deduce the principles of the composition of the fluxes, considered in that point of view in which we exhibited them above.

[a] Durch Mischung gefärbte Pigmente. [b] Durch Verbindung gefärbte Pigmente. [c] Glasmalerflüssen.

The fixed acids[a] combine with bases in all proportions; but each of these combinations has a certain point of saturation at which, when in a liquid state, it possesses just as little affinity for a greater quantity of base, as for a greater quantity of acid. This neutral state takes place in the most easily fusible combination[b], and the reason is as follows:—

If among the combinations of a fixed acid with a base but little or not at all fusible, that be chosen which possesses the greatest fusibility, and an attempt be made to unite with it successively fresh quantities of base, it will be observed that the temperature must be raised in proportion to the increased amount of base brought into combination. This, for example, is the case with the silicates of lime[c], iron, cobalt, copper, &c.

If, on the contrary, we wish to add successively to the combination of a fixed infusible acid with a base fresh quantities of acid, it is a well-known fact, that the temperature must likewise be raised in proportion to the quantity of acid which has entered into combination. Therefore, it may be asserted, that in the combinations which consist of a fixed acid and a base, beginning at the most fusible combination, an increase of base or acid requires a proportionate increase of temperature, provided that the substance which is to be added is not very easily fusible, and its combination in consequence independent of the temperature.

The principle which we have just established is certainly subject to modifications, sometimes in favour of the bases, sometimes in favour of the acids, according as they are more or less fusible[d]. In the silicates of lead the same degree of temperature is not necessary for the combination of a quantity of base, as is requisite for the combination of a larger quantity of acid, because the ready fusibility of the former makes its combination with the silica independent of the temperature. But we have in the borates of iron, cobalt, and copper, an example of the contrary, and here the rule is modified in favour of the bases, because the fusibility of boracic acid[e] renders an increase in the temperature unnecessary.

But exceptions like these are not to be found in the combinations we have just been speaking of, if, in the place of the fusible element, an infusible one be substituted in the mixture. This is the case, for instance, when oxide of iron is added to silicate of lead, or silicic acid to borate of lead.

From what has been premised, we infer that when we begin at the neutral state, the temperature which is requisite to unite an oxide with a flux, affords a rule for determining the disposition of this flux to become still more saturated. The more

[a] Feuerbeständigen. [b] Leichtflüssigsten. [c] Kieselsauren kalk, &c.
[d] Schmelzbar. [e] Borsaüre.

it is saturated, the greater difficulty it has in combining with a larger quantity of base, provided that the latter is not easily fusible. The proportions of the base, which have to be brought into combination, depend upon the temperature: the amount of base is determined according to a given temperature, the above-mentioned cases of easy fusibility excepted. If, therefore, we were to add a fresh quantity of base under the same conditions, it would not enter into chemical combination. This circumstance has now been taken advantage of in the composition of the fluxes of the pigments of the first class.

When the temperature at which the pigments pass into the liquid state is determined, the proper point of saturation for them is at the same time that which is proper for the flux, because we are assured that the colouring matter which has to be combined with it will remain uninjured.

If, then, we take the melting point of the pigments at a cherry-red heat, experience teaches us that the triple silicic and the double sub-boracic salts of lead, soda, and potash, which are then completely fused, can be saturated no further. If, therefore, we wish to colour a pigment with an oxide which shall only remain with its flux in the state of mechanical mixture, we must add to the latter the triple silicic and the double sub-boracic salts, of which we have just been speaking.

But if we wish to obtain a colour by means of an oxide which is to enter into chemical combination with the flux, the degree of saturation at which this combination is effected is fixed with as little precision as that of the temperature. If in this case it is judicious to employ a less saturated flux, this may only be done within the limits in which the pigment preserves its indispensable physical properties. As the temperature lends its aid, the combination of the oxide is always obtained. Hence it follows, that however the composition of the fluxes of the pigments of the first class is subject to certain strict conditions, this is not the case with the pigments of the second class. But even in these, as we shall soon see, directions of great importance must be given.

In the composition of the fluxes for pigments of the first class we have taken a moderate red heat as the point of saturation, for the following reasons: first, the glass which is painted is capable of bearing only a slight degree of heat, and the standard is its point of fusion, consequently the temperature must not be raised to this limit. Besides the degree of saturation which we have recommended is at the same time that at which the flux accommodates itself best to the expansibility of the glass, without our being thereby obliged to sacrifice the other desirable qualities of the pigments.

The saturation of the flux, and the temperature which it has to undergo, are however not the only things which must be attended to in the composition of the pigments. There are other secondary conditions, which are likewise of importance, partly to prevent the combination of the oxides with the pigments of the first class, partly to favour their combination with those of the second class. The exact degree of heat is not always easily obtained; and if it should happen to be exceeded in the pigments of the first class, the flux immediately regains its power over the colouring oxide. The change in this substance is in proportion to the quantity of flux. Hence we have a reason for prescribing as little flux as possible in pigments of this kind.

An opposite principle directs us to use as much flux as possible in the pigments of the second class. Besides, it is known that a greater saturation of the oxide is still more favourable to its combination. In order that the pigments of the first class may not be exposed to injurious alternations of temperature, the fluxes are not fused together with the oxides before they are required; while, on the other hand, no use is made of the pigments of the second class until a previous fusion has shown a perfect combination of the colouring matter.

We have already observed, that the saturation of the triple silicic and double sub-boracic salts[a] has been selected, because it fulfils the requirements of the colouring matter and of the glass, without endangering the intrinsic qualities of the pigment. In fact, we are strictly obliged to confine ourselves to these limits, if we wish to avoid the unpleasant results that have been mentioned above.

When a salt of silicic acid and a metallic oxide is combined with a silicic salt, having an alkaline base, by the agency of heat, the one is dissolved in the other. Does this result from an act of combination, or from simple mixture? The learned observations of Dumas upon the fortuitous crystallization of glass have proved, that the different kinds of glass are composed of certain definite silicates, and we have reason to believe that they are in a state of combination with one another. But even independently of the quality of these silicates, their various states of saturation produce numerous modifications in the properties of these compositions. The most important fact, however, which has been noticed, is the following:— Mr. Faraday has observed, that if only a slight addition be made to the quantity of oxide of lead which the common flint glass contains, this glass, which before was quite proof against moisture, then acquires the property of a hygrometer[b] in a remarkable degree, and in damp air soon loses its transparency. Several others have ascertained the truth of this fact from their own experiments. Flint glass is a silicic compound, of which the acids contain eight of oxygen to one of base. Whenever glass in general contains a

[a] Des dreifach kieselsauren und doppelt basisch-borsauren Salzes. [b] Hygrometrisch wird.

greater quantity of base, it is much more easily affected by water. This may be said of window-glass, looking-glasses, &c., especially when they have been polished. All these combinations yield an alkaline silicate, which is soluble in boiling water, and an insoluble silicic earth is precipitated. This takes place at the various degrees of saturation which lie between the octosilicate and the bisilicate. But it is a very remarkable fact, and one which has been especially observed with regard to those glasses which contain lead, that if flint glass [a], containing a soluble alkali, be reduced to a bisilicate in such a way as to be combined with a greater quantity of lead, this flint glass when pulverized gives up almost all its alkaline silicate in cold water, and that, too, almost immediately.

Hence it is, that the combination of a silicic salt of lead with an alkaline silicate, which is very easily decomposed in mass, in proportion as we descend from the octosilicate, possesses no stability at all when we reach the bisilicate ; for then the latter has become soluble in cold water, and is immediately dissolved in it. It is, however, probable that this is not the case with all bisilicic compounds ; for basic silicates are combined with one another in those kinds of glass which contain lead, whilst in bottle glass, for example, silicates of any kind are combined with basic silicates ; and combinations like these have more stability. But our business here is only with the silicates which contain lead ; for the pigments that are usually employed almost always contain lead. The reason of this is, that the silicic salts of lead are extremely useful in modifying the expansibility of the pigments. By increasing or diminishing the quantity of oxide of lead, we almost always succeed in imparting a degree of expansibility to the pigments equal to that of the glass. The same result cannot be obtained from an alkaline silicate. This shows us the reason why potash is avoided in the composition of the pigments. The necessary fusibility and expansibility require that the fluxes should be brought into that state of saturation in which they have very little stability, and are very liable to decomposition. At a high temperature the potash is decomposed, and evaporates ; when cold, the pigments are easily affected by moisture. This disagreeable circumstance is avoided by substituting for the potash borate of soda. The latter is much more fusible than the silicate of potash, and consequently enables us to obtain a proper fusibility, without lowering too much the degree of saturation. And so less colouring, less liability to change, and greater hardness are simultaneously obtained.

The whole matter may be shortly summed up thus :

1. In the pigments coloured by mixture, those silicates only may be used whose acids contain at most three times as much oxygen [b] as the bases.

[a] Krystall. [b] Sauerstoff.

2. In the pigments coloured by combination, a greater quantity of oxygen in the acids can only be of advantage when all other conditions have been complied with.

3. No pigment containing lead is to be prepared which contains the silicate of an alkali in a state of saturation beyond that of the trisilicate; that is to say, which contains a smaller portion of acid, or a greater quantity of base.

4. In every case, the indispensable conditions of fusibility, hardness, and expansibility, must be satisfied.

In the composition of fluxes, silicic and boracic salts of various metals are usually combined, because the salts formed by these combinations possess greater fusibility, and because among the simple silicates and borates, which might perhaps be sufficiently fusible, they would not have the requisite whiteness if they were employed alone. For instance, the silicic and boracic salts, which contain a great quantity of base, would possess sufficient fusibility; but they have a yellow colour, which is more distinct in proportion as they are saturated. It is therefore necessary to combine them with a certain quantity of alkaline silicates or borates, in order to render this colour less conspicuous.

It would be better if the silicic or boracic salts, which are used in the pigments, were all insoluble, like those of lime, aluminum, lead, &c. But the necessity for obtaining a great degree of fusibility requires the use of alkaline silicates and borates, which within certain limits obtain a sufficient stability from their combination.

From the principles which have been laid down above, it might seem that two kinds of fluxes are sufficient for the two classes of pigments. This would certainly be the case, if nothing more than the proper colour were attended to in the preparation of the pigments. But these pigments, which are made on purpose to be laid on the glass, must possess the same expansibility as the latter. Now the physical properties of the pigments are modified in a remarkable degree by the various substances employed in colouring, collectively and separately, in different ways. Consequently, it is only by changing the nature of the flux that we are capable of imparting the requisite expansibility to the pigments. Hence, also, arises the necessity for the existence of a great variety among the fluxes. When we come to treat of the pigments particularly, we shall also specify the fluxes proper for each. We shall, however, mention a few here, which may be adduced as an illustration of the rules we have laid down.

FLUXES FOR PIGMENTS OF THE FIRST CLASS.

	No. 1.	No. 2.	No. 3.
Silica [a]	1 pt.	3 pts.	2 pts.
Oxide of lead [b]	3 ,,	8 ,,	6 ,,
Calcined borax [c]	0 ,,	1 ,,	1 ,,

Haudicquer de Blancourt, who has described the preparation of the flux, No. 1, in his *Art de la Verrerie*, calls it *rocaille*, and it was formerly used as a glaze for common pottery ware. This flux, however, whose state of saturation is admirably adapted to the preparation of pigments of the first class, cannot be advantageously employed in every case. It frequently happens that a colouring oxide, when mixed with it, contributes to its decomposition [d], since it favours the separation of its elements. The pigment then undergoes a change on exposure to the air, the surface loses its brightness, and crumbles to powder. We are, however, unable to specify the nature of the action of the colouring substance. Perhaps it is only mechanical, and proceeds from the great distribution of parts [e], and from the porosity itself, which a powder in the state of simple mixture imparts to the pigment; perhaps, too, the oxide of lead has less affinity for the silica than the new substance which tries to supplant the first.

The rocaille flux is, after all, only employed with advantage in the pigments of the first class when they have previously to be melted. The more intimate mixture of the flux with the colouring matter then imparts a greater density to the pigment, which defends it against the action of the air. We prefer this explanation. When the pigment does not require to be melted first, it is advisable to substitute No. 2 or No. 3 for No. 1; for they are only a modification of the latter, and possess greater stability.

FLUXES FOR PIGMENTS OF THE SECOND CLASS.

	No. 1.	No. 2.	No. 3.	No. 4.
Silica	3 pts.	1 pt.	3 pts.	3 pts.
Minium [f]	8 ,,	8 ,,	6 ,,	6 ,,
Borax	3 ,,	2 ,,	3 ,,	2 ,,
Saltpetre	0 ,,	0 ,,	1 ,,	0 ,,

Every pigment might be prepared according to the above directions, if nothing but the good quality of these vitreous compounds were had in view. But those

[a] Kieselerde. [b] Bleioxyd. [c] Gebrannter borax.
[d] Zersetzung. [e] Vertheilung. [f] Mennige.

pigments chiefly that are to be produced by combination, are so changed in regard to their expansibility by certain oxides, e. g. those of copper and manganese, that, in order to destroy the effect of the latter, it is necessary to reduce the fluxes to a state of saturation, which cannot be done by the use of alkaline silicates, for they must be employed in such small quantities, that they may be enveloped, as it were, by the other silicates, and thus protected from the action of the water.

In this case the fluxes are very much saturated and less fitted to dissolve the oxides. But even then methods may be employed to facilitate their combinations, which we shall describe when we come to speak of the pigments in particular.

OF THE PREPARATION OF THE PIGMENTS IN GENERAL.

The preparation of the pigments, which embraces a number of particulars with regard to each, may however be reduced to two general methods of operation, according as they are coloured by mixture or by combination.

In the first case, as we have already said, a flux in which the base preponderates is chosen, and with this object in view, care is taken at the same time that the colouring oxide shall remain as short a time as possible in contact with the liquefied flux. For this purpose they are only mixed together by means of the runner upon the mill-stone[a], and the mixture is not heated until it is ready to be laid upon the glass; and exactly as much flux is used as is necessary to give body, smoothness, and brilliancy after the burning in to the pigment.

In the second case—

1. A pigment must be selected, in which the acids predominate as much as possible;

2. It is also necessary to fuse them together in a strong heat, in order to facilitate the reaction;

3. The flux must likewise be present in as large a quantity as possible without injuring the richness of the colouring;

4. The oxide must be perfectly free from combination, which might impede its union with the flux.

These are the most important varieties of the pigments, with regard to their composition and preparation. We subjoin some further considerations concerning the pigments collectively, that is to say, concerning the means of modifying their properties according to circumstances.

With respect to transparency[b], the pigments coloured by simple mixture are remarkably dissimilar to those which are coloured by chemical combination. It

[a] Des Läufers auf dem Reibestein, for the description of which see page 101. [b] Durchsichtigkeit.

will be readily understood, that an opaque colouring matter diffused through a glass vessel diminishes the transparency of the latter, so that the enamel [a] which is produced by it will be less permeable to light than another which has been coloured by a substance dissolved in a flux. It is also just as evident, that in the former case the opaque colouring matter diminishes the transparency of the flux, in proportion to the quantity in which it is added to it. Thus the transparency of the pigments is increased according as the quantity of colouring matter is diminished. But this can only be done at the cost of the colouring, and in such circumstances, where intensity of colour is not required, it will be better even to impair its stability; for the more flux there is, the greater the action known to take place upon the colouring metallic oxides. With regard to the pigments of the second class, their transparency can only be diminished by the mixture of substances which impart opacity to them.

The hardness of the pigments, under circumstances in other respects the same, increases in proportion to the quantity of the silica. This is just the case with regard to their resistance to the action of chemical agents. Consequently the opposite effect is produced as soon as the base is made to predominate.

We come now to their *expansibility*. It is of great importance to make this property of the pigments accord with that of the glass: it may, however, be very easily modified in the case of the former. With regard to this we believe we have observed, that in the borate, silicate, and borosilicate of lead, the base usually produces the opposite effect to that of the acid; but we are unable to state whether the one diminishes or the other increases the expansibility. It is enough for us to know, that if a pigment becomes full of cracks [b], the proper degree of expansibility may easily be imparted to it, either by increasing or diminishing the quantity of oxide of lead. We would recommend here the former method as the proper one in almost all cases.

FUSION OF THE FLUXES.

After the requisite quantities of the various substances that are to be used for a flux have been levigated and accurately weighed, nothing more remains than to fuse them. The powder is first well rubbed and mixed in a mortar. After careful mixture it is put into a covered crucible [c], which is placed in the furnace [d], fig. 9; a gentle heat is first applied, which is gradually increased, until the whole is brought into an undisturbed state of fusion, and all bubbles have ceased to form. The crucible is then taken out of the furnace, and the contents are poured into a vessel of cold water.

[a] Schmelzglas. [b] Rissig. [c] Verdeckten Schmelztiegel. [d] Schmelzofen.

They are then collected and dried upon paper. The action of the cold water splits the mass into small fragments, which can afterwards be more easily levigated. Without this precaution the flux would concrete into a vitreous mass, difficult to pulverize. This is exactly the mode of operation, when we have to combine a flux with a colouring metallic oxide for a pigment of the second class, as is the case with all vitrifications of fluxes or pigments.

If we would have our colours bright and pure, it is of essential importance that the pigments should be prepared from none but the purest substances. It is consequently necessary that we should be well acquainted with the properties of the substances to be employed. We therefore think it advisable to make a few preliminary remarks concerning some of them, and to give a full account of them afterwards in their proper places.

SILICA.

Silica is procured from flints[a], and white ones, or those of a beautiful black colour, are selected for this purpose. The yellow flints are less pure, and contain a great quantity of iron. For this purpose they are heated red hot, and then thrown into cold water to quench them. If the action of the cold water fails in cracking them in such a manner as to allow of their being easily crushed with the fingers into coarse sand, the operation is repeated; they are then reduced to powder and rubbed through a silken sieve. This powder must then be washed, and the supernatant water poured off as long as a fine powder continues to float on the surface, which gives the silica a yellow colour. This powder appears to consist of impurities, which originate partly from the furnace, partly from the cast-iron mortar which is employed in levigating the flint; they seem to be united with very fine silica, which could better be spared than retained in company with these foreign bodies. The particles of iron being very fine are carried off by the water in which the powder is washed, and separated before the process of heating the silica, (of which we shall presently speak,) in which those particles of iron would otherwise be further oxidized, and might not be so easily affected by acids.

After the silica has been washed in the manner above described, it is strongly heated and thrown a second time into cold water. The little grains of which it consists undergo a fresh division[b], which facilitates the action of the acids with which they come in contact, and also the fusion of the metals. They are now treated with hydrochloric acid, washed and dried. Silica might also be obtained in the same way

[a] Aus den sogenannten Feuersteinen. [b] Zertheilung.

from white granular quartz[a], but even the purest granular quartz contains a greater quantity of iron than flint does, on which account the preference is usually given to the latter.

BORAX.

The borax which is used in the preparation of the pigments is *fused borax*[b], which must not be confounded with *calcined borax*[c]. The latter contains still a great quantity of water. It is indispensably necessary to make use of the fused and perfectly vitrified borax, not only to enable us to calculate the quantities exactly, but also to avoid the swelling which would take place if borax in any other form were employed.

We shall hereafter enlarge more minutely upon the manner in which this operation is performed. When the borax is in a state of fusion, and appears perfectly clear, it is poured upon a smooth stone. It then presents the appearance of a beautiful white and entirely colourless glass. It must now be kept in a bottle well corked.

MINIUM.

The *orange-coloured* minium[d], as it is called, is most usually employed. It is the purest, and can be used without requiring a particular preparation. We shall only observe, however, that the minium must part with 2.23 per cent. of oxygen, in order that it may be reduced to the state of protoxide[e].

Of the other bodies which are used for fluxes we shall have occasion to speak elsewhere. Now that we have finished treating of the pigments in particular, we intend to subjoin a few general reflections, which we recommend to the consideration of the reader.

GENERAL REFLECTIONS CONCERNING THE COLOURING MATERIALS.

The chief colouring substances of the pigments are metallic oxides. Sometimes they are simply mixed with the whole body of the glass; at other times they are combined with the silica, and probably form double salts with the silicates of the fluxes. The analogy which prevails between the pigments and the other kinds of glass supports this hypothesis. It is known that in these compositions such alkaline silicates as are soluble in water when uncombined become almost insoluble as soon as they are

[a] Quarzsand. [b] Geschmolzener Borax. [c] Calcinirten Borax.
[d] Orange-gelbe. [e] Oxydul.

combined with other silicates, e. g., with silicate of lime, silicate of lead, silicate of aluminum[a], &c.

Now the combination of these bodies is the sole means by which their properties can be modified.

In the pigments coloured by mixture the colouring oxides are not always used separately; sometimes several are employed, after they have been previously combined with one another. But the conditions to which they are mutually subject are always independent of the flux.

The oxides which are combined in a pigment of this description do not give it the colour which the mixture of their respective colours would produce, but they give it peculiar shades of colour[b], which are determined by their state of combination.

Several oxides are frequently employed also in the pigments of the second class, but are not combined with one another, and the colour which is obtained is only the result of the mixture of the colours which each oxide produces of itself.

The combination of the oxides with one another is a valuable auxiliary in the preparation of the pigments. Sometimes these combinations impart to the oxides a greater power of resisting the action of the flux; at other times, on the contrary, they facilitate their solution in the latter. It is evident at once that the former are used for the pigments of the first class; the latter, on the other hand, for those of the second class. In the former case we should combine oxide of iron, for instance, with oxide of zinc, because the former, by virtue of this combination, which possesses great stability, would prove much more powerful in resisting the action of the flux, and thus the real colour of the oxide could be given to the pigment.

In the second case, on the contrary, we should combine oxide of cobalt with oxide of lead, so that their less stable combination may bring the former of these bodies into a state of fine division favourable to the action of the flux. This direction may be complied with in a very simple manner, if, instead of preparing the flux beforehand in order to combine it with the colouring matter by a second fusion, the colouring oxide be heated when mixed with the ingredients of the flux; for the oxide of lead, which forms one of these ingredients, will dissolve the colouring oxide, and by that means dispose it to combine more easily with the silica. We have therefore no hesitation in prescribing this method universally for the preparation of the pigments of the second class. We know no reason of sufficient importance to oblige us to use fluxes previously vitrified, as is the case with the pigments coloured by mixture.

[a] Der kieselsauren Thonerde. [b] Farbenabstufungen.

The combination of two oxides forms a real salt, in which the one appears in the character of the base, and the other in that of the acid. We shall now give a list of these bodies, in which those that act as base and those that act as acid are classed according to the energy they exhibit :—

ACID OXIDES.

Antimonic acid.
Antimonious acid.
Stannic acid [a].

INDIFFERENT OXIDES.

Protoxide of tin.
Oxide of antimony.
Oxide of chromium.
Sesquioxide of manganese.
Oxide of iron.
Oxide of aluminum.
Oxide of zinc.

BASIC OXIDES.

Protoxide of iron.
Protoxide of manganese.
Protoxide of lead.
Oxide of silver.
Oxide of bismuth.
Protoxide of cobalt.
Oxide of copper.

We shall now give a few examples of the above-mentioned compositions, as they are frequently employed :—

Antimonite of lead . . .	Yellow.
——— cobalt . . .	Dark green.
——— copper . . .	Pistachio green.
Perantimonite of iron . . .	Bees'-wax yellow.
——— zinc . . .	Yellow.
Zincate of iron [b]	Yellow ochre colour.

It is evident that a great number of combinations similar to those we have mentioned might be formed. A variety of mixed gradations of colour are obtained from

[a] Zinnsäure. [b] Zinksaures Eisen.

these compounds, which in painting are called *broken tints* [a], and which are of great service to the artist. Among these compounds are :—

Ferrate of manganese[b],
——— chrome,
——— cobalt,
——— copper,
Manganate of cobalt,
——— copper,
——— chrome,
Cuprate of silver[c], &c.

We shall treat of the preparation of these colouring substances hereafter.

CHAPTER II.

OF THE PIGMENTS IN PARTICULAR.

RED FOR THE FLESH-TINTS.

THIS pigment is coloured with oxide of iron, as it is obtained by calcining the green vitriol[d] of commerce; but must first be purified, principally in order to rid it of the sulphate of copper[e], which it almost always contains, and which, when the pigment is used, turns the red black.

PURIFICATION OF THE VITRIOL.

Dissolve the vitriol in twice its weight of cold water, and throw into the solution iron turnings, iron filings, or iron cuttings of any kind. The sulphate of copper will be decomposed, and the copper precipitated[f] in the metallic state in the form of a reddish powder. The solution should be stirred from time to time, and after the precipitation is completely at an end the liquor poured off and filtered.

[a] Gebrochene Töne. [b] Das eisensaure Mangan. [c] Das kupfersaure Silber.
[d] Eisenvitriol. [e] Schwefelsaurem Kupfer. [f] Niedergeschlagen.

To know whether all the copper has been precipitated, dip into the solution a bright blade of iron, and see whether it is covered with a surface of red copper.

The filtered solution of sulphate of iron must be put into an iron or leaden vessel, which is placed in a common oven, in order that it may become so concentrated by boiling as to have lost 5-8ths of the water which has been taken into solution. Its specific gravity will then be 40° of Beaumé's areometer, and the solution will begin to grow turbid; it is then left to crystallize in a wooden vessel covered with wax; twelve hours afterwards the mother liquor [a] is poured off, and the crystals are collected, strained, and dried.

DRYING OF THE SALT.

In order to dry the salt, and to perform the subsequent operation, two pounds of salt at the most should be treated at a time, for the sake of greater facility in manipulation.

Two pounds of the purified crystals are accordingly put into an iron vessel, which is placed in a furnace, and a moderate fire is applied, in order to melt them in their water of crystallization. When this has taken place the liquid mass begins to boil, and soon assumes the consistency of thin paste [b] and the colour of clay [c] softened by moisture. After it has become concentrated the temperature is lowered, that the melted mass may not boil over. In proportion as the water evaporates and the contents of the vessel are drying they are continually stirred, and during this process the bottom of the vessel especially must be scraped with an iron ladle having a long handle, until the salt is at length converted into a more or less coarse powder. It is now allowed to cool, after which it is pounded in an iron mortar, and finally rubbed through a silken sieve. In this state it is fit for the preparation of the red pigment.

PREPARATION OF THE RED PIGMENT.

For this operation a very thick cast-iron vessel is required, and it is not a matter of indifference whether merely a common iron vessel of moderate thickness be employed for this purpose or not; for there would be a danger of its being perforated with holes and destroyed before the conclusion of the operation; cast iron is more durable than wrought iron when applied to this use.

[a] Mutterlauge. [b] Flüssigen Breies. [c] Aufgeweichten Thones.

An earthen cylindrical furnace must likewise be employed, with a bottom of the same substance, and open at the top. A hole is bored at the bottom, to receive the muzzle of a small smith's bellows. The dimensions of this furnace must be six inches in diameter, and the same in height. In default of such a furnace, a common one might be used, but the temperature can be regulated much better in the one we have just described; for as soon as the operator ceases to blow, the fuel, receiving no air from any quarter, begins to go out. The vessel must be of the same width as the furnace.

These proportions for the furnace and the iron vessel must be adapted to the quantity of the salt that can be used at once, in order to perform the operation with due precaution.

The sulphate of iron, prepared according to the above directions, is heated until it assumes a dark red colour. Meanwhile it is continually stirred with an iron scraping instrument until the operation is finished, in order that fresh surfaces may be continually exposed and the whole may be uniformly heated. The powder at first becomes yellow, then brown, and at last assumes a greenish brown appearance, which after cooling changes to red. An acid and pungent gas is now disengaged. The operation is continued until the powder is reduced to about two-thirds of its volume. It is now from the fire and allowed to cool.

After a little practice, we may know by the colour of the substance when the operation must be brought to a conclusion. Should the operator, however, want experience, let him take portions of the substance at different periods of the operation, and he will thus be sure of obtaining the requisite tint[a]. In every case the operation must be concluded before the gas has ceased to be given off; for if it were prolonged to this point, it would be all to no purpose, and the result could only then be used as a dark brown or iron violet colour.

The red which has been obtained is put into a vessel, and boiling water poured upon it to dissolve the sulphate of iron that has not yet been decomposed. It is frequently stirred, allowed to subside, and the supernatant water is poured off. The red pigment is then cleansed from a few impurities remaining in it by being stirred in a vessel of fresh water, which is quickly poured off as soon as these impurities have subsided. If this operation be repeated as often as is necessary, the impurities will be completely removed. They are generally of a greenish grey colour. The powder of oxide of iron is now washed in a filter with cold water until the latter exudes from the filter perfectly tasteless. The result, when dried, is now ready to be mixed with the flux.

[a] Nüance.

THEORY.

What takes place in this operation? In the first place a portion of the acid of the salt is decomposed into sulphurous acid[a] which is given off, and oxygen, which converts the rest of the salt into persulphate of iron[b], which is mixed with the oxide of iron that has been liberated. This sulphate is now decomposed again; sulphuric acid is disengaged, and oxide of iron, mixed with undecomposed persulphate, remains.

It is well known, that the red oxide of iron changes its colour in proportion as the temperature to which it is exposed is increased. At first it possesses a yellowish red colour, which afterwards passes into a darker red, and finally into violet. If, therefore, it is required to produce a delicate red for the flesh-tints by calcining sulphate of iron, the latter must be acted upon by a heat sufficient to decompose it, but still not so great as to deepen the red which has already formed. Hence is evident the importance of always keeping it at a dull red heat, and of stirring it incessantly, so that the parts which lie at the bottom may not be too much heated. With respect to this circumstance we subjoin the following practical remark, viz., that in order to keep the powder at a dull red heat, while it is stirred, the bottom of the vessel must be at a cherry red heat.

The operation must be concluded before the sulphate is all decomposed, (and this is of the greatest importance,) so that the red which is formed may be mixed with a certain quantity of this salt. When the latter has been dissolved by the water in which it is washed, the oxide that remains is in a state of finer division, and possesses a lively red colour.

If the operation be continued too long, it seems to be prejudicial to the beauty of the red, even if the temperature be not very high. We may infer from this, that the oxide condenses not only in consequence of the high temperature to which it has been exposed, but also on account of the length of time during which it has been heated. And this is the reason why only a small quantity of the salt should be operated upon at a time.

Red of a beautiful tone from iron may be obtained with much greater certainty by a method which is based upon the theory we have just explained. A mixture of sulphate of iron and sulphate of potash is calcined, as in the foregoing operation, these salts having been previously combined in the state of solution, and then evaporated and dried by heat. The mixture may be heated merely in a crucible, provided that care is taken to increase the temperature slowly up to the dull red heat, and to keep it so until the operation is finished. But this latter method is less cer-

[a] Schwefelige Säure.

[b] Schwefelsaures Eisenoxyd.

tain. In every case the undecomposed sulphate of iron, as well as the sulphate of potash, is separated by repeated washings with hot water.

There is still another method which furnishes a red of great richness of colour, particularly for the flesh-tints. It consists in grinding sienna[a] in a solution of sulphate of potash, drying it by heat in an iron vessel[b] or even in a crucible merely, and calcining it the proper length of time at an incipient red heat, in order to develope the colour of the oxide of iron. The product is then washed with boiling water, to separate the sulphate of potash.

A similar result is obtained by calcining a mixture of equal parts of green vitriol and alum, previously united in solution, and proceeding in other respects according to the method we have just described for obtaining the red from sulphate of iron and sulphate of potash.

The preparation of the red from iron requires much more delicate manipulation than would be supposed. Whatever method be employed, the calcining must be performed with the greatest care, and we would particularly caution the reader against imagining that the details we have given are superfluous. It is difficult to determine which method of preparation deserves the preference, because, on a comparison of the various methods, we cannot always be sure of being subject to the same conditions, and we often lay to the charge of the method that which ought properly to be attributed to the manipulation. If we were to recommend one method more than another it would be the second, that which we have most frequently employed.

It now remains for us to explain why sulphate of potash is used in the preparation of the red obtained from iron. This salt is unchangeable at a red heat, and at this temperature has no chemical action upon the component parts of the sulphate of iron. Its action here is entirely mechanical. It supports, as it were, the complete decomposition of the sulphate of iron. But, although it remains undecomposed itself, its presence is by no means a matter of indifference. When the sulphate of iron is dried in contact with the sulphate of potash, it is kept by the latter salt in a state of fine division, analogous to that which it possesses in the state of solution; for every minute particle of iron is surrounded by numerous minute particles of sulphate of potash, so that, when the oxide of iron is separated, it must preserve the extremely fine division of the salt by which the oxide of iron was produced. It thus escapes that condensation and conglomeration which oxide of iron always undergoes when it is heated by itself. The unchangeableness of sulphate of potash at a red heat is the only reason why this salt has been selected for the operation in question. It is likewise employed for the same purpose in similar cases, where, as in the present in-

[a] Siena-Erde. [b] Schale.

stance, the object is to obtain oxides free from water in a state of the most minute division. There are various methods of applying it to this purpose.

1. Sulphate of potash is calcined at a red heat, together with the metallic sulphate whose oxide is to be obtained, provided that this sulphate is decomposable. The process is the same as has been described in the case of the red obtained from iron.

2. If the salt is not decomposable, the oxide in question is precipitated with potash; the solution is then evaporated to dryness, and the product is submitted to a red heat in a crucible. The sulphate of potash is next removed by boiling water.

3. If the oxide of another salt, not a sulphate, is to be obtained, we proceed as follows: after the oxide has been precipitated with potash, and the precipitate washed, it is mixed with a saturated solution of sulphate of potash, next evaporated, and the rest of the process is the same as we have described above.

M. de Montami treated certain oxides, probably with the same object, with chloride of sodium [a] in a similar manner, but his efforts were misdirected. He triturated red oxide of iron and chloride of sodium dry in a mortar together, and calcined the mixture in a bright red heat. In this way he calcined oxides, free from water and already condensed by the action of the fire, with the chloride. The oxides could not penetrate so deeply into the latter combination, which was applied in a solid state, as if it had been in the state of a red-hot liquid; and besides, they had undergone a very great change from the heat before it was introduced.

The red pigment is composed of:—

Red oxide of iron	1 part.
Flux No. 1, or No. 3, of the 1st class . .	3 parts.

The flux must be pulverized before it is weighed, because a certain quantity is always lost by pulverizing it in an iron mortar. It is then mixed with the oxide of iron, and the mixture levigated; at the same time a sufficient quantity of water is added to obtain a liquid paste, which is afterwards dried on plates.

This pigment must contain as much flux as will give it brilliancy when it is exposed to a cherry-red heat; a larger quantity of flux must, however, be avoided, because the flux would react upon the colouring oxide, and contribute to the production of a green silicate of iron which would be prejudicial to the purity of the red. We shall afterwards explain how this pigment is to be prepared for use, and under what conditions it must be heated after it has been laid on the glass.

[a] Chlornatrium.

If a greater degree of freshness and brilliancy is required in the red pigment which is used for the flesh-tints, a certain quantity of chloride of silver[a] must be added. The yellow tint which this combination produces imparts a greater liveliness to the red colour of the iron. The taste of the artist can alone determine the proportion of the substance to be added. The chloride of silver must previously be fused with the flux. The oxide of iron is added afterwards.

PURPLE[b] PIGMENT.

The preparation of the purple is a very delicate operation, the success of which is extremely uncertain. The reason of this is, that the method which is employed in the majority of cases for the preparation of a solution of tin furnishes an exceedingly variable compound, although the process is on every occasion the same. The precipitate which by this method is apparently obtained under exactly the same conditions, frequently varies from a more or less lively purple to a violet more or less dark, and even of a blackish colour ; and even the purple of the most beautiful tone is not always proof against the drying, and is turned black by the separation of the gold.

The method employed in most cases is as follows :—Take aqua regia[c] of 8 parts nitric acid[d] and 1 part sal-ammoniac[e], diluted with twice its weight of distilled water. Set the apparatus in a cold place, and introduce small pieces of tin one after another in proportion as they are dissolved. The action of the acid must be slow, and without a considerable quantity of heat being evolved. When the liquor has assumed a yellow colour, not very intense, it is fit for use. On the other hand, dissolve pure gold in aqua regia containing 1 part nitric acid to 2 parts hydrochloric acid. The gold has now to be precipitated by means of a solution of tin.

For this purpose, a few drops of the solution of gold are poured into a glass, and at least a thousand times their volume of water is added. Into this liquid some of the solution of tin is introduced, a drop at a time, until the water is coloured red.

This liquor is kept in a vessel by itself, and the same process is repeated until at length the requisite quantity of purple is obtained. In a few moments the purple collects in red flakes, which sink to the bottom. As soon as all the purple is precipitated the supernatant liquor is poured away. It is then washed several times with distilled water, which is likewise poured away. Next it is filtered, and whilst it is still moist it is triturated with its flux.

[a] Chlorsilber. [b] Purpurrothes, i. e. purple red. [c] Königswasser. [d] Saltpetersäure. [e] Salmiak.

The success of the operation depends upon the manner in which the salt of tin is prepared. In order that the purple may be of the proper quality, the action of the acid upon the tin must be neither too strong nor too weak; if it is too weak, too much protochloride[a] of tin is obtained, and if it is too strong, nothing but perchloride[b] of tin is produced. It is necessary to know how to keep the acid in exact equilibrium, so as to obtain a mixture of the two salts combined in as nearly as possible the proper proportions. The difficulties which accompany the regulating the effect of the acid in such a way as to obtain every time the same result, although the operation is not performed under the same conditions of temperature, are obvious to every one. Sometimes the protochloride, at other times the perchloride, is in excess; this explains the different appearances which this composition exhibits when used.

If the products of the operation are uncertain, variable in their colour, and disposed to decomposition during the process of drying, there is every reason to believe that the salt of tin is of a bad quality. The difficulty of imparting the requisite properties to this composition induced M. Reboulleau, among others, to seek for a simple and easy method of procuring with certainty a solution of tin adapted to the preparation of the purple. It is composed in a way that Dumas also considers the best, viz., of 1 atom of protochloride and 1 atom of perchloride of tin.

The method employed by M. Reboulleau for this purpose is as follows:—Protochloride of tin is first prepared by introducing grains of pure tin into a leaden vessel which can be closed by a lid of the same metal. A small quantity of concentrated hydrochloric acid is then poured upon the grains. The apparatus is gently warmed in a sand-bath, and small quantities of acid are gradually introduced until the tin is dissolved. The liquor is evaporated to 40° of Beaumé's areometer and allowed to crystallize. We have then merely to convert a definite portion of the protochloride of tin into perchloride. The crystallized protochloride is dissolved in a sufficient quantity of water; the solution is divided into two parts, one of which is set apart, while chlorine gas is infused into the other until the protochloride is completely changed into perchloride, which is removed for fear it should precipitate gold. This solution is added to the one which was set apart, and thus a solution of tin is obtained, in which the two chlorides are present in accurately determined proportions. The success which this method insures in the preparation of the purple is so perfectly certain, that it may be safely recommended to glass-painters and other artists.

The solution of tin serves only for precipitation from chloride of gold which is prepared by dissolving gold in aqua regia, composed of 1 part nitric acid, and 4 parts

[a] Zinnchlorür. [b] Zinnchlorid.

hydrochloric acid, evaporating it until it is dry, in order to drive off the excess of acid, and adding a quantity of distilled water sufficient to dissolve the salt which has been obtained.

The precipitation of the purple is a part of its preparation that requires very delicate manipulation. The manner in which the mixture of the two salts is effected is not a matter of indifference. Two methods may be employed: the solution of gold may be poured into the solution of tin, or vice versâ; but these two methods do not promise equal success. The following remarks will show why one method is to be preferred to the other.

When the precipitation of the purple is effected by the mixture of the salts of tin and gold, one of these three things will take place: viz., either the salts will be in proper proportions, or the salt of tin will predominate, or the salt of gold will be in excess.

If the salts are in proper proportions, the purple precipitate follows, accompanied by certain indications with which it is necessary to be acquainted. The liquor assumes an intensely red colour, similar to that of wine. The precipitate does not follow immediately, but the purple remains a longer or shorter time, as the case may be, in the solution, and frequently it is several hours before the separation is complete. When the precipitation takes place too quickly, it is always a proof that the purple is of a bad quality and contains an excess of gold.

If the salt of gold is in excess, a precipitate is formed which varies from a pale rose colour[a] to a more or less lively red, and the separation takes place immediately. In this case also the purple is imperfect.

If, on the contrary, the salt of tin predominates, no formation of purple takes place; the liquor assumes a yellowish or rose-coloured appearance, without affording any precipitate.

From what we have just stated, any one would be inclined to think that if the quantities of the two salts are previously determined, it would be sufficient to pour the solution of the one into that of the other and to stir them together. But this expectation is not easily realized; and it is thought more advisable to obtain a proper mixture by adding successive drops of the solution as long as it shall be found necessary; nor even then is it immaterial whether the solution of tin be poured into the solution of gold, or the solution of gold into the solution of tin.

Is the solution of tin to be poured into the solution of gold? As the addition is made by drops, the gold remains in excess in the liquid until the whole of the solution of tin has been introduced. Consequently an imperfect precipitate may be

[a] Rosenroth.

formed if the proper quantity of the solution of tin be not introduced with tolerable rapidity; and this is very frequently the result. If, on the contrary, too much solution of tin be added, no precipitation takes place, and it becomes necessary to reverse the operation, and to add the solution of gold. This method is therefore very uncertain.

Is the solution of the salt of gold to be poured into that of the salt of tin? So long as the salt of tin is in excess no precipitation takes place; but if we continue to add gold the purple soon makes its appearance, and we can always stop at the right time, because we are not obliged to hurry ourselves in the least degree. Only an inexpert operator runs the risk of introducing too much solution of gold. In such a case a precipitate of bad quality would be produced, and the experimen would entirely fail.

It is evident that, of these two methods, that according to which the solution of gold is poured into the solution of tin has the best prospect of success, and is the least liable to accidents. It may be asserted, that it is the only one which affords invariable results. It admits, too, of the treatment of any quantity we please, while the other method is only applicable when the solution has to be treated with a few *decagrammes*[a] at a time.

But whatever method be pursued, the solution of tin must at all events be diluted with a thousand times its weight of water, in order that the precipitate may be so much the more finely divided and more gelatinous. After the precipitation of the purple powder has subsided, it is put into a filter and washed with distilled water. It is advisable then to dissolve it in ammonia, and keep it in a well-stopped bottle. The capability of being dissolved in ammonia is the test of its good quality. If this property is wanting, we may be certain that it is of no use, for it will not possess durability.

In order to unite the purple with its flux, the latter is pulverized, moistened with the ammoniacal solution of the purple powder, and the mixture is effected by levigating them together upon a plate of glass. The relative quantities of the purple and the flux depend upon the richness of the colour which is intended to be given to the pigment. One-tenth of the purple in a dry state gives an intense colour. If we know the composition of the purple, the quantity of gold that is used, the quantity of ammonia in which the purple has been dissolved, it is an easy problem to determine the proportions of this solution, which must be added to the flux, in order to have used the equivalent of one-tenth of dry purple.

[a] The *decagramme* is equivalent to 154.42 English grains avoirdupois (the *gramme* being 15.442 grains,) according to the new metrical system of weights and measures.

The purple colour which is produced in fused pigments by the above mentioned composition, proceeds from metallic gold in a state of exceedingly fine division. The same colour is likewise obtained from pure chloride of gold, sulphuret of gold, and fulminating gold[a], in similar circumstances, and these combinations play the same part as the purple powder. When the latter is mixed with its flux and strongly heated, the tin is separated from the gold; but the latter, reduced to the metallic state, remains in a state of the most minute division, because the flux, being melted, is present in a liquid form. But as soon as the gold can collect together in particles of a larger size, there is a transition from red to violet and blue. This phenomenon is produced by several circumstances, which arise from the following causes:—

The flux for the purple must contain not much lead, but, on the contrary, a great quantity of acid, and must at the same time possess great fusibility. Stannic acid has in fact a great affinity for oxide of lead. When it is combined with gold, in the form of the purple powder, and is brought into contact with a flux containing a large amount of base, and at the same time lead, it leaves the gold in order to combine with the lead before the pigment is completely melted. This premature separation of the tin from the gold facilitates the agglomeration of the particles of the latter, which then assume the violet or blue colour we have been speaking of.

A large proportion of acid gives more stability to the silicate and borate of lead, so that it is more capable of resisting the action of the stannic acid.

The colour of the purple is, on the other hand, destroyed when the flux with which it is mixed wants fusibility. The temperature necessary to fuse the mixture produces at the same time the decomposition of the purple before it can be brought into its incipient state of division.

So also a purple pigment mixed with its flux, if too strongly heated, would undergo the same change from a contrary action, because the too great fusibility of the flux is favourable to the condensation of the gold.

Consequently it is necessary that the purple, at the moment when it is being decomposed, should be held in solution in a dense mass of liquid glass, in which every one of its particles may, as it were, remain isolated, in the same way as an oleaginous body is suspended in a slimy fluid.

The flux which seems best adapted to the purple is the following:—

Calcined borax	7 parts.
Silica	3 ,,
Minium	1 part.

This flux possesses sufficient fusibility, and at the same time great stability.

[a] Kuallgold.

Another still more fusible flux[a] :—

Calcined borax	7 parts.
Silica	3 ,,
Minium	1 part.

These substances are fused together.

Another still more fusible flux :—

Calcined borax	7 parts.
Silica	1 part.
Minium	1 ,,

These substances are likewise fused together.

For the purpose of obtaining a still more fusible flux, it is not unusual to increase the quantity of borax very considerably, without employing the other substances in larger quantities. Thus, for example, the following flux is used :—

Calcined borax	12 parts.
Sand	1 part.
Minium	1 ,,

A flux like this is, indeed, far more fusible than the foregoing, and more conveniently used for glass-painting, because only a moderate heat is required for it; but such a composition is liable to imperfections, and is not only more easily affected by moisture, but is also in the habit of coming off in scales. The purple colours generally possess these imperfections. It is owing to the great quantity of acid which they contain that their expansibility does not accord with that of certain kinds of glass. When this kind of painting is looked at with a magnifying glass, after the burning in, several cracks and fissures may be observed; and after a certain time, especially when the painting has been exposed to moisture and a variable temperature, it scales off, so that at last the glass becomes perfectly bare. It is of importance to examine in every case whether the pigments agree well with the glass in regard to expansibility, and it is frequently necessary either to vary the composition of the flux or to choose another kind of glass.

A carmine tint is given to the purple by adding to it a small quantity of chloride of silver, previously fused with ten times its weight of the flux which is used for the purple.

[a] Here there is evidently some mistake in the original, this and the foregoing flux being perfectly identical.

As the purple from gold is prepared in different manufactories in a great variety of ways, and the preparation is attended with various results, we shall conclude by stating several methods, for which we are indebted to men whose reputation is great in the scientific world.

According to Bastenaire Daudenart, the purple is prepared in the following manner:—

Nitric acid and gold are taken in the proportion of 8 parts, by weight, of the former to 1 of the latter. In order, however, that the operation may be performed with greater certainty, it is better, in case the acid should be more concentrated at one time than at another, and in order that similar results may be always obtained, to introduce gold into a retort until the acid is completely saturated. Especial care must be taken that the solution of gold is in a perfectly neutral state.

The nitro-muriatic acid[a], for the solution of gold, is composed of

Nitric acid	4 parts.
Muriatic acid[b]	1 part.

The former acid is poured into a retort, which is placed in a heated sand-bath, the muriatic acid is then introduced, and the liquid is at the same time stirred; a few minutes after, the gold is thrown into it, a small piece at a time. Gold riband[c] should be preferred, which may be bought at the goldbeater's, or else the gold, if it is at all thick, should be beaten very thin.

When the acid is observed to be incapable of dissolving any more gold, the retort is taken out of the sand-bath and placed upon a layer of rushes of a concave form, to receive the globular part of the retort. The liquid is left for some hours by itself, after which it assumes a beautiful dark yellow appearance.

The solution of tin is likewise made with nitro-muriatic acid, but instead of 4 parts of nitric acid 6 are used, and the following compound is obtained:—

Nitric acid	6 parts.
Muriatic acid	1 part.
Distilled water	4 parts.

The solution of the tin requires infinitely greater care than that of the gold; it must take place without any effervescence, and very slowly. Tin leaf[d], such as is used for covering mirrors, is selected for this operation. The solution takes place

[a] This is erroneously called "Saltpetersäure," nitric acid, in the original.

[b] Salzsäure. [c] Des bandförmigen Golblechs. [d] Blattzinn.

without heat, and only a very small quantity at a time is introduced into the acid which has been diluted with water; e. g., pieces of tin leaf eighteen *millimetres*[a] square, one after another, for the space of twelve hours, until the acid is completely saturated.

When both the solutions have been prepared in this way, the one is precipitated with the other; and this is the moment when it is the most difficult to obtain a beautiful purple. Many persons have been quite discouraged, and have given up even attempting to prepare this colour, because they have undertaken the operation too carelessly, when, in fact, it requires great nicety, or because they have not clearly understood the theory of the phenomena which take place in the mutual decomposition of the two soluble salts. Care must first be taken that both the solutions are very considerably diluted with water, for without this precaution gold is precipitated by the tin in a metallic state, which causes such a cohesion of the minute particles of the metal, that the desired results cannot be obtained in the precipitate. To avoid this disagreeable occurrence, which renders the whole operation fruitless, a large glass vessel, three parts full of distilled, or at all events very pure water must be taken, and into this a certain number of drops of the solution of gold must be poured. The number of drops must be in proportion to the size of the vessel. Suppose the vessel is capable of containing one *litre*[b] of water, as much as eighteen drops of the solution of gold may be dropped into it. This done, the liquid is stirred with a piece of the tube of a barometer, and it must then be of a pale yellow colour, but very clear; eight, ten, or twelve drops of the solution of tin are then dropped into the vessel, and care is taken to stir the mixture well, just while the solution is being dropped. As soon as the liquid is observed to have assumed a colour like that of red wine, no more solution of tin is added, (we should suppose that this would take place at the sixth drop,) because if the process be continued after the beautiful red colour has appeared, only a purple is obtained which approaches too near to violet.

There must be a large vessel of porcelain, or well-glazed Delf ware[c], ready to receive all the red liquid which is transferred from the glass vessel into which the solution of tin was dropped. Accordingly, when the liquid in the latter vessel is well saturated with the purple colour, it is introduced into the large vessel of Delf ware, and a fresh quantity of water is poured into the glass vessel, and then eighteen drops of the solution of gold. Whilst the solution of tin is being dropped the liquid

[a] The *metre* is 39.37079 English inches; the *millimetre*, being the 1000th part of the *metre*, is therefore equivalent to .03937079 inches.

[b] The *litre*, or cubic decimetre, is .22009687 of an imperial gallon.

[c] Fayance.

is stirred with a glass rod: the drops of the solution of tin must never amount to more than two-thirds of those of the solution of gold, especially if the purple is to be of a beautiful rose colour.

When as much gold and tin as is considered necessary has been precipitated, all the water which has been coloured red is poured together, and then left undisturbed. In the course of twenty-four hours a reddish-brown precipitate settles at the bottom of the Delf ware vessel. To hasten this subsiding, one or two pinches of kitchen salt may be thrown into the red liquor. Some writers have also recommended the addition of a certain quantity of fresh urine; but some solution of phosphorus may be more advantageously substituted for the latter. In other respects, it is far better that the subsiding at the bottom of the vessel should take place slowly and of itself, and in that case the supernatant liquor must be perfectly clear. This is poured off, and the remainder edulcorated several times with plenty of water: the precipitate is collected upon a piece of white paper, and dried in the shade. In the course of a few days it is easily removed from the paper, whereupon it is put away in a wide-mouthed bottle with a greased stopper, and kept from the light.

The formation of the purple proceeds:—1, from the elective affinity of gold and tin; 2, from the high state of oxidation of the tin; and 3, from the circumstance that the solutions are diluted with a great quantity of water, to weaken the affinity of the acid for the oxides as bases; for so long as the metals (gold and tin) are intimately combined with the acids in which they are dissolved, there is no chance of obtaining a purple of a beautiful colour.

Moreover, all the precipitates which are obtained by means of gold and tin differ from one another in a variety of circumstances. The quantity of water poured into the first vessel, namely, into that into which the solution of tin is dropped to mix with the solution of gold; the number of drops of the solution of tin in proportion to the number of those of the solution of gold; the purity of the water in which the precipitation is effected: all these circumstances might produce a great variety of tints. However, in general the purple is the more disposed to assume a violet colour when the precipitate contains a greater quantity of tin in proportion to the gold; on the other hand, the purple is more beautiful or more rose-coloured, the more solution of gold the precipitate contains. It is therefore quite at the option of the experimenter to prepare a more or less beautiful purple, if he only act upon this intimation with proper care. Proust and Oberkampf[a] have analyzed several red and violet-purple precipitates: they found in a beautiful rose-purple,—

[a] Annales de Chimie, T. lxxx. et lxxxvii.—(*Note of the Author.*)

20.58 oxide of tin, and
79.42 gold,

and in a violet purple precipitate,

60.18 oxide of tin, and
39.82 gold.

According to Berzelius, the purple contained—

28.35 oxide of gold,
65.00 oxide of tin,
7.65 water.

According to Buisson, the purple precipitate contains—

28.50 gold,
65.00 oxide of tin,
5.20 chlorine.

Cassola, Professor of Chemistry at Naples, gives the following receipt for the preparation of the purple.

Hydrochlorate of gold is prepared in the usual way: at the same time, tin filings are digested in vinegar for two or three days, and the solution is filtered. The solution of gold is then diluted with four or five times its weight of water, and the solution of protacetate of tin is generally poured into it until the red precipitate has formed; it is then washed and bottled up.

Cassola asserts that he obtained the same results by using a solution of protonitrate of tin, procured from tin filings, dissolved in concentrated nitric acid which had been diluted with fifteen parts of water. According to what he says, this solution of protonitrate of tin must not be used until it has been for two days in contact with the tin. Both solutions—that of the tin and that of the gold—must be mixed cold, in which case a purple precipitate, without a tinge of black, is immediately produced. Cassola, however, prefers the process with acetate of tin. He also employed protosulphate of tin, diluted largely with water, for the precipitation from the solution of gold, and obtained the same favourable results. The same phenomenon, however, with regard to the colour of the precipitate, takes place in precipitating with sulphate of tin, if it is used in excess, as if muriate of tin is employed in too great a quantity.

A beautiful purple may also be obtained by the following method:—1 part thin gold leaf is dissolved in aqua regia, the solution is poured into a glass, and diluted with 15 parts rain water; a solution of 1½ parts clean tin filings in muriatic acid, which has been allowed to cool, is added, and at the same time the mixture is continually stirred. After it has remained a quarter of an hour undisturbed, ½ part clean urine is poured into it, and the whole is well stirred. About two hours afterwards the liquor is poured away from the purple, which has now subsided, and the latter is completely edulcorated.

According to Stegers, a very beautiful purple is prepared in the following manner:—

Fine gold is dissolved in aqua regia. If the gold has been alloyed with silver, the solution is poured away from the precipitated chloride of silver; the latter is washed with distilled water and added to the solution, which, without being filtered, is evaporated with a moderate heat until a thick incrustation of crystals is formed, and only a little of the red solution bubbles up from under the incrusted surface when the vessel is inclined on its side. The whole is now left to cool, whereby it gradually solidifies throughout, and is dissolved without delay in ten times its weight of water; to avoid the attraction of moisture, the solution is filtered, and a small quantity of metallic gold is left behind. In order to wash out the filter, a portion is reserved out of the water, which has been accurately weighed, and this is afterwards added to the solution. The crystallized salt of tin of commerce is quite good enough for the purpose; if it is moist, it should be dried between printing-paper. One part of this salt is dissolved in four parts of distilled water; the solution is filtered and used immediately, because in time it becomes turbid, owing to its attracting oxygen from the air, and submuriate of tin is deposited in the form of a white powder. Next, 1 part of gum arabic is dissolved in 3 parts of hot distilled water, and the solution is filtered through gray blotting-paper, because printing-paper, on account of its greater closeness, impedes the passage of the glutinous fluid. When the three liquids have been prepared in the foregoing manner, 20 grains of the solution of gum are mixed with 3 ounces of distilled water, and, after careful stirring, 14 grains of the solution of tin are introduced. The vessel in which the latter was weighed out is rinsed with a little water, the whole is then mixed with 23 grains of the solution of gold, and the vessel which contained it is likewise rinsed, not with water, but with the mixture itself. The colour which arises from the above-mentioned proportions of these ingredients is a fiery reddish-brown; it is only in the fire, when this preparation is used for glass-painting, that it developes a purple unequalled in beauty. The colour may be slightly affected by the action of the acid which has been disengaged by the formation of the purple in the liquid; but this is obviated by diluting the solution with twice its weight of water, dissolving 10 grains of bicarbonate of potash in it, and mixing with it, according to the above direction, some of the solution of tin containing gum.

To separate the purple, whose precipitation is at present retarded by the gum, alcohol is added to the mixture until it grows very turbid; for this purpose about twice its weight of 75 per cent. spirit is required, that is to say if bicarbonate of potash has been used, otherwise three times is necessary. In the course of an hour, if the solution has been occasionally stirred during this time, the purple is precipitated in reddish-brown flakes, and the surpernatant liquor remains clear, with only a slight tinge of colour. This is decanted, and the precipitate is then washed with some more spirits of wine; it is strained through a filter of printing-paper, gradually deprived of its moisture by being squeezed with the latter through blotting-paper, removed to a rubbing saucer, and then ground with weak 50 per cent. spirits of wine to a thin paste, which is boiled for three minutes in a vessel proper for the purpose, and then poured into a cylindrical glass. As soon as it has subsided in this vessel, the liquor is poured away, and is replaced by twice as much water. This operation is repeated, by which means the gum is removed, all except a slight residue, which can do no harm. Should the purple subside very slowly from the last liquor, and form a dense, almost transparent, red stratum over the sediment, a fact which proves a disposition to be dissolved, the water must be poured away, and a small portion of strong alcohol must again be added to the remainder, in order that the purple may coagulate rather more densely, and the last addition of liquid may be filtered. In either case, the precipitate from which the liquor has been strained is pressed, as before, with the filter, between blotting-paper, and while moist is scraped off with a blunt knife and dried in a porcelain saucer, whereby it diminishes considerably in bulk and becomes of a perfectly dingy colour.

According to Buisson, the purple is prepared with the greatest certainty in the following manner:—1 *gramme* of the purest tin is dissolved in a sufficient quantity of muriatic acid. The solution must be neutral. Further, 2 *grammes* of tin are mixed with aqua regia, composed of 3 parts of nitric acid and 1 part of muriatic acid, so that the solution contains no protochloride of tin. Lastly, 7 *grammes* of fine gold are dissolved in a mixture of 1 part of nitric acid and 6 parts of muriatic acid, and this solution must likewise be neutral. The latter is diluted with $5\frac{1}{2}$ *litres* of water, the solution of perchloride of tin is added to it, and that of the protochloride is introduced a drop at a time, until the precipitate that is being formed possesses the requisite colour. This precipitate is edulcorated as quickly as possible.

It is of importance to know that the perchloride and the protochloride must not be produced separately, but both the chlorides at the same time, to enable us to obtain the purple from chloride of gold; and that it is further requisite that the three chlorides should be prepared for use perfectly free from acid.

Herr G. Creuzburg[a], a practical chemist, particularly recommends, in the preparation of the purple, the use of a solution of tin chemically pure; he therefore advises that the broken tin ore should be first treated with nitric acid, which dissolves all other foreign metals and converts the tin into an oxide. After the blue solution which contains the foreign metals, and among others copper, has been poured away from the oxide, which is in the form of a white powder, and the latter has been washed, dissolved in muriatic acid, and inspissated, chloride of tin, chemically pure and free from acid, is obtained. It now only remains to observe, that perchloride of tin, digested with metallic tin, gives protochloride of tin. When the two solutions of tin have been prepared in this manner, the remainder of the operation is performed according to Buisson's method. After a few slight preliminary experiments have been shown about the maximum of perchloride of tin that the solution of gold will bear, in order to give the purple with the protochloride, the requisite quantity of perchloride is poured all at once into the very dilute solution of gold, which is not thereby rendered turbid, and a slow precipitation is produced by the introduction of the protochloride, very much diluted, until the purple tint appears.

It was now a still more difficult task to find a suitable flux and other ingredients, in order to obtain a beautiful enamel colour. At last it was discovered that antimony and white enamel were the substances which, when mixed with the flux, were capable of lightening the tint of fine purple, so that the rose colour was particularly beautiful. The addition of metallic silver and chloride of silver, by which the purple colour used formerly to be brought out more strongly, was not applicable to this purple, and gave a useless colour, mingled with a horny-looking yellow, even on the addition of a very minute quantity of these substances.

Porcelain, of different kinds of glazing, gave various tints with one and the same purple.

Herr Creuzburg observes, that antimony not only brings out the purple tint more finely than any thing else, but also gives considerably more body to the colour, so that it bears more flux, and consequently a given quantity goes further.

Persons who were experienced in the preparation of a beautiful purple, and with whom he was personally acquainted, assured him that they never used the precipitate of Cassius in the preparation of their finest purple, unless they had obtained it accidentally. According to their assertion, the precipitate, which is of a grey colour

[a] Journal für praktische Chemie, herausgegeben vom Prof. Erdmann und Prof. Schweigger-Seidel. Bd. ix. Heft. 6.—(*Note of the Author.*)

approaching to violet, should give the most beautiful purple; the dirtier the colour of the precipitate, the more brilliant the purple which it gives when fused. This dirty precipitate should contain more gold, and urine should be employed in its preparation.

Frick, the privy counsellor of the mines, gives the following process for the preparation of the purple:—Tin is dissolved in very dilute aqua regia, without the application of heat, until the liquid begins to assume slightly the appearance of opal; the tin is then taken out and weighed, the liquid is diluted with a very great quantity of water, and some dilute solution of gold and dilute sulphuric acid, in certain given weights, are simultaneously poured into it whilst the mixture is being stirred. The quantity of the solution of gold to be poured into the solution of tin must be such that the weight of the gold will be to that of the tin as 36 to 10.

We are indebted to Professor Fuchs, of Munich, for a remarkably simple method of preparing the purple. A solution of permuriate of iron is added to a solution of protochloride of tin until the former loses its colour and assumes a greenish tinge. The mixture is then diluted with water, and some of it is poured into the solution of gold which has been properly diluted. The most beautiful purple is immediately produced, while the protoxide of iron remains in the solution without having any injurious effect. The precipitate becomes lighter coloured in drying, and appears as a dirty brown powder.

Herr C. F. Capaun considers the method of Professor Fuchs the best, judging from his own experience, but recommends the following process in the preparation of the purple powder:—

Let a solution of chloride of iron (the *liquor ferri muriatici oxydati* of the Prussian pharmacopœia) be diluted with 3 parts of water, to which let a solution of protochloride of tin, prepared from 1 part of protochloride of tin dissolved in 6 parts of distilled water by means of a few drops of muriatic acid, be added, until the mixture has assumed a greenish colour. Let this mixture be further diluted with 6 parts of distilled water and kept ready for use. If both the solutions were to be diluted at once with the whole quantity of water, the transition of the brown into the greenish colour would not be so clearly perceived. In the mean time, let pure muriatic acid be poured upon so much gold as is required for the operation; let the whole be heated to boiling, and pure nitric acid be introduced in small quantities at a time, until all the gold is dissolved: an excess of acid, especially nitric acid, should be avoided. To this solution let a portion of distilled water (360 times that of the gold to be used) be added, and some of the solution of iron and tin be poured into the mixture, whilst it is being stirred, as long as precipitation takes place. The precipitate will be of a beautiful purple, when dry will appear browner, but will dissolve in ammonia and fused pigments with an intense purple colour.

Dr. Bolley, however, could not always obtain exactly the same preparation according to the above method; he therefore attempted to procure a solution of the sesquioxide of tin in another way. The combination of chloride of tin and chloride of ammonium, (*pinksalt*[a], as it is called—a salt consisting of an equal number of atoms of chloride of tin and chloride of ammonium,) seemed very well adapted to this purpose. This salt is anhydrous, and not affected by the air, so that when exposed to dry it undergoes no changes which would be likely to induce an unscientific chemist to adopt wrong methods of proceeding. It contains an accurately balanced quantity of chloride of tin not liable to change, and this very circumstance renders it adapted to the preparation of the oxidized matter which lies half-way between the protoxide and the peroxide.

Dr. Bolley does not recommend the production of this sesquisalt of tin by the use of a prescribed weight of protochloride of tin dissolved in water containing muriatic acid, because any directions for doing this would be uncertain on account of the various quantities of water which the salt of tin contains, and partly on account of the increased oxidation of the latter: experience alone teaches us that perchloride of tin boiled with tin can be converted into the protochloride, and consequently, if the right quantity of tin be used, into the sesquichloride. According to Dr. Bolley's experiment, perchloride of tin combined with sal-ammoniac is the same in this respect as perchloride by itself. The *pinksalt* contains 70.8 per cent. perchloride, of which 32.3 per cent. is tin: if this amount of tin be increased by one-third, the quantity of chlorine remaining the same, sesquichloride will be produced from the perchloride. Consequently 100 *pinksalt* requires 10.7 metallic tin. Dr. Bolley subjected *pinksalt* and tin in the proportion we have specified, together with water, to the action of heat until the tin was dissolved; he then used the solution for the precipitation of the purple.

We now proceed to give a more detailed account of the experiment. 1.34 *grammes* of gold were dissolved in nitro-muriatic acid, an excess of acid being carefully avoided, and the solution was diluted with 480 *grammes* of water, the proportion specified by Capaun. To 10 *grammes* of dry *pinksalt* he added 1.07 of tin filings; 180 *grammes* of water were weighed out, and of these about 40 *grammes* were immediately brought in contact with the tin and *pinksalt*, and heat was applied until the tin was dissolved. The solution was now mixed with the remaining 140 *grammes* of water, and some of it was gradually introduced into the slightly warmed

[a] Pinksalz.

solution of gold until all precipitation ceased; the precipitate soon subsided, was taken out of the filter, washed and dried at the temperature of 100° C.; it weighed 4.92 *grammes,* and had become dark brown. The strained liquor was yet only of a pale red colour. The precipitate dissolved when digested in strong ammonia. The gold which it contained (calculating from the quantity of gold consumed) amounted to 21.4 per cent., a result which is most in accordance with Fuchs' analysis of the purple: he found in it 19 per cent. gold. In either case, every one who is engaged in the preparation of the purple for the purpose of applying it to the arts, will find in what we have stated an infallible means of obtaining the most efficacious proportions of the peroxide and the protoxide of tin that have yet been discovered.

OF THE BLUE.

The blue pigment receives its colour from oxide of cobalt, and belongs to the class of fused pigments which are coloured by chemical combination. The oxide of cobalt combined with silica and boracic acid acts as base. This pigment is also one of those which require to be fused before they are employed. As the peroxide is the most easily prepared of all the oxides of cobalt, it is usually mixed with the flux, for we know that it passes into protoxide at a high temperature. This change takes place much more rapidly and more effectually when assisted by the action of a fixed acid. The presence of the flux satisfies the latter condition. The peroxide of cobalt is reduced in contact with silica and boracic acid, and readily unites with them in the state of protoxide. The ease with which the reduction and combination take place is naturally in proportion to the abundance of silica or boracic acid in the flux. But if, on the contrary, the flux contains too great a quantity of base, the cobalt upon which the action of the acids is now less powerful, is reduced with difficulty to the state of protoxide, and requires an intense heat to effect a perfect combination. And even then the colour is seldom pure, and a blackish blue tint is usually obtained. Another circumstance, viz., impurity, contributes to impede the solution of the cobalt in the flux. There are even anterior combinations of cobalt with certain oxides, which, whenever they happen, render it extremely insusceptible of the action of the flux. In this case it very frequently assumes a greenish tint. It is therefore evident, that every thing which contributes to resist the conversion of the peroxide into the protoxide opposes the combination of cobalt with the acids of the flux. The whole resistance lies in this; for if the protoxide is for a moment produced, it is rapidly absorbed again, as will appear from the following remarks.

Certain necessary conditions of expansion frequently require that the vitrification of the cobalt, contrary to the directions we have given, should be effected in very saturated fluxes. In such a case, its combination is assisted in a remarkable manner by the following process. If a certain quantity of oxide of antimony be added to the peroxide of cobalt at the moment of its mixture with the flux, by virtue of its great affinity for the oxygen, it rapidly and completely effects the reduction of the peroxide of cobalt. The antimonious acid which is thereupon produced does not injure the purity of the colour in the slightest degree, and does not perceptibly impair the transparency, provided that too much oxide of antimony is not used. It is extremely probable that the protoxide of tin produces the same effect.

A mixture of oxide of zinc and peroxide of cobalt produces the same effect in another way. The remarkable endeavour of the oxide of zinc to enter into various combinations with the protoxide of cobalt affects the peroxide in the same way as the silica itself.

Phosphoric and arsenic acid likewise favour the solution of protoxide of cobalt in the fused pigment, whether they are added in an isolated state, or in combination with the cobalt itself, that is to say, in the state of phosphorates and arseniates. In the former case, they act by increasing the quantity of the acids; in the latter, because they contain cobalt in the state of protoxide. It is then only necessary to mix them with the flux.

We have said that the peroxide of cobalt is generally employed in order to obtain silicate of cobalt, which colours the fused pigment blue. The principal reason why this is chosen is, that if protoxide were used it would be converted into peroxide before the combination is effected, because it burns at a red heat. The carbonate would furnish the same result. But a combination of oxide of cobalt with oxide of zinc, which resists the action of heat better, may be employed with advantage. This combination is obtained by dissolving 1 part of sulphate of cobalt and 2 parts of sulphate of zinc in a sufficient quantity of water. Into this liquid a solution of subcarbonate of potash is poured until no more precipitate is produced. This precipitate is placed in the filter, washed and dried, and is then the composition which was required.

Not only does the oxide of cobalt produce the richest colour of all the oxides, but also a very small quantity only is necessary to impart a very deep colour to the fused pigment. The blue pigment is composed as follows:—Peroxide of cobalt 1 part, or zincate of cobalt 3 parts, flux from 6 to 9 parts.

The flux which is used for the blue pigment is one of the three which we have specified among the fluxes for pigments of the second class. The flux and the oxide are levigated together, the mixture is put into a crucible which is kept at a red heat until the contents are perfectly fused and all ebullition has ceased; the pigment is then poured into cold water, dried, and levigated.

The oxide of cobalt is employed in various proportions according to the strength or weakness of the colouring. The taste of the artist is easily satisfied in this respect.

As far as regards the blue pigments of the ancients, they are the best of all their compositions. The receipts of Felibien and Haudicquer de Blancourt, which we possess, afford a very excellent coloured glass. The blue pigments that Levieil and the brothers Recollet used to employ seem to have been drawn from the same source, although the imitation is not very correct. This pigment was composed in the following manner:—

Minium	1 part
Oxide of cobalt	1 ,,
Silica	4 parts
Nitrate of potash . . .	3 ,,

It is a quadrisilicate, and reminds us of M. Guinant's composition of flint glass. For 2 atoms of oxide of lead, 2 atoms of protoxide of cobalt are substituted here.

This enamel, like the majority of the ancient ones, is not capable of being used as a pigment, on account of its slight fusibility. However well it might have been adapted to the window-glass[a] of the ancients, it is certainly unfit for the glass of the present day, which is much more fusible.

The saturating point of this pigment was applied by the ancients to other colours, particularly to green, on account of which we have dwelt longer upon it than we should otherwise have done.

OF THE YELLOW.

The fused pigments may be coloured yellow by a great number of substances.

A lively and brilliant colour is obtained by means of metallic silver. The oxide of uranium by itself, when dissolved in a flux, furnishes also a beautiful yellow; but, in most cases, those oxides which are used as colouring materials are combined with one another by twos, and often in greater numbers. Thus, e. g., we combine—

Protoxide of lead with antimonic acid;
Protoxide of lead with oxide of iron;

[a] Scheibenglas.

Oxide of zinc with oxide of iron;
Oxide of iron with antimonic acid.

Other compounds likewise furnish useful yellow pigments. Among these are chloride of silver, chromate of lead, &c.

Each of these colouring substances produces the colour which belongs to it.

Silver gives a yellow varying from siskin yellow[a] to purple.

The oxides of lead and antimony also furnish a siskin yellow, but it is opaque.

The oxides of zinc and iron give an ochre-coloured yellow.

Chromate of lead, too, yields a very lively yellow tint, &c.

Among all these colouring substances, the chloride of silver, zincate of iron, and antimoniate of lead, are considered the best. The three tints which are produced by these colouring materials satisfy all the requirements of glass-painting.

YELLOW FROM SILVER.

This colour is obtained without the intervention of a flux. The process consists in covering those parts of the glass that are to be stained with a paste composed of chloride of silver and calcined yellow ochre, both levigated together with water. After the glass has been heated to a red heat in the muffle, the layer of ochre which adheres to the surface is removed by means of a spatula, and the glass is found to be stained. The yellow obtained in this way varies from siskin yellow to purplish yellow. It is not always, however, at the option of the artist to obtain any of these tints whatsoever, for some kinds of glass are stained by this process only bright light yellow, while others are capable of receiving a deep orange colour. The orange colour is frequently only to be obtained by repeating the process once or twice.

That kind of glass which, when plastered over with clay, is most disposed to lose its glaze[b], and which partly or entirely gives up the potash which it contains, seems to receive the best colour.

Dumas is of opinion that the white kinds of glass, those which contain a great quantity of aluminum, are the best for staining with silver, and they are the very kinds which, according to this chemist, can be the most easily deprived of their glaze. In the act of parting with their glaze, which is effected by the assistance of a paste[c], a formation of certain silicates which crystallize, and a separation of a part of the bases, take place. Those of them which are volatile, e. g. the alkalies, are disengaged, and the fixed oxides, e. g. those of iron and manganese, pass into the state of sesquioxide.

[a] Zeisiggelb. [b] Sich zu entglasen. [c] Cement.

This is the case with regard to the separation of a portion of soda or potash, upon which the colouring of the glass by means of silver depends. When the glass is covered with the paste of clay with which chloride of silver is mixed, and exposed to a red heat, the chloride is volatilized, its vapour saturates the glass, and as soon as it comes in contact with the potash which has been liberated, the silver is reduced to the metallic state; chloride of soda or chloride of potash is produced and volatilizes, while the metallic silver is fixed upon the surface, and often even penetrates a considerable depth into the body of the glass. If the quantity of reduced silver is small, the colour is siskin yellow. If it is more considerable, the yellow becomes deeper, and passes over into a more or less intense red.

The latter colour may be obtained in less time, and with greater certainty, by using glass with which a certain quantity of chloride of silver has been mixed at the moment of its manufacture. For this purpose the glass must be well refined, and contain no excess of uncombined alkali by which the chloride of silver would be reduced too soon. The colouring is then effected in the manner we have already described.

That it is the reduced metallic silver which produces the colour in the glass has been demonstrated by very decisive experiments.

If we take glass with which $\frac{1}{200}$th of its weight of chloride of silver has been mixed, heat it red hot, and in this state cause a stream of hydrogen gas[a] to pass over its surface, the glass immediately receives an intensely red colour, which result is likewise obtained by covering the glass with pure clay. In the former case, the action of the hydrogen gas upon the chloride of silver is manifestly the principle upon which the colouring of the glass depends. Now the action of this gas consists in reducing the silver to the metallic state; for if the quantity of chloride of silver be increased, the surface, when acted upon by the hydrogen gas, is covered with a stratum of silver possessing a metallic lustre.

The same colour is also produced, as we have stated, by the surface being in contact with a layer of clay, and we believe that the nature of the process by which it is produced is exactly the same. It does not appear, however, as if the clay effected this by an immediate action, that is to say, by the reduction of the chloride of silver. We attribute this action to one of the phenomena which accompany the depriving the glass of its glaze, namely, to the volatilization of the potash.

Even up to the present day, the staining the glass yellow has been attributed to the oxide of silver; but experience incontrovertibly proves that this effect is produced by

[a] Wasserstoffgas.

metallic silver. In this there is a striking analogy between the manner of colouring of the latter and that of gold. The yellow or red colour proceeds from the silver in a state of extremely fine division, and the purple from gold in the same condition.

When the silver is in such a state of division as to be capable of colouring the glass, it only continues so under certain conditions. Accordingly, as soon as ever the yellow is produced, care must be taken not to let the glass pass into the state of fusion, for in the disturbance produced by the motion of the liquid mass the particles of silver assemble in larger groups, from whence arises a new colour in place of the former. The silver in this state of less minute division assumes a very intense blue colour. Hence we arrive at this practical conclusion, viz., that silver is only capable of colouring glass at that moment of its formation at which it has been brought to the proper density, and that for the colouring of fused pigments it can only be used within certain limitations of fusibility at a heat which the glass shall be able to bear.

We have one or two more words to say upon the preparation of the paste for the yellow. Ferruginous clay is used, commonly known by the name of *yellow ochre.* This clay must be calcined, otherwise the paste which is laid on the glass would be full of cracks, in consequence of the diminution in bulk which clay undergoes when exposed to a strong heat. Those parts of the glass which correspond to these cracks would then receive no colour. Consequently, the yellow ochre must be raised to at least as high a temperature as the glass in the muffle.

The relative quantities of chloride of silver and burnt ochre are as follows:—

Chloride of silver	1 part.
Ochre	From 6 to 12 parts.

A greater proportion of chloride of silver would cause the paste to adhere too strongly to the glass. The chloride of silver and the clay are carefully rubbed upon a glass plate with a sufficient quantity of water to form a paste, which is applied in a thick layer to the surface of the glass by means of a paint-brush.

This yellow is frequently employed to give brilliancy and liveliness to the red obtained from iron. In this case it is applied to the side opposite to the painting.

Chloride of silver, by itself, is also capable of staining the fused pigments yellow; but then it imparts to them a colour of its own, if it mixes with them without being decomposed. Here metallic silver is not the cause of the colour. The chloride of silver must be fused with its flux in the proportions of from 1 to 2 parts of the former to 10 of the latter. When united with one of the fluxes for pigments of the first class, it is used as a mixture for the flesh-red to give it brilliancy. With the purple it produces a carmine tint, and only a very small quantity requires to be mixed with it.

The yellow pigment which chloride of silver furnishes can also be employed in an isolated state.

ORANGE COLOUR FROM SILVER[a].

This orange colour is only a shade of the yellow from silver which we have been speaking of, and is likewise prepared in the same way, except that for chloride sulphuret of silver in the same proportions is substituted. Similar phenomena may be observed during the process, and metallic silver is always the element of the colour. Orange-yellow is obtained with much greater certainty from sulphuret of silver, while on the other hand chloride of silver answers much better for a light yellow, although it is not always in our power to produce any given colour.

RED FROM SILVER[b].

A red colour is also infallibly obtained by using sulphuret of silver. In this case the preparation which was employed for the orange-yellow is slightly modified by adding a few drops of sulphuric acid at the moment when it is being used. If no red be obtained at the first laying on of the pigment it must be laid on a second time.

The sulphuret gives an intense colour with much greater certainty than the chloride of silver, for at a red heat it decomposes of itself, and can therefore produce its effect without the aid of the unglazing. The latter, however, is not prejudicial to it, and is only to facilitate the saturation of the glass by metallic vapours. The mixture of sulphuric acid has, in our opinion, no other object than this. Some sulphate or other is undoubtedly formed by the agency of this acid, which is decomposed in the red heat by the silica of the clay and occasions the internal motion of the glass, whilst it affects its surface. This is what actually takes place in the unglazing of the glass, which unglazing we are convinced is effected by means of a mixture of sand and sulphate of lime.

The unglazing which is capable of facilitating the colouring of the glass by silver is not so great a change in the glass as to deprive it of all its transparency, but merely a slight modification by which its properties are uninjured. It is worth observing, however, that a piece of glass stained red in this manner does not possess the purity of colour which belongs to one coloured by copper. When the tone of colour is the same for both, that which was coloured by silver appears the darker.

Sulphuret of silver is prepared in the following manner :—Pure silver is melted in

[a] Silverorangegelb. [b] Silberroth.

a crucible, half its weight of sulphur is then introduced. The sulphuret of silver which is generally used is prepared by heating together 2 parts of silver and 1 of sulphuret of antimony.

OCHRE YELLOW[a].

The ochre yellow pigment is one of those fused pigments which are coloured by mixture. It receives its colour from the mixture of oxide of zinc and oxide of iron. This fused colour is a zincate of iron in which each atom of the one oxide is combined with an atom of the other oxide. This salt is obtained from sulphate of iron and sulphate of zinc precipitated with potash, soda, or their carbonates.

The persulphate of iron is prepared by dissolving 96 parts of protosulphate of iron in 100 parts of water, and adding half as much sulphuric acid as the salt already contains. The solution is heated to boiling, when small portions of nitric acid are introduced, until all nitrous acid has ceased to be disengaged. This operation may be explained in the following way:—

The protoxide of iron contains,

1 atom of iron	339.21
1 ,, ,, oxygen	100.
1 ,, ,, acid	501.16
1 ,, ,, protosulphate of iron	940.37

The persulphate of iron consists of,

2 atoms of iron	678.43
3 ,, ,, oxygen	300.
3 ,, ,, acid	1503.48
1 ,, ,, persulphate of iron	2481.91

It is therefore necessary for the obtaining 1 atom of persulphate of iron to add to 2 atoms of protosulphate of iron 1 atom of sulphuric acid, that is to say, half as much as the salt already contains, and 1 atom of oxygen besides, which is supplied by the nitric acid.

The protosulphate of iron, when crystallized, contains 44—45 per cent. water, and the sulphuric acid of commerce contains only 81.68 per cent. pure acid. Consequently 18 parts of the sulphuric acid of commerce must be added to 100 of crystallized protosulphate of iron.

In order to form zincate of iron, so that each atom of the one oxide shall be com-

[a] Okergelb.

bined with an atom of the other oxide, a solution of persulphate of iron and another of sulphate of zinc, both having the same weight on the areometer, must be prepared separately, and so much in volume must be taken from each, that the salt of zinc may be to that of iron as 2 to 5; or a solution of the salt of zinc, weighing 10° B., and another of the salt of iron, weighing 25° B., may be mixed together in equal quantities. The precipitate which is then obtained by means of potash, or its carbonates, will contain in its composition the proper proportion; for sulphate of zinc consists of,

1 atom of oxide of zinc	503.32
1 ,, ,, acid	501.16
1 ,, ,, sulphate of zinc	1004.48

The quantities of the sulphate of zinc and the sulphate of iron, each of which contains 1 atom of oxide, are in the proportion of 2 to 5.

When the oxides are precipitated by means of a fixed alkali any excess of the precipitating substance must be avoided, to prevent the oxide of zinc from being dissolved again. Just so much, however, is added as will produce a complete precipitation. The product is filtered, washed and dried. Lastly, it is submitted to a red heat, in order to drive off the water which it contains. If the solutions of zinc and iron, after they have been poured together, are treated with an alkaline carbonate, the precipitate must in this case be heated to drive off the carbonic acid. The calcining is intended moreover to give stability to the combination of the two oxides. If it is required to colour a fused pigment by chemical combination or simple mixture, the object must be to obtain the colouring oxide in a state of the finest possible division. By this means, in the former case the combination takes place more easily, and in the latter the mixture is more intimate. Now calcining is always opposed to the direction we have given, for oxides condense by being calcined. This is also the case with the kind of pigments we have just been speaking of. On this account it answers to use the means which we recommended for obtaining the flesh-red; for they not only admit of compliance with the conditions which require calcining, but of the production of the colouring matter in a state of the finest division. We will now speak of the mixture of sulphate of potash.

The precipitate from the two oxides contained in the carbonates of zinc and iron is mixed with a concentrated solution of this salt; the liquor is evaporated, and the precipitate, when dry, is calcined at a dull red heat. It is then softened with water, placed in a filter which separates the zincate of iron from the solution of sulphate of potash; this precipitate is carefully washed and then dried.

This we consider to be the best process for the preparation of zincate of iron. The colouring matter which is obtained must now be united with the flux which serves as a vehicle for it. The best kind of flux for ochre yellow is No. 3, of the first class. They are mixed in the following proportions :—

Zincate of iron	1 part.
Flux	4 parts.

As this fused pigment belongs to that class which is coloured by mixture, it ought not to be melted before it is used; we have, however, found it useful to frit it, *i. e.* to keep it at a dull red heat for some time; it is then levigated for use. In this way the colour becomes more beautiful and more transparent. This method should be employed principally in that kind of painting which the French glass-painters call *peinture par enlevage.*

YELLOW FROM ANTIMONITE OF LEAD.

The fused pigment which is coloured with antimonite of lead belongs to the foregoing class, inasmuch as it contains the colouring matter in a state of simple mixture. It is prepared by fusing in a crucible 1 part of antimonic acid and 3 parts of minium, levigating the product and mixing with it twice its weight of rocaille-flux, and then fusing the mixture again. This pigment has the fault of not being transparent. Therefore, although it is one of those which are coloured by mixture, it is advisable to melt it, in order to impart to it the greatest possible transparency. The quantity of flux must also be very small, for the oxide of lead being attracted by the flux is easily liberated from the antimonious acid, and the latter then gives only a feeble, opaque, white colour to the glass. The rocaille-flux is therefore preferred in this case also, because it is the most saturated and consequently the least disposed to act upon the colouring matter.

The tint produced by antimonite of lead may be modified by adding some oxide or zincate of iron.

In order that it may be better understood what takes place in the process by which this colour is prepared, we may mention that at a red heat the antimonates are converted into antimonites.

YELLOW FROM ANTIMONITE OF IRON.

The yellow obtained from this compound belongs to the same class as the two preceding. Like them it wants transparency, but it possesses a very rich colour, so that it can be used in many cases for mixed tints, and for the shading of green and brown. It is also of great use when employed alone.

Antimonite of iron is obtained through double decomposition, that is to say, by precipitating persulphate of iron with antimonate of potash. The product is washed, dried and calcined. Antimonite of iron is likewise prepared by direct mixture of antimonic acid with oxide of iron in the proportion of 4 to 1. This latter method admits of the relative quantities of the two compounds being varied at pleasure. The antimonite of iron, like the foregoing, is used with the rocaille-flux or with some flux of the first class. In the former case the mixture must be brought into a state of fusion, according to the treatment of the rocaille-flux in all other circumstances. In the latter case it is only levigated. Three parts of flux to one of colouring matter are required.

We think it superfluous to speak of the pigments that can be prepared with the aid of the other yellow colouring materials which have been mentioned; they are little studied, and moreover are not in general used. It may be briefly stated, however, that in modern times the metal uranium has been used in Germany for the preparation of a yellow pigment. The process is as follows:—

Uranium ore [a] is broken in pieces and roasted, dissolved in nitric acid, the solution filtered and the lead which is present in it precipitated by the addition of some drops of sulphuric acid. The clear green solution is then evaporated to dryness, and the salt is heated until it is converted into a yellow mass. One part of the substance so obtained is ground with three parts of a flux composed of four parts of minium and one part of powdered silica, fused together and levigated.

OF THE GREEN.

The green pigment generally receives its colour from oxide of copper, oxide of chromium and protoxide of iron, either separately, or by the combination of two or more with one another. The ingredients of this pigment are in combination with the flux. It is difficult to make its expansibility the same as that of the glass on which it is laid. The oxide of copper, even in a very slight quantity, alters this property in a great degree, and disposes the pigment to shell off the surface of the glass. The oxide of chromium does not partake of this quality in so remarkable a manner, but it requires a very fusible flux to dissolve it. Now this fusibility can only be obtained by mixing with the flux substances which modify its expansibility in the same way as oxide of copper does, and borate of soda in particular is one of these substances. The colour which protoxide of iron gives by itself is not rich enough,

[a] Uranerz.

consequently this protoxide can never be employed alone. In most cases it is used in combination with oxide of copper.

To colour a fused pigment green, the oxide of copper must be in combination with one or more acids of the flux, that is to say, it must be in the state of borate, silicate, or borosilicate. One of the fluxes which we have specified for the pigments of the second class seems best able to effect its solution, but these fluxes receive a degree of expansibility from the copper, which ill accords with that of the glass. Those fluxes therefore must be avoided which contain an abundance of acid, and those should be preferred which contain a large amount of base, especially of oxide of lead, although they possess less capability of being dissolved. Flint-glass [a] (*fondant rocaille*) seems best adapted to this purpose, and yet no large proportion of oxide of copper can be mixed with it without producing the unpleasant result just stated. The green pigment is therefore best obtained from the following composition :—

Minium	12 parts.
Silica	4 ,,
Oxide of copper	1 ,,
Red oxide of iron	$\frac{1}{8}$,,

This pigment may be prepared in two ways :—

1. The colouring oxides are melted in a crucible with the flux which has been previously prepared and ground together with them.

2. The oxides are fused together with the substances proper for the composition of the flux, after which the whole is well mixed and ground together.

It is not immaterial which of the two methods is employed ; we have always preferred the latter. In this method, when the mixture begins to be red-hot, the oxide of lead begins to melt, and dissolves the oxide of copper, while at the same time the latter is acted upon by the silica. This previous union of the two oxides is intended to separate the particles of the copper so as to dispose it to combine with the silica as soon as ever it is acted upon by it. In the former case, on the contrary, the oxide of copper is merely acted upon by the silica of the flux.

The foregoing receipt for the green pigment affords a colour of no great intensity, and we cannot expect to obtain a richer green by merely increasing the quantity of copper, for this, as we have just shown, could not be done with safety. Accordingly, in order to increase the respective proportions of the colouring oxides without risk, the composition of the flux must be modified at the same time by an addition to the quantity of oxide of lead.

[a] Bleiglas, lit. lead-glass. This flint-glass, the composition of which is given under the head No. 1 of the fluxes for pigments of the first class, will be found to contain more oxide of lead than the English flint-glass.

DARKER GREEN.

Silica	1 part.
Minium	4–7 parts.
Oxide of copper	1 part.

In these receipts we have no intention of laying down absolute proportions, for we well know that there are certain kinds of glass which will bear a greater quantity of oxide of copper without the colour shelling off. But we have endeavoured to impart such qualities to our pigments as will ensure continual success, and consequently we have perhaps carried our caution to an extreme rather than render the success doubtful.

Oxide of chromium does not answer so well for the green of the fused pigments as oxide of copper; for it seldom obtains so pure and bright a colour as the latter. Even if it is combined with very fusible fluxes it generally wants transparency, and yet the quantity of the substances which impart greater fusibility to the flux cannot be safely increased.

Oxide of chromium is mixed with one of the fluxes for pigments produced by combination, in the proportion of 1 part of oxide to 9 parts of flux, the same proportion that we specified for oxide of copper; and we are of opinion that it is better to heat the oxide of chromium with the elements of the flux, than with the flux itself.

Notwithstanding what we have said concerning the properties of protoxide of chromium, it should not be neglected in the preparation of the pigments. As glass-painting frequently bears a certain degree of opacity very well, oxide of chromium may be employed with advantage, especially if it is only used for the colouring of a pigment by mixture. The green colour peculiar to it, which it possesses before it is united with a flux, makes it very well suited to this purpose, and the only problem now is to preserve it in a state of sufficiently fine division.

There are other substances which may be used for green pigments, but they give an opaque colour. Among these are zincate of cobalt, Rinmann's green, and antimonite of cobalt. Of course these compounds are not acted upon by the flux, and merely form pigments of the first class.

With respect to this matter we will describe a method which, in our opinion, seems to promise manifold advantages. When it is required to mix oxide of chromium with a fused pigment containing lead, the neutral chromate of lead may be used, which furnishes at the same time oxide of chromium and oxide of lead, or at least a part of the latter. When this salt is submitted to a red heat it parts with oxygen and leaves behind a combination of the two oxides in the following proportions :—

1 atom of oxide of lead	1394.6
1 ,, ,, chromic acid	650.7
1 ,, ,, neutral chromate	2045.3

And this gives after calcining,

1 atom of oxide of lead	1394.6
½ ,, ,, ,, ,, chromium . . .	502.
1 ,, ,, plumbate of chromium . . .	1896.6

It is evident that the oxide of chromium, which is thus held in combination with oxide of lead, must be in a state of most minute division, whereby its union with the silicates or borosilicates of the flux is facilitated to a remarkable degree. This pigment may be composed in the following way :—

Silica	2 parts
Minium	5½ ,,
Calcined borax	3 ,,
Calcined chromate of lead	2 ,,

These ingredients are melted and poured out.

The old glass-painters frequently availed themselves of the combined effects of yellow and blue, in order to obtain a green. Thus, for example, they gave to glass which had been coloured blue in the melting pot a yellow stain with the help of sulphuret of silver and the paste. This method is not in general use at the present day.

OF THE VIOLET.

There are two modes of preparing violet pigments. The first consists in employing a colouring substance which is capable of producing a violet of itself; according to the second, the requisite violet is obtained by mixing a blue with a red pigment. The substances which are capable of bringing out a violet without the assistance of another colour are the purple precipitate of Cassius and oxide of manganese.

We have already explained, in speaking of the red pigment, under what circumstances stannate of gold affords a violet colour, and have observed, that the purple of Cassius, whenever it is decomposed before the fused pigment can dissolve its particles, produces a violet and even a blue, according as the change which takes place in it is more or less complete; and this happens in the case we are now speaking of. If 1 part of the purple of Cassius be mixed with 9 parts of one of the fluxes coloured by combination, without fusion, a violet pigment is obtained. This product is the effect of two causes which operate simultaneously, that is to say, the want of fusibility in the pigment, and the too great abundance of oxide of lead. Should the violet which is obtained in the manner we have just specified be not brought out with sufficient clearness, it may be still better developed by adding to the fluxes of the first section a little of flux No. 1.

Oxide of manganese gives an exceedingly deep violet colour, but, as we have elsewhere observed, it imparts to the pigments an extraordinary disposition to crack and shell off. This unfortunate property is easily overcome, however, by adding a large quantity of minium to its composition.

The composition should be as follows:—

Silica	1 part
Minium	6—8 parts
Peroxide of manganese	$\frac{1}{2}$ part.

When this oxide of manganese is heated in contact with oxide of lead, it rapidly gives up oxygen, and is converted into sesquioxide.

This pigment is distinguished from the rest by this remarkable peculiarity, namely, that it can only be employed on condition that it is not painted on with any liquid which, after the burning in, leaves a carbonaceous substance in its mass. This will be more apparent, when we remember that peroxide of manganese is used for whitening glass, on account of its property of extracting the carbon, which would impair its clearness. Here the carbon acts upon the manganese, deprives it of a portion of its oxygen, and converts it into a colourless protoxide, while it is liberated itself in the state of carbonic acid.

Now this would be the case if the pigment, at the moment of its liquefaction, contained carbon which was produced by the vehicle with which it was laid on the glass before the burning in. We would therefore recommend for this purpose a solution of borate of soda, instead of the gum or sugar water, and the thickened essence of turpentine, which are generally used.

The violet, which is obtained by a mixture of blue and red, is prepared with common smalt and the purple of Cassius, the proportions varying at the discretion of the artist.

There is another violet, which is produced by the red oxide of iron, which is exposed to a white heat for some time; but it is almost entirely opaque, and produces on the glass only a kind of opaque and dull violet-grey. The pigment which is thus obtained is, nevertheless, of great use in glass-painting, and is prepared in the following way:—

Violet oxide of iron	1 part
Flux	3 parts.

No. 3 of the pigments of the first class is used for the flux.

OF THE BROWN.

The brown is an undefined colour, which may be prepared in a variety of ways, according to the requirements of the art, and the taste of the artist. We will describe the principal browns.

Zincate of iron, which contains one atom of zinc, and two of iron, gives a *yellowish-brown*, which is frequently used. It is prepared in the same way as ochre-yellow, except that the quantity of the salt of iron is doubled. For the composition we are now speaking of, the salt of zinc must be to the salt of iron as 2 to 10. The flux proper for this is the same as that which is used for the ochre-yellow, and is also employed in the same proportions.

Zincate of iron, ochre-yellow, as it is called, when mixed with either red oxide of iron or burnt sienna, gives a *reddish-brown*, whose shade of colour varies with the proportions.

The same zincate of iron (ochre-yellow) forms, with burnt umbre, a much *darker brown* than the preceding, and one which has no affinity to red.

Oxide of iron alone, when properly prepared, affords a *brown* of considerable utility. It is prepared in the moist way as follows:—A solution of persulphate of iron is treated with an alkaline or carbonized oxide, (with potash, soda, ammonia, or their carbonates); the precipitate which is obtained is either an hydrated oxide or a carbonate. It is placed in a filter, washed and dried, and then subjected to a red heat, in order to drive off the water or the carbonic acid. After this preparation the oxide of iron presents a brown colour, whose shade may be varied by heating it more or less. This oxide of iron bears no resemblance to that which is obtained in the dry way, although the calcining develops in it a more or less distinct red tone.

Burnt umbre, when mixed with a flux, also affords a brown pigment.

A mixture of peroxide of manganese and oxide of iron likewise serves as a brown pigment of some utility. In order to prepare all these pigments, it is merely necessary to know that each of the colouring substances we have mentioned must be mixed with thrice its weight of flux No. 3 of the pigments of the first class.

No previous fusion is required. The colouring materials are merely brought into a state of the most intimate mixture by levigation together. The brown pigments are all pigments of the first class, and possess great opacity, but by virtue of this property they are exactly adapted to the use to which they are applied.

OF THE BLACK.

The completely opaque pigments, whatever their proper colours may be, when laid upon glass, appear black in a transmitted light. The reason of it is this, viz., that a substance which allows no transmitted ray to reach the eye must cause a shadow, and consequently produce a black colour. Therefore either a black or an opaque colour may be used for the black lines of a drawing upon glass, or the parts that are in shadow. There is, however, a difference between the effect produced by a really black colour and that of any other colour not transparent.

When we look at a large transparent surface, e. g., a church-window, besides the refracted rays transmitted through the glass, the eye receives also a few reflected rays, especially if the external light is not particularly intense. In this way the pigments, which only produce a black colour by virtue of their opacity, are slightly tinged with the colour which properly belongs to them. The black which proceeds from them thus loses its hardness, and falls more agreeably upon the eye. On this account pigments of *broken tones*, as they are called, are used for the black lines and shadows of a picture, and of these the brown pigments exhibit a great variety.

A pigment which shall appear black in a reflected as well as in a refracted light, may be prepared in two ways:—

1. Opaque substances of a black colour may be mixed with a flux, e. g., oxide of iron, peroxide of manganese, peroxide of cobalt, and oxide of copper, in such considerable quantities as to prevent their vitrification taking place during the time of the burning in. A black pigment, by mixture, is thus obtained, which is composed, e. g., of—

Oxide of copper	1 part
Peroxide of manganese	1 ,,
Peroxide of cobalt	1 ,,

Oxide of iron	1 part
Flint-glass	8—12 parts.

2. A black pigment by combination may also be prepared, and, after fusion, a certain quantity of oxide may be united with it, merely in the state of mixture, in order to render its opacity complete, as well as to impart to it the property of not splitting off in scales. This is therefore a combination of the two kinds of pigments. For the preparation of this compound, the following ingredients are melted in a crucible, in the following proportions:—

Oxide of iron	2 parts
Oxide of copper	2 ,,
Peroxide of manganese	1 part
Flint-glass	5 parts
Fused borax	½ part.

As soon as the whole is melted, the contents of the crucible are poured out and levigated with

Peroxide of manganese	1 part
Oxide of copper	2 parts

The theory of the composition of this pigment may be explained in the following way:—by fusing together oxide of iron, oxide of copper, and oxide of manganese, with the flux of flint-glass and the borax, borosilicates are formed. The two former are green, and the latter violet-red. Now green and violet-red, in proper proportions, give a black. The oxides which are afterwards added, as we have already stated, only render the opacity complete, and give the pigment a proper expansibility. The advantage of this latter circumstance is evident, when the effect of the oxides of copper and manganese upon expansibility is considered. If, on the other hand, it is required to prepare a pigment which shall only appear black in a reflected light, let the following ingredients be mixed together without being fused:—

Black oxide of iron	1 part,

or even

Red or bright violet oxide of iron . .	1 part
Flint-glass or flux	2–3 parts.

When this colour is used, it appears black by transmitted light, but by reflected light it assumes a reddish tint approaching to violet, less hard and more agreeable than black.

OF THE WHITE.

The white pigment is almost useless in glass-painting. We shall, however, treat of it more fully than we should otherwise have done, in order to complete the series of the pigments of which we have here given a short account.

The white pigment has been used in modern times for ornamenting panes of glass with a kind of drawing whose whole effect depends upon the combination of the dull and opaque white of the pigment with the transparent glass, without the aid of any other colour. This branch of art, which borders a little upon the one we are treating of, seems, however, to have received no particular cultivation. The white pigment is a vitreous compound of more or less opacity, and this opacity is owing to the presence of zincic or antimonic acid. This pigment is prepared according to the following process:—an alloy is first made of 20 parts of tin to 80 parts of lead. The metal is melted in an iron ladle or a vessel of a similar kind, and the oxide which covers its surface is removed as fast as it is formed. When the entire mass has been converted into oxide, the calcining is continued a little while longer, while the oxide is stirred incessantly until it assumes a perfectly homogeneous appearance. It is then poured into a vessel full of water and well stirred, in order to effect the separation of the unoxidized grains of the alloy, which are mixed with the mass. These grains collect at the bottom of the vessel. The oxide is now dried and is fit for use. When this substance is mixed with potash, silica, and borax, in the proportions which we are about to specify, and then vitrified at a high temperature, a white pigment is obtained.

The white pigment of commerce that is used in enamel-painting may also be employed for the purposes of glass-painting, although it is rather deficient in fusibility. It is usually composed of the following ingredients:—

Potash	1 part
Oxide of lead	8 parts
Silica	6 ,,
Stannic acid	2 ,,
Calcined borax	2 ,,

This enamel is also prepared by fusing together in a crucible the following ingredients:—

Carbonate of potash	2 parts
The oxides of tin and lead calcined	5 ,,

Silica	3 parts
Borax	1 part.

As soon as the enamel has ceased to bubble, and appears in the state of a clear liquid, it is poured out. It must be melted several times after being levigated, or at least pounded in a mortar. It is thus freed from the excess of potash which it contains, and at the same time rendered whiter.

The enamel of M. Clouet, as a specimen of an enamel coloured by antimonious acid, may be contrasted with the above. It is prepared from

White glass	12 parts
Uncalcined borax	4 ,,
Saltpetre	1 part
Purified *antimonium diaphoreticum*	4 parts.

This is a quadruple borosilicate of lime, potash, soda, and alumina.

It is less adapted to painting on glass than the one we have mentioned before, and more disposed to scale off, since it is deficient in oxide of lead.

We recommend the following enamel, which seems to contain the qualities requisite for painting on glass. Its composition is as follows:—

Silica	3 parts
Calcine [a]	7½ ,,
Calcined borax	2 ,,

The ingredients are melted, and then poured out.

The old glass-painters frequently used white pigments similar in composition to those which we call pigments of the first class. Levieil prepared a white pigment by mixing sulphate of lime (gypsum) with rocaille-flux (flint-glass). Felibien, Haudicquer de Blancourt, and the Abbot of Marsy propose the same substance, but with a different enamel. Flint, pulverised rock-crystal [b], and the powder of calcined bones, have also been used for this purpose; a better result would have been obtained with stannic acid employed in the same way.

CALCULATION OF THE ATOMIC WEIGHTS OF THE PIGMENTS.

Now that we have shown that the various kinds of glass are composed of several silicates in definite proportions, probably in combination with one another, the study of

[a] By *calcine* is meant the calcined oxide of an alloy of 20 parts of tin and 80 of lead.—(*Author's note.*)

[b] Bergkrystall.

their atomic weights [a] must on this account be the more interesting. Moreover, if we would employ ourselves in making satisfactory inquiries into the art of composing the pigments, this cannot be done with any success unless we are acquainted with the calculation of the atomic weights which are made use of in these compositions. We will therefore communicate an easy method of determining the composition of a pigment, or any other kind of vitreous substance, according to the atomic weights.

TABLE OF THE ATOMIC WEIGHTS OF THE MAJORITY OF THE SUBSTANCES USED FOR PIGMENTS.

Silicic acid	192.6
Boracic acid	435.98
Oxide of aluminum	643.33
Oxide of calcium	356.03
Oxide of potassium	587.91
Nitrate of potash	1264.93
Oxide of sodium	390.92
Subcarbonate of soda	666.25
Borate of soda	1262.88
Oxide of manganese	1467.
Sesquioxide of manganese	1011.5
Peroxide of manganese	555.7
Oxide of iron	978.
Stannic acid	935.29
Antimonious acid	1006.4
Oxide of zinc	503.32
Oxide of cobalt	469.
Peroxide of cobalt	1038.
Oxide of chromium	1003.
Oxide of copper	495.6
Protoxide of lead	1394.5

When it is required to determine the number of atoms of each of the bodies which are used for a pigment whose composition is known, each of the expressions of the formula must be multiplied by one and the same number, e. g., 100, 1,000 or 10,000, just as it may happen to be necessary, in order to enable us to divide all these expressions by the atomic weight of the substance which they represent.

[a] Atomengewichte.

Let a pigment, for example, be composed of—

Silica	45 parts
Potash	6 ,,
Oxide of lead	70 ,,

If only the two first expressions of the formula were considered, it would be sufficient to multiply them by 100; for the products would be divisible by the atomic weight of the silica (192.6) and that of the potash (587.9). But it is evident, that they must be multiplied by 1000 in this case on account of the third expression. Accordingly we get—

Silica	45,000	divisible by	192.6
Potash	6,000	,, ,,	587.9
Protoxide of lead . .	70,000	,, ,,	1394.6

If the division is performed, the following result is obtained:—

Silica	240	atoms or	24
Potash	10	,, ,,	1
Protoxide of lead	50	,, ,,	5

Consequently, if every atom of these bodies contains 100 parts of oxygen, the quantities of this gas will be to one another as the atoms themselves, namely:—

Silica	2,400	or	24
Potash	100	,,	1
Protoxide of lead	500	,,	5

The oxygen of the acid is four times as much as that of the bases. A double quater-silicate thus appears. The oxygen of the potash is moreover to that of the oxide of lead as 1 to 5, and consequently we have 1 atom of the quater-silicate of potash and 5 atoms of the quater-silicate of lead.

To compose an enamel, then, which shall contain 5 atoms of silicate of lead and 1 atom of silicate of potash, we must take—

5 atoms of oxide of lead $= 1394 \times 5 = 6970$
1 atom of potash $= 587 \times 1 = 587$

Further, if it be required that these bases should form with the silica quater-silicates, we must take as many atoms of silica as are necessary, in order that the latter may contain four times as much oxygen as the bases. Now if the oxygen of the bases amounts to 6, we get for the silica $4 \times 6 = 24$.

$$24 \text{ atoms of silica} = 192 \times 24 = 4608.$$

By simplifying the expressions we obtain at length,

Protoxide of lead	70 parts.
Potash	6 ,,
Silica	45 ,,

In order to obviate the necessity of making calculations, we have drawn up Tables, by the assistance of which the reader may discover at the first glance the quantity of any body which corresponds to a given number of atoms.

SILICIC ACID.

Atoms.	Parts.
5	1
10	2
15	3
20	4
25	5
30	6
35	7
40	8
45	9
50	10

BORACIC ACID.

Atoms.	Parts.
1	0.4
2	0.9
3	1.3
4	1.7
5	2.2
6	2.6
7	3.0
8	3.5
9	3.9
10	4.0

OXIDE OF POTASSIUM.

Atoms.	Parts.
1	0.6
2	1.2
3	1.8
4	2.3
5	2.9
6	3.5
7	4.1
8	4.7
9	5.3
10	5.9

SUBCARBONATE OF POTASH.

Atoms of Potash.	Parts of the sub-carbonate.
1	0.9
2	1.7
3	2.6
4	3.4
5	4.3
6	5.2
7	6
8	6.9
9	7.8
10	8.6

NITRATE OF POTASH.

Atoms of Potash.	Parts of the Nitrate.
1	1.3
2	2.5
3	3.8
4	5
5	6.3
6	7.6
7	8.8
8	10.1
9	11.4
10	12.6

OXIDE OF SODIUM.

Atoms.	Parts.
1	0.4
2	0.8
3	1.2
4	1.6
5	1.9
6	2.3
7	2.7
8	3.1
9	3.5
10	3.9

BORATE OF SODA.

Atoms of Boracic Acid.	Atoms of Soda.	Parts of the Borate.
2	1	1.3
4	2	2.5
6	3	3.8
8	4	5
10	5	6.3
12	6	7.6
14	7	8.8
16	8	10
18	9	11.3
20	10	12.6

SUBCARBONATE OF SODA.

Atoms.	Parts.
1	0.7
2	1.3
3	2
4	2.7
5	3.3
6	4
7	4.7
8	5.3
9	6
10	6.7

OXIDE OF CALCIUM.

Atoms.	Parts.
1	0.3
2	0.7
3	1.1
4	1.4
5	1.8
6	2.1
7	2.5
8	2.8
9	3.2
10	3.6

OXIDE OF ALUMINUM.

Atoms.	Parts.
1	0.6
2	1.3
3	1.9
4	2.6
5	3.2
6	3.8
7	4.5
8	5.1
9	5.8
10	6.4

PROTOXIDE OF LEAD.

Atoms.	Parts.
1	1.4
2	2.8
3	4.3
4	5.6
5	7
6	8.4
7	9.7
8	11.1
9	12.5
10	14

MINIUM.

Atoms of Protoxide.	Parts of Minium
1	1.4
2	2.8
3	4.3
4	5.7
5	7.1
6	8.5
7	10
8	11.4
9	12.8
10	14.3

The difference between minium and protoxide of lead is so considerable, that it may be perceived at once in any given number of atoms, as will appear from a comparison of the two tables.

PROTOXIDE OF MANGANESE.

Atoms.	Parts.
1	1
2	2
3	3
4	4
5	5
6	6.1
7	7.1
8	8.1
9	9.1
10	10.1

DEUTOXIDE OF MANGANESE.

Atoms.	Parts.
1	1.5
2	2.9
3	4.4
4	5.9
5	7.3
6	8.8
7	10.3
8	11.7
9	13.2
10	14.7

PEROXIDE OF MANGANESE.

Atoms of Protoxide.	Parts of Peroxide.
1	1.1
2	2.2
3	3.3
4	4.4
5	5.5
6	6.7
7	7.8
8	8.9
9	10
10	11.1

PEROXIDE OF MANGANESE.

Atoms of Deutoxide.	Parts of Peroxide.
1	1.7
2	2.3

Atoms of Deutoxide.	Parts of Peroxide.
3	5
4	6.7
5	8.3
6	10
7	11.7
8	13.3
9	15
10	16.7

These two latter tables show the quantities of peroxide of manganese which are necessary to produce by their decomposition a given number of atoms of protoxide or deutoxide.

OXIDE OF ZINC.

Atoms.	Parts.
1	0.5
2	1
3	1.5
4	2.0
5	2.5
6	3
7	3.5
8	4
9	4.5
10	5

OXIDE OF IRON.

Atoms.	Parts.
1	1
2	1.9
3	2.9
4	3.9
5	5
6	5.9
7	6.9
8	7.8
9	8.8
10	9.8

PROTOXIDE OF COBALT.

Atoms.	Parts.
1	0.5
2	1.3
3	1.4
4	1.9
5	2.3
6	2.8
7	3.3
8	3.7
9	4.2
10	4.7

PEROXIDE OF COBALT.

Atoms of Protoxide.	Parts of Peroxide.
1	0.5
2	1
3	1.5
4	2.1
5	2.6
6	3.1
7	3.6
8	4.1
9	4.7
10	5.2

The table of the peroxide of cobalt has been composed on the same principle as that of the peroxide of manganese.

OXIDE OF CHROMIUM.

Atoms.	Parts.
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10

OXIDE OF COPPER.

Atoms.	Parts.
1	0.5
2	1
3	1.5
4	2
5	2.5
6	3
7	3.5
8	4
9	4.5
10	5

ANTIMONIOUS ACID.

Atoms.	Parts.
1	1
2	2

ANTIMONIC ACID.

Atoms of Antimonious Acid.	Parts of Antimonic Acid.
1	1
2	2.1
3	3.2
4	4.1
5	5.3
6	6.3
7	7.4
8	8.4
9	9.5
10	10.5

STANNIC ACID.

Atoms.	Parts.
1	0.9
2	1.9
3	2.8
4	3.7
5	4.7
6	5.6
7	6.5
8	7.5
9	8.4
10	9.3

In order that we may make no mistake in laying down the proportions of the oxygen of the base to that of the acids, we must remember that these compositions contain different quantities of oxygen to one atom, namely :—

1. Boracic acid	300 parts.
2. Alumina	300 ,,
3. Sesquioxide of manganese	400 ,,
4. Protoxide of manganese	300 parts

5. Peroxide of manganese . . . . 200 parts.
6. Oxide of iron . . . . . . 300 „
7. Stannic acid . . . . . . 200 „
8. Antimonic acid . . . . . . 500 „
9. Antimonious acid . . . . . 200 „
10. Oxide of chromium . . . . . 300 „
11. The other bodies . . . . . 100 „

Before we conclude the chemical part of our subject, we wish to direct the attention of those who are engaged in the preparation of pigments for glass-painting to a series of compositions which are capable of being used with very great advantage in the art. We wish to speak of certain combinations of the colouring oxides with one another, about which we have at present said very little. Farther back, where we were speaking of the colouring substances in general, we expressed our opinion concerning these kinds of compositions, which we likewise admitted into the class of salts. We have already had occasion to consider a certain number of these combinations which are very much used in the manufacture of the pigments, and we now intend to impart what information it is in our power to give upon a few other matters less known, but which seem capable of affording valuable resources to the art of painting on glass; and lastly, we intend to point out those particulars which, in our opinion, deserve to be studied. We wish to open to fresh observers a fruitful field, full of objects both useful and interesting, and we only regret that it was not our lot to explore it ourselves.

The most stable amongst the combinations which the indifferent oxides are capable of entering into with the basic oxides, are the following:—

Protoxide of manganese and oxide of iron;
Protoxide of manganese and peroxide of cobalt;
Protoxide of manganese and oxide of copper;
Protoxide of manganese and oxide of chromium;
Protoxide of manganese and oxide of zinc;
Oxide of iron and peroxide of cobalt;
Oxide of iron and oxide of copper;
Oxide of iron and oxide of chromium.

Amongst all the other possible combinations of the colouring metallic oxides with one another, there are a few more of great stability, although certain of the oxides out of which they are formed are remarkably deficient in this stability. Thus, among other combinations, there are a cuprate and a plumbate of silver, of which the oxide of silver is reducible at less than a red heat, and further, a manganate of silver, which appears to possess the same property.

PROTOXIDE OF MANGANESE AND OXIDE OF IRON COMBINED IN EQUAL ATOMS.

First process:—Two solutions, both of equal weight, according to Beaumé's areometer, one of protosulphate of iron, and the other of protosulphate of manganese, are mixed together; they are then raised to the boiling point, and treated with an excess of carbonate of soda. The precipitate, after it has been washed and dried, is moistened with nitric acid, and exposed to a red heat in a crucible, until it is perfectly decomposed. This operation explains itself, and we need merely remark, that these sulphates contain equal quantities of protoxide, and that both the protoxides are converted into sesquioxides, and give an equal number of atoms.

Protosulphate of Iron.		Protosulphate of Manganese.	
2 at. protoxide	878.42	2 at. protoxide	911.4
2 at. acid	1002.32	2 at. acid	1002.32
2 at. protosulph. iron	1880.74	2 at. protosulph. mang.	1913.72

Sesquioxide or Peroxide of Iron.		Sesquioxide of Manganese.	
2 at. protoxide	878.42	2 at. protoxide	911.4
1 at. oxygen	100.00	1 at. oxygen	100.00
1 at. peroxide	978.42	1 at. sesquioxide	1011.4

Second process:—A stream of chlorine gas is caused to pass through water with which carbonate of manganese, or the oxide obtained by precipitating sulphate of manganese with potash, has been mixed. The oxide which is obtained in the state of hydrate is mixed in proper proportions with hydrated oxide of iron, and exposed to a red heat.

Hydrated Peroxide of Iron.		Hydrated Peroxide of Manganese.	
2 at. iron	678.45	2 at. manganese	711.5
3 at. oxygen	300	4 at. oxygen	400
Water	168.70	Water	150
1 at. peroxide	1147.15	1 at. peroxide	1261.5

The following result is obtained by heating the mixture:—

Anhydrous Peroxide of Iron.		Anhydrous Sesquioxide of Manganese.	
2 at. iron	678.45	2 at. manganese	711.5
3 at. oxygen	300	3 at. oxygen	300
	978.45		1011.5

These hydrates, it is evident, must be mixed together in equal parts.

PROTOXIDE OF MANGANESE AND PEROXIDE OF COBALT.

This combination is obtained by precipitating with an alkali, as in the case of iron, from a solution of sulphate of manganese and sulphate of cobalt, in equal quantities and of equal density, and calcining the precipitate merely at a red heat. The atoms of the acids are here likewise combined in equal proportions. We have assumed these proportions for all analogous combinations.

PROTOXIDE OF MANGANESE AND OXIDE OF COPPER.

The composition is prepared in the same way as the foregoing; but it is better to effect the precipitation from the sulphate of copper and sulphate of manganese with an alkaline carbonate, because the oxide of copper is very likely to be re-dissolved if an alkali is used. Moreover, the proportions of the solutions must be equal. We may proceed in the same way in the calcining; it is as well, however, to add a little nitric acid to the mixture, to render the oxidation of the manganese complete.

PROTOXIDE OF MANGANESE AND OXIDE OF CHROMIUM.

This combination arises from pouring chromate of potash into a solution of sulphate of manganese. The protoxide of manganese is oxidized at the expense of the chromic acid, which is thus transformed into oxide of chromium.

PROTOXIDE OF MANGANESE AND OXIDE OF SILVER.

This combination arises from heating a mixture of peroxide of manganese and metallic silver, which has been precipitated with copper from a solution of nitrate of silver.

OXIDE OF IRON AND PEROXIDE OF COBALT.

This is obtained from a mixture of solutions of sulphate of iron and sulphate of cobalt, which are treated with an alkaline subcarbonate, in order that the precipitate which is thus obtained may be calcined.

OXIDE OF IRON AND OXIDE OF COPPER.

The same process as before.

OXIDE OF IRON AND PROTOXIDE OF COPPER.

A mixture of oxide of copper and finely triturated iron filings are subjected to a red heat The copper returns into the state of protoxide, and gives up its oxygen for the iron to form an oxide with it. Probably it would be necessary, in using this compound as colouring matter, to keep it carefully from the air as soon as it passes into a liquid state. We may avail ourselves of this composition for colouring glass red, but it is probable that in this case there is no combination between the two oxides.

OXIDE OF IRON AND OXIDE OF CHROMIUM.

This combination takes place when a solution of protosulphate of iron is treated with chromate of potash. The protoxide of iron is brought into a higher state of oxidation by means of the oxygen which the chromic acid gives up, and the chromic acid is thereby reduced to the state of oxide of chromium.

PROTOXIDE OF COPPER AND OXIDE OF SILVER.

This combination is obtained by heating in a crucible oxide of copper with metallic silver in the form of powder. The same phenomena may be observed here as in the case of iron and copper.

PLUMBATES.

We have already mentioned the fact, that oxide of lead to a great degree possesses the property of combining with the other metallic oxides. The combinations into which it enters with them are particularly valuable, although for an entirely different reason from that for which the similar compounds of which we were just now speaking are valuable: they are valuable, because the oxide of lead imparts a very slight stability to them. But while it combines with the oxides, it dissolves them, separates their particles, and facilitates in a remarkable manner the vitrification of those pigments which are coloured by combination.

The most important of the plumbates are those of cobalt, copper, and manganese, which are prepared by subjecting minium with the oxides of one or other of these metals to a red heat.

PART II.

CHAPTER I.

THE MECHANICAL PART OF GLASS-PAINTING.

PREPARATION OF THE COLOURS FOR USE.

WE shall now distinguish the colouring materials, when combined with their fluxes, by the epithet *colour*.

The colours must first be reduced to an extremely fine powder, by long-continued levigation upon porphyry, or in a mill of porcelain biscuit, constructed expressly for this purpose, which we shall describe hereafter. In order to do this it is necessary to mix with it a sufficient quantity of pure water; it is then dried and put away in well-stopped bottles.

The levigated colours, at the time when they are used, are mixed with liquids of various kinds, but all for the purpose,

1, of giving them sufficient stickiness and consistency, so that they may not run on the surface of the glass;

2, of causing them to adhere sufficiently, when dry, until the time when they are fixed by the firing;

3, of adapting them to the various kinds of paint-brushes which are generally used in glass-painting.

These liquids are usually—water, oil of turpentine and oil of lavender, somewhat thickened by the substances which are to fix the colours, after they are dry, upon the glass. Thus, for example, sugar-candy or borax are generally mixed with water; thickened oil of turpentine and oil of lavender to the oils of turpentine and lavender. This inspissation is produced by a longer action of the air upon these essential oils or essences. Among the preparations which are bought under the name of thickened essence of turpentine, &c., we must distinguish between those which have been really thickened by the action of the air, and those which are nothing more than the residue after the distillation of the ordinary essences of turpentine and lavender. A residue like this will never answer our purpose well, and we might just as well use turpentine, or even varnish. But it will be explained hereafter why liquids of this kind must be rejected.

The *fat*, or thickened essence, as it is called, is obtained by exposing to the air and light one of the above-mentioned essential oils in a glass vessel with a wide mouth, which must be covered with a woven texture that will allow the air to pass through without difficulty. The contents are stirred from time to time, and the essential oil has attained to the proper degree of inspissation when it is of the consistency of a thick syrup.

The water colours and the essential oil colours may both be advantageously employed, and they are frequently used alternately in one and the same painting.

The implements with which the colours are laid on glass are various sorts of paint-brushes, viz.:—

1, *Marten's hair pencils* [a], brushes which run to a fine point, and are generally used for water-colour painting;

2, *Fitch pencils* [b].— These are not finely pointed, but cut off abruptly at the lower part, so that they present a flat surface perpendicularly to their length;

3, *Broad Badger's hair pencils* [c].—These are broad and flat brushes for softening the colours;

4, *Stockfish tails* [d], of soft hog's bristles, of the same form as the foregoing;

5, *Hard pencils,* of the same form as the fitch-pencils, only prepared from hog's bristles;

6, *Hog's bristle pencils* [e], such as are used for oil-painting.

USE OF THESE PENCILS.

In order to lay an uniform coating of colour upon the glass, a marten's hair pencil must be used, when the space which has to be covered is small; if, on the contrary, it is large, either a stockfish tail, or a cut badger's hair pencil, must be used. By the help of these implements, the colour is laid on the glass and spread over its surface by being rubbed in one direction, and then in the opposite, until the whole coating is uniform. Painting of this kind has generally furrows or channels

[a] Marderpinsel. [b] Iltispinsel. [c] Dachspinsel.
[d] Stockfischschwänze. [e] Die pinsel ans Schweinsborsten.

which are caused by the hairs of the pencil, but these may be removed when it is considered necessary, by means of a fitch pencil, or, still better, by means of a cut badger's hair pencil.

The fitch pencil, as we have stated, is terminated by a flat surface, and it is used for touching the glass with the ends of its hairs, but not for drawing over the surface, as is the case with the other pencils. If this is done skilfully, and continued for a sufficient length of time, not only will the streaks thereby disappear, but the colour will also be diffused uniformly over the whole of the surface which is to be covered. The pencil must, however, be used until the colour is almost dry, and a very short time before this takes place the colour will be distributed with perfect uniformity.

The fitch pencil answers very well for laying on thin coatings of very liquid colour, when they are required. A little colour is taken with the pencil from the palette, and lightly dabbed on those parts which are to be covered with the colour

The marten's hair pencil, on the contrary, is used for laying on those colours which are required to be fused, for marking the lines, &c.

The hard pencil of the same form as the fitch-pencil, is used for removing certain water-colours which were previously laid on the glass, in order to execute in this way a species of painting of which we shall presently speak more fully.

For mixing up the colours properly, certain precautionary measures are necessary. When a colour is to be mixed with an essential oil, for example, a little of this colour, which, as we have before stated, must have been previously well levigated and dried, is put upon a palette and mixed, by means of a spatula, with a sufficient quantity of thickened essence to allow of its being worked to a stiff paste. It is then diluted with more or less essential oil of turpentine, according as the colour which is to be laid on is intended to be of a more or less rich tone; it is then ground a little more in the mill, and used in the manner above described. These precautions are especially important towards ensuring a successful use of the fitch pencil.

The process is the same with regard to the water-colours, except that instead of a thickened essence a thick syrup is used, and instead of essential oil of turpentine, water. The object of this method of operation is to determine the proportion of sugar or thickened essence without difficulty. For the borax colours, and even for those in which pure essence of turpentine is used, we are limited to the employment of as much liquid as will yield a thick paste. As a general rule, the enamel colours should not be much moistened.

It is not immaterial whether a water-colour or an oil-colour, and whether essence of turpentine or essence of lavender be used. The water-colours are, generally speaking, more liquid than the oil-colours, under circumstances in other respects the same. They have less consistency, and consequently do not admit of being softened so well with the paint-brush. On a large surface of paint, the oil-colours are much better adapted to forming an uniform layer of colour, and the streaks and furrows which the stockfish-tail leaves behind may be more easily removed by means of the cut badger's hair pencil. The use of the fitch pencil also ensures a far more satisfactory result with oil-colours, and consequently these colours are preferred in all cases which are analogous to the above.

In comparing the essence of lavender with the essence of turpentine, we find that the latter dries much sooner than the former; the former, therefore, is employed whenever a liquid which is long in drying is required. It is not used alone in the preparation of the colours, but as much of the essence of turpentine is mixed with it as is necessary to cause it to dry at the proper rate. These means are employed when the fitch pencil is to be used for softening, which always requires time. In the water-colours we cannot advantageously substitute for sugar other viscid substances, e. g., gum, &c.; for the former has the advantage of being much softer, and at the same time not so liable to peel off.

Two styles of execution essentially different from each other are adopted in glass-painting. That which in former times was chiefly employed, namely, the Gothic, consisted in using no enamel for colouring the glass, but in merely marking the outlines and shadows with a brown opaque pigment upon glass which had been coloured in the melting pot. This style of painting, or rather of drawing, notwithstanding its simplicity, is susceptible of the most beautiful effects which the decoration of panes of glass is capable of producing. To it we are indebted for the beautiful Gothic windows which adorn our old churches. This style of glass-painting is moreover the easiest of execution, for the artist need only be a skilful draughtsman, and has occasion for nothing else, except one single pigment, which is easily prepared, and not at all difficult to use.

The second style belongs to the period of the revival of glass-painting; it supposes likewise the use of coloured glass, but at the same time requires the use of numerous pigments, by means of which the artist executes a real painting on the glass, which, in regard to its effects, may be compared with oil-painting. The artist is therefore under the necessity of having a palette covered with vitrifiable colours, which is of the same use to him as a palette supplied with oil-colours is to the oil-painter. The execution of this style is difficult, and requires a particular study.

Glass-painting, taking it altogether, presents numerous and considerable difficulties, which proceed from the nature of the colours and of the glass itself, either in relation to the mechanical application of the pigments, or in relation to the realization of the results which the artist endeavours to obtain. We will mention the kinds of manipulation which are necessary in the various cases.

The smooth and polished surface of glass is not very favourable to the laying on the colours. When we are laying any colour on the glass, a second stroke of the brush frequently takes off what the first had deposited; and thence arises the impossibility of hesitating in this work. This difficulty has disposed some artists to paint only on glass whose smooth surface has been removed by sandstone or emery.

But the greatest obstacle to the painter arises from the nature of the vehicle, which does not easily admit of the several coatings of colour being laid one over the other, which, on account of the substances that are used, do not even adhere after the first coating is thoroughly dry. As the vehicle for fixing on the first coating retains its solubility, it is capable of being softened and removed from the surface by the succeeding coatings. To meet this difficulty it was happily suggested that the vehicle should be changed in every coating of colour which was laid on over another. Thus, for example, we paint with water-colour upon an oil-colour, and vice versâ, with oil-colour upon a water-colour. The fixing substances of the one colour being insoluble in the liquid of the other, there is no danger of removing, by a second application of colour, that which has been produced by a first.

The inconvenience, however, which accompanies the employment of colours prepared in different ways, gave rise to the discovery of a method by which we may paint with the same vehicle. This discovery was arrived at by observing the following fact. An oil-colour rendered viscid with thickened essential oil of turpentine, or Venice turpentine, retains its solubility in this liquid, if it has been dried by exposure to the air; but if the painted pieces of glass have been submitted to a moderate temperature in a drying-oven, the colour loses its easy solubility, bears the friction of the pencil very well, and the fresh coatings may be laid on without difficulty.

In proceeding according to the method which we have just described, the painter will sometimes have occasion to interrupt his work, in order to dry the painted pieces of glass in the oven; and this circumstance was so disagreeable to many artists, that they considered how they might avoid the necessity of doing so, and at length they succeeded in painting on glass with water or oil-colour, as is the practice in painting on canvass, without being obliged to dry the first painting. We must observe, however, that this is to be attributed more to their skill and dexterity, than to the method itself to which they ascribe this invaluable superiority in practising their art. In order to explain their method of proceeding, we will consider a painting with water-colours. The artist first of all makes up his colour, and mixes with it no more sugar than is necessary to cause it to adhere. This colour laid on, he paints upon the first coating with colours which contain more dissolved sugar, without being thereby of a thicker consistency. The increasing solidification of the vehicle prevents its solvent action upon the colour which was originally laid on.

If this is dexterously performed, it admits of the painting being *impasté*, to use a technical expression. But nothing but long experience and perfect dexterity will—we repeat it—enable us to employ this method with advantage.

For the execution of paintings on glass, particularly Gothic, a method as simple as it is ingenious, is frequently had recourse to, which enables the artist to work with the greatest certainty of success. This mode of painting is designated by the French term, *peinture par enlevage*, and consists in drawing the outlines with an oil-colour, and painting over the whole with a water-colour, which, after it is perfectly dry, is to be removed with a hard paint-brush. By a dextrous use of this paint-brush, portions of colour of different degrees of thickness are removed, according as shadows, half-tints or lights are required. Wherever the glass is left bare by a complete removal of the colour, we get the lights; the places which the brush has spared give the shadows, and the half-tints are produced by an imperfect removal of the colour. In this way the process of laying on the ground-colour of the picture is performed, and after the latter has undergone the firing, it is again painted over, and retouched with a colour which has been made up with sugar or thickened essence.

The colour proper for the *peinture par enlevage* is an enamel colour, with which a little borax is mixed, and which is then levigated with enough water to give a thick paste. The colour is laid on by means of a stockfish-tail, and softened uniformly with a cut badger's hair pencil, with the assistance of which the colour is easily spread over the glass. The small quantity of borax which has been mixed with the colour causes a sufficient adhesion of the latter to the glass, so that the hard pencil may be fearlessly applied to the removal of the water-colour.

The majority of the pigments of the second class are well adapted to the employment of this method. There are, however, among the pigments of the first class, some whose colouring matter is acted upon by borax, so that a combination arises which imparts to the colour which has been laid on too much adhesiveness to admit of its being removed with the hard pencil. Among these colours are ochre yellow and all those pigments which contain oxide of zinc.

This unpleasant circumstance may, however, be certainly obviated by fritting these pigments before they are levigated for mixing with borax.

To *frit* a pigment is to heat it to that point at which it coagulates, and, by reason of an incipient fusion, forms a mass of the consistency of dough.

Pigments of the second class are seldom used for the *peinture par enlevage.* As this kind of painting only has in view a simple sketch upon a previously coloured ground, it requires in most cases merely an opaque pigment coloured by mixture. That which is best adapted to this purpose, consists of a flux of flint glass and of brown or violet oxide of iron in the usual proportions, with a mixture of calcined borax, whose weight is equal to the eighth part of that of the flux. The proportions of the borax and the flux are calculated for the preparation of flux No. 3 of the pigments of the first class.

The method which we have just described is capable of an important modification with respect to the preparation of the colour proper for *peinture par enlevage.* Instead of dissolved borax, merely the oil of turpentine of commerce is used. In this case, the drawing is first sketched with a pen in water-colour, and a coating of oil-colour is laid on over it. This modification is based upon the property which essence of turpentine possesses of giving sufficient firmness for the *enlevage* pencil to be used. The essence of turpentine owes this property to a small quantity of resin which it contains, but which is not to be found in it after it has been rectified by a new distillation. Hence it follows that this method is the opposite to the former. Certain precautionary measures, however, ought not to be neglected, to obtain a successful result. The water-colour must accordingly be properly mixed with sugar, so that the oil-colour may be incapable of softening it. Moreover, after the oil-colour is laid on, it must be submitted in the drying oven to a temperature sufficient to produce the requisite firmness. It is also necessary to avoid adding essence of turpentine frequently to the same colour, because the proportion of resin is likely to be increased by that means, and the consequence would be too strong an adhesion of the pigment to the glass, so that it could not then be easily removed with the *enlevage* pencil.

Circumstances arise in which this method is rather complicated, and this is the case when it is required to paint upon glass which has not been coloured. In order to paint a head, for example, a light tint is laid on for the colouring of the lights, and upon this a coating of colour suited to the *enlevage*, in order to form the shadows and half-tints. Thus, upon a drawing prepared with water-colour, the first coating must be laid on with a colour mixed with thickened essential oil, and the second with a colour mixed with borax; but if the drawing has been executed in colour mixed with thickened essential oil, the first coating of paint must be laid on with colour mixed with sugar water, and the second with colour moistened with pure essential oil, in conformity with the directions we have given above.

The *peinture par enlevage* is not only simple, but is also executed in a very short time. It is peculiarly adapted to decoration, especially to the execution of such designs as stand out in light colours from a dark ground, and to the representation of the embroidered parts of drapery. In this case the *enlevages* are executed in a different way. To make the drawing clean and correct, wooden scrapers of various forms must be substituted for the hard pencils. The colour which is here operated upon is of no particular kind, but may be any pigment whatever that has been levigated with thickened essential oil.

Finally, glass-painting justifies every possible artifice, the object of which is to lessen difficulties, or to enable us to obtain results which are not to be obtained in any other way. Thus, for example, it is not uncommon to paint both sides of the glass, in order to obviate the unpleasant results of laying on one colour over the other. The same method is adopted in the case of yellow from silver, because the substances by which it is produced ought not to be brought into immediate contact with the colouring enamels. In this way a green is obtained, that is to say, by giving a yellow stain to the back of a piece of glass which has been painted blue.

The same method is also followed in order to impart brilliancy and a remarkable freshness to the brownish red colours from iron; that is to say, a yellow is applied to the opposite side to the brown.

Whatever method be adopted, the employment of the colours is always, however, subject to certain restrictions. Care must be taken to use as few mixtures as possible. The colours are by means of the latter mutually destroyed at the temperature at which they are burnt in, while at the same time new combinations take place. By avoiding a mixture of the pigments we obtain purer, less perishable and much more certain colours. It is better to lay one colour over the other, instead of mixing them. In order, therefore, to produce an effect similar to that which may be obtained with ochre yellow and red from iron, the yellow is first laid on and then tempered with red.

It is also of consequence to lay on the pigments as thin as possible, and there are several reasons for so doing. Thus if the colours are laid on too thick, the adhesive substances that are in them form a mass which possesses too little softness and flexibility. The motions caused by expansion, which the glass undergoes in the changes of temperature, unless they are shared by the painting, at length overcome the adhesion of the colours and loosen them from the surface of the glass. This always takes place when water-colours and oil-colours are laid on in alternate coatings, for the heterogeneous qualities of the substances by which those colours are fixed are still more conducive to this result. The mere drying of itself is often sufficient to produce this unpleasant result in consequence of the unequal contraction of these substances.

On the other hand the water-colours certainly part with the water they contain, in drying on the glass, but then they retain the sugar which was mixed with them; the oil-colours give up the volatile part of their vehicle, whilst the thickened essence which is in the latter has lost the power of being converted into vapour, and consequently remains upon the glass. Hence it follows, that these substances must be consumed in the firing, and leave a certain quantity of carbon lying between the particles of the pigment. This body re-acts upon certain combinations, e. g., the oxides of iron and lead, which it turns black by robbing them of their oxygen, which it does so much the more, as the carbon being protected by a thick coating of colour resists combustion the longer. This circumstance is at least of importance with regard to the flesh colouring. This *contretemps* which we have just pointed out would not take place if a firm substance, and one perfectly volatile at a certain temperature were invariably used as a means of fixing on the colour, as, for example, camphor, or borax, which contains no carbon at all. But the former substance is yet to be tried, and the latter could not always be conveniently used. Nevertheless, it follows from what we have already stated, that, of the substances which are adapted to fixing the painting upon the glass, the preference should be given to those whose combustion leaves the least carbon behind, and which at the same time preserve a certain ductility, as a security against cracking and splitting. Perhaps wax would answer very well with regard to these two particulars, for a portion of it volatilizes when it is exposed to heat, and it possesses moreover great ductility. For this purpose we have only to dissolve it in essential oil of turpentine.

It would be a waste of time to describe the various manipulations used here, which are purely artistical; and we would rather therefore confine ourselves to some few particular cases. Painting on glass is always done by copying oil-paintings, or original designs expressly prepared, which are called *cartoons*. The original design is traced by means of transparent paper, and this is used for transferring the drawing to the glass. For this purpose the piece of glass is laid upon the tracing, which has been first spread out upon a table. The transparency of the glass makes it easy to follow the outlines and shadows of the tracing; but if the glass is very much coloured and destitute of transparency, it becomes necessary to use a perforated pattern for finding out the drawing through the glass. This is a kind of tracing, the outlines of which are drawn through numerous contiguous punctures of the size of a needle's point. The paper which lies on the glass is then struck with a bag of powdered charcoal, and the outlines appear marked with sufficient distinctness. It is best to begin by drawing in Indian ink the object to be painted, when it is in our power to correct and modify the sketch, just as we think proper, and then the painting may be executed according to it with the greatest certainty. If corrections are made after the pigments have been laid on, a want of uniformity and completeness will always be observed in the work. Besides, correcting is then much more difficult. In other respects the same rules and precautions are applicable to glass-painting as to painting on canvass. The easel and the *maulstick* are used equally in both. The easel is constructed in a particular manner, which we shall describe hereafter. The pieces of glass that are placed upon it must be fastened with a soft adhesive wax prepared solely for this purpose. In order to take advantage of the transparency of the glass, the painter places his picture between himself and the light, and can at once judge of the effect of his work, as he proceeds.

A paint-brush or a goose-quill is used for drawing on glass with a pigment. A water-colour is best adapted to the goose-quill. Oil-colours, which are preferred for painting upon a flat surface, because they admit of being diffused more uniformly with the pencil, are not suited so well to the quill and do not adhere so well to the glass; nevertheless they are frequently used. A large quantity of sugar facilitates the drawing; still it is necessary to define the amount which should be mixed with the colour. Six grains of sugar to one drachm of colour produce a sufficiently strong adhesion, but for the quill at least seven grains of sugar must be mixed with the colour. A mixture of twelve grains would cause the colour to peel off. It is a very good precaution, when it is intended to paint with a quill, to wash the glass beforehand with essential oil of turpentine. Drawing in Indian ink is likewise more easily executed if this plan be adopted.

Should it devolve upon a glass-painter to paint a church-window of large dimensions, he must begin by dividing it into more or fewer compartments which are surrounded by iron bars properly disposed and firmly united, so that all parts may be equally firm. He first determines the direction which is to be given to the iron bars and lead casing which are intended to unite the different parts of the picture. In doing this he must study to make these parts follow the outlines as much as possible, and to hide them in the shadows in such a way that they may not injure the effect of the picture. He ought not to be afraid of giving them a proper thickness, and increasing their number when necessary for the sake of greater firmness; this is of the greatest importance for the duration and preservation of a work of art which is always exposed to the violence of the winds. It is a necessary condition which fetters the author of the original design himself in his composition. He must always take care that the execution of the painting will not require pieces of glass which are too large to admit of being durably fixed by means of iron bars and leading.

If the artists of the present day understand not only how to ensure firmness to a painting on glass, but also at the same time how to satisfy the demands of the art as far as is necessary, this, whatever may be said of it, is an improvement which we owe to the modern style of painting, and to which the manufactory at Sèvres has greatly contributed. As for the rest both these conditions may be satisfied at once without much difficulty. The presence of the iron bars and of the leading does not disturb the harmony of the painting nearly so much as would be supposed. Can this be a magical result of this kind of human creation? The human mind has the power of dismissing these obstructions, and the largest of them always appear like objects which are outside the picture. Now whether the ancients sacrificed everything to solidity, or were deficient in mechanical skill, their church-windows afford frequent instances in which the painting is far from harmonizing with the materials which support it. Thick iron bars are frequently carried across the figures or abruptly cut the masses in the finest centre of light. Every one, therefore, will certainly coincide in our opinion, namely, that this is granting too much to the demand of solidity and too little to the effect of the painting. But did not a very simple principle of economy frequently predominate in this matter? This hypothesis seems at least reasonable, the construction of the *arming* being one of the most expensive parts of the construction of painted church-windows. When we come to work the iron bars into complicated forms, this, as every one must see, can only be done at a great expense. It is a consideration of some importance, why the ancients thought themselves obliged to restrict the claims of the art to limits marked out by economy.

After we have explained the various manipulations of the proper art of glass-painting, we must not omit to speak of a branch of industry which has something in common with the art with which we are at present engaged. We mean the manufacture of the *mousseline* glass, which consists in covering panes of ordinary window-glass with a coating of opaque white enamel, upon which a transparent sketch is drawn by *enlevage*, which seems to be executed upon a faintly-polished ground. To obtain this result, a fitch pencil must be used, whose form we have already described. This is dipped into thickened oil of lavender, and the surface of the glass is touched perpendicularly with it until the whole is covered with an uniform coating. As soon as this layer has acquired a proper consistency, a powder composed of one part of oxide of tin and three parts of a flux of the second class, is sifted over it. The thickened essence retains a proper quantity of this enamel. This coating is then dried for six or eight hours, and after it has become sufficiently hard, the excess of enamel powder is removed by means of a badger's hair pencil.

Now, in order to draw upon a plate of glass like this lines which shall possess the polish and transparency of glass, we lay under the glass a pattern whose lines are sufficiently conspicuous even through the layer of powder. The pattern having been previously well secured, the artist removes by means of an etching tool the colour from those places which are indicated by the drawing. This painting is now exposed to a proper degree of heat, that it may adhere or become burnt in. There is little in this operation that admits of the application of the proper art of glass-painting, the use of the wooden etching tool alone being accidentally borrowed from this art. It is an exceedingly convenient tool for executing transparent drawings in imitation of embroidery; it is also much better adapted to *enlevages* than the steel scraper. The method which is employed in producing white enamel is preferred on account of its succeeding in a very short time, but is better adapted to white enamel than to the other colours. Laying on by means of the fitch pencil ensures greater uniformity, and enables us to obtain the requisite tone of colour with certainty.

THE BURNING IN OF THE PAINTING.

The glass, after it has been painted, must be exposed to a temperature at which the pigments liquefy, and are thereby united to the glass. For this purpose the pieces of glass are arranged in a kind of box of fire-clay, called the *muffle*, which is placed in a furnace and there heated until the colours which have been laid on are liquefied.

DESCRIPTION OF THE FURNACE.

The furnace consists of four walls formed by bricks standing on their ends; these bricks enclose a space which is again subdivided into three parts. The upper compartment contains the muffle, which is open in front for the purpose of putting the glass in and taking it out. This aperture must be walled up, after the muffle has been filled. The intermediate space contains the fire-place; the lower space contains the ash-pit. A cast-iron grate separates the fire-pot from the ash-pit; it is composed of single cast bars, in order that it may be more easily repaired. These bars are merely laid by the side of one another. Two or three arches span the fire-pot transversely, and are placed at equal distances from each other; they serve for the support of the muffle. An arch of burnt clay is perforated with several holes to allow the escape of the flame and the products of combustion. The muffle has a wide aperture in front for the purpose of putting in and taking out the glass, and another one of a small size under the arch for the escape of the gases which are evolved in the interior of the muffle. The door which closes the large aperture is usually provided with a sort of pipe in the middle, through which the experimental pieces of glass or the pyrometer are introduced into the muffle. By means of the latter we are enabled to observe the temperature. It is better, however, to have two apertures of the same kind, as we shall presently see on a closer examination.

MANAGEMENT OF THE PAINTED PIECES OF GLASS IN THE MUFFLE.

As the colours which have been laid on are to be melted, the plates of glass should not be placed in immediate contact with one another, or they would necessarily bake into one mass. They are therefore laid apart from one another by means of fire-proof earthenware shelves, (in France, by means of slabs of lava from Auvergne,) or plates of cast-iron, which are ranged horizontally in parallel layers, so that a small space is always left between them. These shelves are kept apart by the insertion of small parallelopipeda of baked clay in the four corners. The shelves are also laid upon cross-bars of iron, of which two are used for every shelf, and are inserted at both ends of the muffle into notched bars; the former method, however, is preferred. Before the glass is put into the muffle, the shelves must be covered with a stratum of Spanish chalk mixed up with water, so that the glass, if it should happen to become soft when heated, may not adhere to the surface of the shelves. This coating of the shelves must be carefully dried, and then the pieces of glass must be laid side by side, but without touching one another; moreover, a clear space must be left at each corner of the shelves for the little supports which we have already mentioned. After the muffle has been filled, the aperture is hermetically sealed by being plastered over with clay which is proof against fire, and the front of the furnace is walled up with bricks. Thus shut up, the glass may be heated without the colours being exposed either to the action of the flames or the vapours which arise from the fire-pot.

According to Dr. M. A. Gessert, to whom we are indebted for an excellent history of glass-painting, the introduction of the painted pieces of glass into the muffle is effected in the following way in Germany:—Well-calcined lime is first of all slaked with water, and when it has crumbled to powder, is properly dried over the fire. The bottom of the muffle to the thickness of an inch is covered with this powder, as it falls through a coarse hair-sieve; this substratum is carefully levelled, otherwise the pieces of glass might become distorted in the firing; these pieces of glass are then laid side by side, but in such a manner that they may not be in contact either with one another or with the sides of the muffle. A thin layer of lime is then sifted over them, other painted pieces of glass are disposed in a second series, and the process is continued, until we reach the centre of the muffle, at least the aperture for drawing out the tests, which consist of strips of glass from 6 to 7 inches in length and 1 inch in breadth, painted over with patterns of the colours which are to be burnt in. These, like the painted pieces of glass, are laid upon a stratum of lime, and sprinkled over with a coating of the same, but are so arranged that one end of them reaches to the centre of the muffle, while the other projects half an inch out of the test aperture, to admit of their being taken hold of and drawn out by the pincers. The artist then continues introducing the other pieces of glass, and strewing line, until all have been arranged in their places in the manner above described, or the muffle is full. If only *one* has to undergo the burning in, the muffle is filled with ordinary pieces of glass instead of painted glass, and the only piece which is to be fused is introduced into one of the interior layers of the muffle. The latter is then covered up.

The furnace must be heated with wood, inasmuch as no other kind of fuel will answer the purpose, at least for the species of furnace of which we are now speaking, because the heating of the muffle is effected less by radiation from the fire-pot than by contact with the flames. Consequently that kind of wood should be selected which gives a long and bright flame, e. g., the wood of the aspen, birch or poplar, which, moreover, must previously be seasoned as thoroughly as possible. The fire must be made to burn up slowly, in order that the muffle may acquire the same degree of temperature in all its parts. The ignited matter must therefore have time to propagate itself. Were we to proceed otherwise, the glass which lay next to the sides of the muffle would have already endured a degree of heat which would not only affect the pigments but would even bring the glass itself into a state of fusion, whilst the plates of glass which were situated in the centre of the muffle had only attained the proper degree of temperature. The better to escape so unpleasant an occurrence, we must proceed in the following manner:—

The fire must be constantly kept at a moderate temperature, until the muffle has attained a lively red heat, when the temperature must be lowered. The heat penetrates into the interior, and the muffle at last becomes of a dull red heat; the fire is now stirred, and as soon as the muffle is again at a lively red heat, is lowered a second time. This is continued until the centre of the muffle is at the requisite temperature. According to this method it can never happen that the exterior of the muffle has already attained a high temperature before the interior is properly heated.

The temperature which it is intended to arrive at is generally a moderate cherry red heat; this is determined by looking into the various apertures of the muffle. But these observations are very liable to error, because we are not always in the same condition with regard to light. Suppose, for instance, that the room in which the furnace stands is very well lighted, then the red-hot muffle is not nearly of so bright a colour. In a more subdued light, the red appears much more intense; so that one day's experience is frequently fallacious. It is therefore necessary to hang curtains before the windows, in order to obtain a tolerably uniform light for this examination.

The temperature is also determined by painted pieces of glass for testing, which are laid in the apertures of the muffle; but such tests as these are not conclusive, inasmuch as they only indicate a local temperature. An experiment made in one part of the muffle affords no clue towards determining the state of the other parts. But if after all the artist should be disposed to use this test, he must endeavour to keep always below the requisite temperature, and to lower the fire before the test-glass has actually arrived at the proper degree of fusion; for he may be sure that the temperature will increase towards the centre. Carmine is generally employed in experiments of this kind. The changes of colour which it undergoes in mass, when it is raised to a higher temperature, render it peculiarly adapted to this purpose. When not much heated it has a dirty violet colour, it then passes over into pure carmine; and when at length it is heated too much, it appears yellow in reflected light, and violet in refracted light, that is to say, upon an opaque body, e. g., a piece of porcelain, it will appear yellow; upon a piece of glass, on the contrary, in transmitted light, it will appear violet.

Finally, the temperature may be determined by means of particular instruments contrived on purpose to measure the heat of the furnace. Among these are the *pyrometers* of Wedgewood and Brogniart. The former is constructed on the principle that clay contracts in proportion to the heat to which it is exposed. It consists of a plate of copper, on which two or three rulers, likewise of copper, are fixed. Between these is inserted a cylinder of clay baked in the fire, which has been exposed to the degree of heat which is to be determined. The more it has diminished in bulk the greater was the degree of heat which was applied. The instrument is divided into 240 parts. The zero answers to 580.55° Centigrade; every degree is equivalent to 72.22° Centigrade. This pyrometer is therefore adapted to the measurement of very high temperatures, but does not answer well in the case before us, in which the other is preferable. This latter is constructed on the principle of the expansibility of the metals by heat, and consists of an apparatus of baked clay, along which a groove runs longitudinally, but stops short of one of the ends. A bar of metal and another of baked clay lie in this groove in such a way that their ends touch one another. The other end is furnished with a dial-plate, in the centre of which a finger moves, one end of which is in contact with the earthenware bar in the groove.

That part of the instrument which contains the bar of metal is introduced into the muffle in such a way that the bar shall be completely in the muffle. As it expands by the heat, it must necessarily, since it lies at the end of the groove, push forward the earthenware bar; the latter again communicates the impulse to the finger, which then indicates upon the dial-plate the expansion which has taken place. The metallic bar must be made of a metal whose point of fusion is far beyond the temperature necessary for burning in the painting; it must not even become too soft at this degree of heat. Iron and silver may be employed for this purpose, but silver is generally preferred, because it becomes less oxidized. If a metal still more difficult of fusion were required, a bar of platinum might be used.

In order that we may use this instrument effectually, the following conditions must be complied with:—The door of the muffle must be furnished with two apertures, one of which must be made in the lower part, and the other in the middle, or rather about the upper third of its height. A pyrometer is prepared for each aperture. When the lower one indicates a dull red heat, the fire is not allowed to increase, but is stirred in proportion as the heat has been reduced below that temperature. The artist proceeds generally according to the directions above given, until the upper pyrometer indicates a proper temperature.

In beginning to light the fire, it is important to cause a feeble current of air to pass through the muffle, in order to allow the gases, which are formed in the latter by the combination of the substances which are used for fixing the painting with those which come out of the fire-pot, and penetrate through the sides of the muffle, to escape with rapidity. For this purpose one of the apertures in front, as well as that of the upper part, is left half open. Upon the latter is also placed a stove chimney, a few decimetres in length, which when heated draws the air out of the interior of the muffle, and accelerates its upward motion. It is only when the muffle is being first heated that the most injurious of the external gases penetrate in larger quantities. After it has arrived at a red heat, they become more completely dissipated on the exterior. These gases always exercise a pernicious influence upon the painting, which it is necessary to guard against.

The creating the current of air of which we have just been speaking, is not less useful as a means of obviating an unpleasant occurrence, which, without this precaution, frequently takes place, viz., the *cracking* of the painting. This may be explained as follows :—When the muffle is being first heated, a large quantity of smoke often penetrates through the hole at the top. The glass is still cold, whilst the sides of the muffle are hot; consequently the aqueous vapour of the smoke condenses in small drops upon its surface. As soon as the glass begins to grow hot, the water which lies upon it begins to boil before it is converted into steam, and at last affects the painting with which it is in contact. The consequence of this is, that a peculiar kind of cracking takes place, similar to that which varnish undergoes when it is laid on an oil painting just finished. The possibility of this accident is diminished by creating a draught of air at the commencement of the heating; but this draught should not be so strong as to chill, and consequently to crack the objects with which it comes in contact. If this be avoided, it seems to be attended with no other prejudicial results.

There is also another source of moisture, viz., in the clay with which the door of the muffle is plastered over. It is customary, therefore, to heat for a short time the muffle, with its contents, before plastering on the clay, and to close the furnace. The muffle being already hot at the time the clay is laid on, its contents are not so likely to condense the vapour.

That kind of glass-painting which is executed with coloured fused pigments, is not finished after the first firing. The fusion of the colours gives in general too feeble a tone of colour. The pigments of the first class especially lose some of the intensity of their colour when they are exposed to too high a temperature. It becomes necessary after the first firing to give expression to those parts which are deficient in this particular, and generally to impart the requisite harmony to the whole. It is even sometimes useful to re-touch the work after the second burning-in, and in this case a third burning-in becomes necessary; but the painting is not capable of bearing more than this, for a large portion of the pigments would be considerably damaged and even entirely destroyed by the repeated action of heat. When a painting is to be burnt-in a second time, and it becomes necessary to restore harmony to the various parts of which it consists, the artist generally lays them together in the position which they are afterwards intended to occupy, in order that he may be enabled to judge of their combined effect. For this purpose he fixes them in their respective places upon the glass plate of the easel, or upon a plate of glass of a proper size, which is placed in a frame.

There are two ways of holding the pieces of glass together. They may be fastened upon the glass plate with wax, which is spread out between the fingers and rolled upon a flat surface. The wax takes the place of the leading, and fills up all interstices. The pieces of glass may also be encased in lead. Fastening with wax has the advantage of being materially cheaper than leading, only it is deficient in solidity. When it is warm, the wax becomes so soft that the pieces do not hold together well, and numerous accidents are the result. A work which has occupied much time may be ruined in a single moment. It is also difficult to free the glass entirely from the wax which adheres to it without a considerable loss of time, and if any wax remains behind, it is injurious to the painting. Besides, the idea that leading is more expensive is merely illusory, when it is the painter himself who fastens the pieces with wax; for the cost of the leading is more than compensated for by the value of his time, because the former is done by a glazier, who only solders together the ends of the strips of lead. Fastening with wax is only practised at Sèvres; at Munich leading is preferred.

OF ENGRAVING UPON GLASS WITH HYDROFLUORIC ACID.

This style of decoration, which has nothing in common with the proper art of glass-painting, is nevertheless frequently and advantageously employed as an assistant to this art. It is generally used for *overlaid* glass[a], as it is called, (white glass, upon which a coating of coloured glass is fixed in the blowing.) It consists of a kind of white drawing upon a coloured ground, and it is obtained by removing the coating of coloured glass in all those places where it is intended to lay bare the white stratum, according to the form of the drawing. The process of engraving is as follows:—The glass is first covered with a coating of oily copal varnish, or, what is better, with merely linseed oil which has been boiled with litharge, in order to preserve from the action of the acid the parts which are not to be etched. This layer is dried in the drying-oven, and the varnish is then removed by means of a graver or needle, and a scraping instrument, from those parts where the glass is to be acted upon by the acid. As soon as this operation is finished, the plate of glass is laid horizontally upon a table, and a raised border of wax is carried round the edge which is capable of containing the acid, which is then poured upon the glass. The acid is allowed to remain upon the glass as long as is necessary to destroy the coloured stratum wherever

[a] Ueberfangglas.

it is exposed. After this, the piece of glass is washed and freed from the border of wax and the wax ground. The engraving is clean and fine in proportion to the thinness of the coating of glass, and the diluted state of the acid. If the acid is very much concentrated, its action extends over the etching ground, and the lines seem undermined. This kind of drawing is frequently employed for exhibiting silver embroideries upon coloured dresses. It is white at first, but may be coloured yellow, so as thus to imitate gold ornaments.

Glass may be etched by means of hydrofluoric acid, because the latter has the property of dissolving silica. But on account of the exceedingly pernicious effect of this acid upon the health of those who employ it, it has been hitherto almost impossible to use it. In order, therefore, to apply the art of etching on glass to the arts and sciences, it became necessary to find out another means of etching perfectly harmless, and a suitable etching ground. Dr. Bromeis, of Hanau, a clever young chemist, and after him the celebrated professor, Dr. Böttger, of Frankfort-on-the-Maine, each however by himself, and without being acquainted with the researches of the other, have now discovered such a method of etching, and by means of it have etched plates of glass of any thickness, and have prepared them for giving impressions in the presses which have been hitherto generally employed.

Professor Böttger gave a full account of this invention, which is called *hyalography* by the inventors, in a lecture delivered at a meeting of the *Physical Society* of Frankfort. At the same time he pointed out the advantages which were associated with this discovery, of which we shall only particularise the following :—

1. The substance used for etching is *perfectly harmless*, and no vapours or gases are evolved, which, as is the case in copperplate engraving, are in the habit of producing an injurious effect even upon the plate ; moreover, it does not lose its strength, the same quantity can be used for etching several hundreds of lines in glass.

2. Glass admits of an exceedingly delicate treatment, and the lines are more perfectly developed than in engraving on steel or copper.

3. All kinds of porcelain and flint-glass may be very easily supplied with colouring and glittering ornaments, by rubbing in the drawings that are etched upon them with vitreous porcelain colour, which is not difficult of fusion, and then burning it in in the muffle.

The inventors intend to make known their method, which, independently of *hyalotypy*, promises to be of great interest, for a very moderate remuneration, as soon as at least fifty persons in the district of the Zollverein will combine to purchase it.

DESCRIPTION OF THE EASEL [a] PROPER FOR GLASS-PAINTING.

The easel consists of an oblong wooden frame, whose greatest dimension is its height. Its interior edge is furnished with grooves for the reception of a plate of glass. This frame is placed in a larger frame, and may be raised or lowered in grooves at pleasure. We have an exact representation of it in the old sash-windows. The exterior frame has a series of holes in the direction of its height, on both sides, and the interior frame can thus be supported at any given height by means of pegs which are inserted into these holes on either side. This apparatus is placed obliquely on a table, and supported in this position by two props at the back, which are joined to the upper part of the large frame by means of two hinges. These two pieces are joined together by a cross-bar, and held at a proper distance from the frame by means of moveable iron hooks; a contrivance precisely similar to what we find in step-ladders, for, like them, when it is not wanted to be used, it can be shut up, so as to occupy less room.

MILL [b] FOR GRINDING THE PIGMENTS.

The mill is a circular vessel of porcelain, which receives the runner [c] and the substances to be ground. The bottom of it, towards the centre, rises in the form of a conical or rounded projection, which forms with the lower part of the side a wide groove [d], in which the runner moves. The runner consists of a thick crown of porcelain, formed out of the segment of a cylinder. It is placed perpendicularly in the vessel, projecting above it. Its lower edge is situated in the groove. As it is supported by the bottom of the vessel, it is capable of revolving on its axis in a horizontal direction. The levigation of the pigments is therefore effected by the rubbing of the lower edge of the runner upon the surface of the groove. This groove is intended to retain the runner in its position, and to cause the substances which are to be ground to collect at the points where the grinding takes place. The upper edge of the runner is level. It has two holes situated opposite to one another, and bored perpendicularly from the surface: they serve to fasten on the piece which is destined to communicate motion to the runner.

A tin plate, of the width of the runner, closes the opening at the top. It has two pegs, which are inserted into the above-mentioned holes. By this contrivance the runner is made to follow every motion which is communicated to the plate.

There are two ways of causing the motive power to act by the help of the plate of metal. We may act upon a point in the circumference by means of a revolving handle, which is let into a wooden plate that serves as a cover. This is the

[a] Staffelei. [b] Mühle. [c] Läufer. [d] Furche.

simplest method: but as in this case the runner moves at liberty in its receptacle, as soon as ever it meets with any check in its circular motion, it suddenly quits its path, and the moving it then becomes very troublesome. This might be entirely obviated by means of a pin passing through the centre of the runner and of the outer vessel; but it is better to produce motion by means of a crooked handle [a], which is made to work in the following manner:—The upper surface of the metallic plate has in its centre a circular iron bar, well secured. This bar or spindle serves as an axis, and turns in a hole which is bored in a horizontal cross-piece, or rather in the centre of the lid of a box which covers the runner. The handle is fastened on just where the axis projects out of the box. By this means the centre of the runner is always retained in the same place. It assists the action of the handle, which thus distributes the impulse it receives to all parts at the same time; consequently the runner cannot suffer any concussion, as in the foregoing case.

When the pigments are being ground, it is often advisable to increase the weight of the runner at the commencement of the operation. This is done by placing upon the tin plate another plate of lead of the same diameter, whose weight may be determined at pleasure. It is moveable, and can be easily laid on the plate, and at the same time as easily removed, for which purpose it is merely necessary to take the handle off.

OF THE DRYING OVEN [b] IN WHICH THE PAINTED PIECES OF GLASS ARE DRIED.

The drying oven is constructed of baked bricks, and at the bottom of it is a cast-iron plate. This cast-iron plate lies over the fire, from which the necessary temperature is conveyed to the interior of the oven. The interior is provided with wire sieves, fixed in frames lying horizontally at short distances one above the other, which admit of a free circulation of air. In front of the oven there is a door, which is closed as soon as the pieces to be dried have been laid in their places. The heating apparatus is similar to that of a common oven which is heated with charcoal or coal.

FURNACE [c].

The furnace consists of a wall of baked bricks;

A fire-pot, the interior of which is lined with fire-bricks, as well as with a coating of clay which is proof against fire;

Grating;

Ash-pit;

Pipe through which the air is conveyed from a pair of bellows into the ash-pit;

[a] Kurbel. [b] Trockenschrank. [c] Schmelzofen.

and grating perforated with several holes, in order to distribute the wind of the bellows uniformly throughout the interior. A good smith's bellows should be used for this furnace.

This kind of furnace is preferred to the common draught-furnace for the preparation of the pigments, because it is capable of producing a very high temperature, and by that means shortening the operation.

WAX FOR FASTENING THE PLATES OF GLASS UPON THE EASEL.

This wax is similar to modelling-wax, and consists of

Bees'-wax[a]	4 parts.
Burgundy-pitch . . .	1 part.

It owes its ductility to the Burgundy-pitch, and its adhesive property principally to the greasy matter which the bees'-wax of commerce almost always contains. If this is found to be wanting, the deficiency should be supplied by mixing with it tallow in small quantities.

CHAPTER II.

THE WORK OF THE GLAZIER.

The work of the glazier consists—

1. In cutting out the various pieces of glass which are to be painted, and in giving them exactly the form which the drawing requires.

2. In encasing the glass in lead when the painting is finished, and forming it into the panels[b] of which the whole picture is composed.

3. Lastly, in arranging it permanently in the *arming*.

In the two first operations the glazier is guided by a cartoon prepared expressly for this purpose. Upon this the outlines of the pieces of glass are indicated by a mere line, which at the same time determines the arrangement of the strips of lead. The irons by which the glass is fixed in the window are likewise drawn here in their natural dimensions.

OF THE CUTTING THE GLASS.

The cartoon having been placed on a table, the glazier lays upon the drawing a plate of glass whose colour has been determined to a nicety by the painter. He draws the outline of the piece with a brush containing white paint, and then cuts it with

[a] Gelbem Wachs. [b] Felder.

the diamond, after which he brings it to the exact form by means of the *riesel-iron*[a]. Among other things he takes care to leave a space between each piece of glass, which is determined by the thickness of the interior of the strip of lead by whose edges the pieces of glass are afterwards to be united. The colour with which the glazier draws the outline of the pieces which are to be cut out, is composed merely of Spanish white and weak gum-water; the paint-brush which he employs for this purpose consists of long, flexible hairs attached to a thin cylindrical stick. The painter on porcelain also uses this pencil, and it has the advantage of yielding a line of uniform width.

Although the diamond and its use are well known, we shall, however, mention a few interesting particulars in relation to the properties of this instrument. The diamond which cuts with its natural edge is preferable to that which comes from the hands of the lapidary; for such a diamond only cuts by means of an angle artificially produced. The latter may be very easily seen, when looked at with a magnifying glass, to possess level sides, and to form a rectilineal edge where these planes intersect. That of the natural diamond is not perfectly rectilineal, but always convex; and this is just the form which is best adapted to cutting glass. When the diamond acts upon the glass by means of one of its edges, it either cuts or furrows it. But in this there is an essential difference, for a piece of glass which has been merely furrowed can never be so well divided. The diamond leaves a scarcely visible trace upon well-cut glass; on furrowed glass, on the contrary, a very distinctly fringed groove may be observed. When the diamond is cutting well, a low, monotonous sound may be heard; if it is furrowing, the sound which it produces is very perceptible to the ear and even to the hand of the glazier. When a line has been drawn with the diamond, and the endeavour which is made to break off the piece of glass is fruitless, the attempt must not be obstinately continued, for it is only necessary to strike gently with the handle of the diamond or some other hard body upon the side opposite to the cut, in order to cause it to begin to separate; only a little more trouble is then required to carry on the separation along its whole length. In this way we avoid breaking the glass. When it is necessary to cut a piece of glass of such a form that it would be difficult to cut it with the diamond, and the attempt would probably fail, recourse may be had to the action of fire.

After the outline of the piece which is to be cut off has been drawn, a little incision is made with the diamond in any part of the line, the glass is then heated with a hot coal at those points through which the separation is to be continued, the heating beginning at the point where the diamond has commenced the separation. If the coal is carried in this way slowly over the glass, in proportion as the separation

[a] Krösel-oder Rieseleisens. In French, *grugeoir*.

takes place, the whole piece is at last disengaged. The glazier would do well, however, to draw the piece rather larger than it ought properly to be, for fear that any deviations which might take place as the crack is being continued should spoil the whole piece. The *riesel-iron* is used as a finishing tool to give the requisite form to the glass.

To prevent the necessity of blowing incessantly upon the coal, in order to keep it burning and sufficiently hot, pieces of white wood saturated with subacetate of lead are used, which possess the property of continuing to burn without further assistance, as soon as it has once been ignited at one of its ends. These pieces of wood are generally cut from the willow or poplar, and are then steeped for several days in a solution of the above-mentioned salt, after which they are dried. They are very convenient for hot coals.

The glazier must be supplied with rectilineal and also with curvilinear rulers of various kinds, for cutting the glass. Suppose he has to cut a piece of glass of complicated form—he removes, first of all, from the plate of glass by a rectilineal cut, the glass which lies outside the proper outline, and then, by several cuts in succession, he penetrates into the corners, so that at last it is only necessary to use the *riesel-iron.*

THE RIESEL-IRON.

This tool consists of a blade of soft steel $1\frac{1}{2}$ *lines*[a] in thickness, and about 5 inches 5 *lines* in length. At each end is a shallow notch in the direction of its thickness; and by means of these notches a number of small fragments are chipped off the glass one after another, so that those parts which are outside the outline are removed with tolerable rapidity. The glass to be operated upon is held in one hand, and the *riesel-iron* in the other; the edge of the glass is then inserted without any difficulty into a notch of the *riesel-iron,* and by gentle pressure downwards and upwards, the part which lies in the notch is broken off. This action is rapidly and continually repeated, but the use of this instrument requires some skill. The *riesel-iron* must be made of soft steel, and thus possess sufficient flexibility to hold fast the corner of the glass, and at the same time must be hard enough to last a long time for this continuous work. Iron would be too soft.

A *riesel-iron* of a somewhat different construction is also used, which is suited to glass of any strength, and which can be easily repaired. It consists of two perfectly level rulers, 5 inches 5 *lines* in length, at one end of each of which there is a rectangular projection a little more than a *line* in length. These rulers fit one upon

[a] The line is $\frac{1}{12}$ of an inch French.

the other in such a way that that end of the one which is without a projection is received by the angle of the other, so as to form the notch of the *riesel-iron*. The two rulers slide upon one another, and are joined together by a band, by the binding screw of which they can be fixed in any position. By means of this apparatus, the proper width may be given to the notch, and the instrument may be easily repaired by being taken to pieces.

OF THE LEADING[a].

After the various parts of a painting on glass have been burnt in, the parts themselves must be united, so as to form a whole. This operation is performed by means of strips of lead in the following manner:—

These strips of lead consist of two narrow ribbons joined together lengthwise, by one narrow slip of the same metal running along the centre of both. The arrangement of these three pieces produces a groove[b] in each side of the strip of lead, for the purpose of receiving the edges of the two pieces of glass, which border on one another, and which are thus separated by the middle slip[c], and covered by the overlapping parts of the leading. The length of the strips of lead is determined at pleasure, and the breadth should be from two to six *lines*, so that the overlapping part may be from two to four *lines* in breadth. We shall afterwards explain how the strips of lead receive their proper form.

The cartoon, according to which the pieces of glass have been cut out, is also used for putting them together and leading them. The glazier begins as nearly as possible in the centre of any of the pannels which are to be made up. As soon as the first piece which is to be fixed has been laid in its proper place, it is fastened in several places by pegs which are driven into the table. These pegs or nails without heads accomplish this purpose by the help of small pieces of milled lead, which are laid between the pegs and the glass. One of the sides of the piece of glass is then inclosed in a piece of lead. After this piece has followed the whole outline of the piece of glass, during which pressure has been applied by means of the *lead-jack*[d], the superfluous breadth is cut off with the lead-knife. A second piece of glass is then fitted on, which, like the first, is fixed with pegs, until a strip of lead has been fastened on. The edges of the lead are pressed down with the *lead-jack*, and the operation is continued until the pannel is finished.

The glazier then proceeds to the soldering, which consists in applying the solder[e] to the joinings, which unites the various pieces of lead and imparts a greater firmness to the net which they form.

[a] Verbleiung. [b] Falz. [c] Kern. [d] Bleiknechtes. [e] Loth.

The solder is an alloy of lead and tin, less flexible than the pieces of lead themselves, consequently it imparts to them a greater power of resistance. In this alloy the tin and the lead are united in equal quantities. Before the solder is used, it must be previously prepared in such a way that it may be conveniently applied. Lead is melted in an iron bason or pot, and as soon as it has become liquid, an equal quantity of tin is added. This done, it is kept at a moderate temperature, and a small quantity of resin or grease is thrown into it, which deoxidizes the metal, and thus restores it to a perfectly liquid state. The oxide and the foreign bodies which float upon the surface are then removed, and the metal is poured out. It is best to cast it in thin ribbon, which on account of its form and its pliability can be much more easily handled. This ribbon may be obtained by pouring a small quantity of solder upon a grooved plate, and inclining the latter a little in the act of pouring. The inclination of this mould must be such that the ribbons or strips which are thus obtained shall be sufficiently pliable, without being too thin. As soon as the glazier has provided himself with a sufficient quantity of solder, he sets to work. The solder is applied by means of the soldering iron[a]. This implement consists of a piece of copper in the form of a cone, the base of which is prolonged and serves as a handle. The latter is held in the hand by means of two concave and moveable pieces of wood which completely surround the hand in their junction. The soldering-iron might also be made of iron, and then it would probably be more durable; but iron does not seem so well adapted to receiving the solder as copper. The soldering-iron must be previously tinned at its point. For this purpose it is necessary to have a tin plate rather concave in form. After the soldering-iron has been heated in a proper furnace, it is rubbed over a piece of sal-ammoniac, in order to clean it, and then over the before-mentioned tin plate, upon which a little resin has been sprinkled for the purpose of deoxidizing the tin. The soldering-iron then receives a portion of tin from the tin plate, and becomes thereby tinned. It is advisable to clean the tinned end of it, whenever it is taken from the fire, by passing it over the tin plate, the metal of which must be renewed as soon as it becomes necessary.

The soldering-iron having been properly heated and tinned, is brought near to the lead, upon which a small quantity of resin has been previously sprinkled. In this position, the solder, which is applied with the other hand, is melted. It is then diffused uniformly and regularly by the point of the soldering-iron being made to pass over the whole surface of the lead. The soldering-iron must be heated to the proper temperature. If it is too hot, it will melt the lead; if it is too cold, it gives

[a] Löthkolbens.

the soldering a wrinkled appearance, which proceeds from the imperfect fusion of the alloy. The lead is soldered on one or both sides, according to the degree of strength which is to be given to the leading. As soon as the soldering is finished, the lead is cleansed from the resin that remains, by being rubbed with a piece of linen which has been dipped in oil of turpentine.

The furnace for heating the soldering-iron is nothing more than a circular tin box with neither grate nor draught. This box is generally placed on three feet, sufficiently high to allow of its being conveniently used. The coals are made to burn up merely by a pair of hand-bellows.

PREPARATION OF THE GLAZIER'S LEAD.

The bars of lead are cast in a mould, and when in a rough state bear some resemblance in shape to the strips we have already described, for the production of which these bars are used. The mould is a sort of frame consisting of two parts, each of which is from 1 inch 6 *lines* to 1 inch 10 *lines* in breadth, from 5 to 7 *lines* in thickness, and from 1 foot to 1 foot 6 inches in length. These two pieces have each three longitudinal grooves, which, when they are joined with those of the opposite side, form the cavities in which the bars are cast. The parts of the mould are united at one end by a hinge which admits of the grooves of the frame being shut and opened at pleasure. At the other end of one of these parts is a bifurcated[a] handle which moves on a hinge, and which is capable of clasping the opposite piece with its fork and holding it fast. The grooves of the frame are terminated by a transverse groove near the handle, into which the metal is poured. The frame being shut is held perpendicularly by the handle with one hand, while the melted lead is poured in with the other. As soon as the lead has solidified, it is taken out of the frame in order to make room for other castings.

After the casting is finished, the bars are smoothed, that they may be subjected to the milling machine, whereby they are converted into what is called *glazier's lead*[b].

THE MILLING MACHINE[c].

The milling machine consists, first, of two vertical cheeks[d], which are parallel to one another, and are held together by strong cross-pieces, by means of screws and burrs. Each cheek is furnished with two wide holes between the cross-pieces, in which there are as many revolving cylinders[e], which we shall presently describe more fully. The corresponding holes in each cheek are at the same height from

[a] Gabelförmigen. [b] Glaserblei. [c] Bleizug; in French *tire-plomb*. [d] Wangen. [e] Wellen.

the bottom of the machine. At the bottom of each of the cheeks also there are two horizontal projections chamfered off, and furnished with holes to receive the iron bolts with which they are fastened to a bench. Two iron cylinders pass horizontally through the intermediate space between the cheeks, and their ends are let into the above-mentioned corresponding holes at each side. The upper cylinder projects beyond the hinder cheek, and at the end of it is a tooth-wheel[a] of 12 teeth, which is held in its place by a burr. The other end of the cylinder only extends to the outer surface of the cheek. The lower cylinder projects beyond the cheeks at both ends. At one end there is a tooth-wheel similar to the one we have already mentioned, into which it fits; the other end is squared to receive a handle. On each of the cylinders, at an equal distance from either of the cheeks, there is a wheel, or disk[b], which is capable of being disengaged from or fastened to the cylinder. These two disks are thus situated opposite to one another, without however coming in contact. The bar of lead which is to be drawn out by the revolving motion of the disks in opposite directions, when the cylinders are set in motion by means of the handle, must pass between these two disks. Their thickness determines the breadth of the groove, and the distance at which they are apart the thickness of the interior strip. On the circumference of these disks there are a few lines engraved, like the scratches of a file, and these are for the purpose of holding the lead more securely.

To each of the cheeks between the cylinders there is attached a heavy piece, of complicated form, which is called the *die*[c]. The die, which is let into a morticed hole in its corresponding cheek, presents an angular surface on its opposite side which is bounded at the top and the bottom by a rectilineal part called the *nageleinsatz*.

The two planes of the angular surface bear the name of *engorgeures* in French, the broader one being the *engorgeur d'entrée*, the other the *engorgeur de sortie*. At the top and at the bottom of each die there is a semicircular groove corresponding to the adjacent cylinder. It is now evident that the dies, in their mutual relations to one another, in conjunction with the disks, complete the mill which is to give the proper shape to the lead. They serve to form the outer surfaces and the sides of the lead, just as the disks form the core and the grooves. In order to draw the lead, the end of the bar is placed between the two disks in the intermediate space between the dies; the handle being now turned, the bar must pass through the rolling-press, and receive the form and dimensions of the latter. In this operation the lead is considerably lengthened; a bar one foot long will give a strip of lead of more than four feet in length. It is impossible to obtain milled lead of various dimensions without having

[a] Getriebe. [b] Scheibe. [c] Lager.

several pairs of wheels and dies of proper sizes; consequently, if the disks are fixed to the cylinders, it is necessary to have just as many cylinders as disks.

The bench of the machine consists of a simple piece of wood, the ends of which are supported by three legs fixed in the ground.

Before the lead is placed in the machine, it must be smoothed, and then *condensed*[a]. The latter operation is performed in the following manner:—one end of a bar of a lead is bent into the form of a right angle, which is placed under the foot, while the other end is wound upon a piece of wood, by which means the lead is forcibly drawn out; it is thus considerably lengthened, and becomes more rigid. When it is to be used, the lead jack is passed between the overlapping edges to separate them from one another, so that the glass may be more easily pressed into the groove.

OF THE ARMING.

The chief object of the *arming* is to impart sufficient firmness and power of resisting external violence to church windows. The net of lead which holds the pieces of glass together is by no means capable of doing so for any length of time, unless it is of very small dimensions or supported at certain distances by iron bars. But this iron work contributes sometimes even to the decoration of the window; Gothic church windows afford an example of this, which consist of numerous pannels containing forms of various kinds artistically disposed, so that the whole presents a very pleasing appearance. Here the *arming* pays its tribute to the art by affording the requisite strength to the window; it isolates the pannels, and renders their agreeable outlines conspicuous, whilst at the same time by its complicated pattern it forms a drawing so much the more powerful and effective, as it appears black upon a transparent ground. In those windows, on the contrary, where the *arming* is evidently of no use to the painting, but is merely for the sake of rendering the glass secure, its presence cannot be otherwise than prejudicial to the effect; therefore, in that case, it must be our object to conceal it as much as possible in the shadows, unless we prefer presenting it to the eye as a piece of trellis work independent of the picture, just as is generally the case in church windows. The ancients did this very frequently, from a principle of economy.

There are several other methods of constructing the iron *armings;* sometimes, for example, as in the case of Gothic windows, simple iron bars, which have been bent into the form of the outline of the pannels, are used, and the latter are fastened to the bars by means of pins disposed at equal distances throughout the whole extent of the

[a] Verdichtet.

former ; sometimes there are iron bars which in certain modern church windows receive the pannels in grooves in which they are fixed by nails running transversely through them. Sometimes there are merely thin iron bars disposed at the back of the painting, which, by means of bands of the same metal laid on the lead on one side, carried round it and twisted together on the other, render the leading compact.

Armings which are furnished with grooves are difficult of construction ; the bars are composed of two plates, which are connected longitudinally at right angles, one in the centre of the other, by means of clenched rivets ; or they may be made of a single strip of tin bent at right angles, and then bent back again, so as to form two right angles, which constitute the groove. This kind of *arming* is exceedingly expensive, and will always increase the cost of those church windows to which it is applied. The Gothic *arming*, although simpler, is nevertheless always expensive, on account of the great strength of the iron and the splints which belong to this kind of *arming*. The *arming* which is constructed with thin bars and with ribbons of lead is much more easily prepared, but is less durable, and presents no pleasing appearance.

After the glazier has arranged the pannels in the *arming* with splints, nails, or ribbons of lead, he cements all the places through which the rain is capable of penetrating, and thus finishes his work.

CHAPTER III.

OF THE INGREDIENTS [a] FOR COLOURED GLASSES.

The preparation of the glass which is coloured in mass is, strictly speaking, no part of glass *painting*, but belongs properly to the art of *making* glass. Since, however, such kinds of glass are frequently used by glass-painters, we shall here briefly state the ingredients proper for the various kinds of coloured glass.

If we mix with glass, at the time of its manufacture, certain metallic compounds, we impart various colours to it, the shades of which we are capable of varying to any extent by following the general rule, viz., that according as it is required to increase

[a] Versatzen.

or diminish the intensity of the colour, a small quantity of the colouring metallic oxide must be either added to or taken from the mixture. The colour thus imparted is not superficial, as in the case of porcelain and enamel painting, but is diffused throughout the whole mass, the colouring matter having become a real constituent part of it. In other respects, the same substances are applied to this purpose as are used for the colouring of the pigments in general.

OF THE PURPLE GLASS.

Gold is employed to give a purple colour to glass, similar to that of ruby, for such glass is the most perfect imitation of the ruby in colour, and resembles it almost in brilliancy and liveliness. There is no other substance which is capable of imparting a red of so beautiful a tone to the pot metal; but extremely delicate manipulation is required in the management of the gold, and a variety of precautionary measures are necessary to ensure success. The precipitate of Cassius is the preparation of gold, which is most frequently employed for colouring glass purple. We have already described the methods of obtaining it, and we shall now state the reason why it is generally preferred to the rest.

The precipitate of Cassius is one of those combinations containing gold which possesses the greatest stabilty. It resists a high temperature, and if the reduction of the gold, as we believe it to be, takes place after it has united with the glass, this will only happen at the moment when it can be held by the whole mass in the state of division in which it exists when united with the tin. This combination is less disposed than any other preparation of gold to pass over into violet or blue. The purple of Cassius absolutely requires, in order to be used, to be levigated in a gelatinous state with pulverized glass, borax, or any other substance which is capable of entering into combination with glass, and this with a view to prevent a conglomeration of the particles of the gold. Its power of colouring is such, that one part of the purple of Cassius is capable of colouring 1000 parts of glass. In using this purple it is customary to mix with it the sixth part of its weight of the white oxide of antimony, in order to give the glass a faint tinge of yellow, which reduces the red that slightly approximates to violet to a lively purple. In other respects, all that we have said about the pigments coloured by means of the purple of Cassius applies just as well to the colouring of glass in the melting-pot.

Fulminating gold is also used for colouring glass purple. It is one of those combinations which are obtained by precipitation with ammonia from chloride of gold.

Its property of exploding at a very low temperature renders it unsafe to use. In order to deprive it of this property, it is customary to mix it with silica, lime, &c. The same result is obtained with a fixed alkali, the mixture being exposed to a gentle heat. It is also sufficient for the purpose to levigate the mixture with essential oil of turpentine. But the precautionary measures which we are under the necessity of adopting, in order to prevent an explosion, are at the same time indispensable to success in colouring, and that too on the same principle which guides us in the preparation of the purple of Cassius. I mean that the fulminating gold, while moist, must be mixed with a substance which will deprive it of its explosive property, and at the same time hold it in a state of the most minute division.

The purple colour of glass may also be produced by using chloride of gold, sulphuret of gold, and even from aurates[a], if the operator proceeds according to the method which prevails in the other preparations of gold.

OF THE RED GLASS.

The red glass receives its colour from copper, if not in the metallic state, at least at the degree of strongest oxidation. To make red glass, a mixture of sulphuret of copper and oxide of iron is added to the melted mass of glass; or, after a green has been first produced in the mass by means of oxide of copper, the metal is deoxidized by the mixture of a substance containing carbon, and the colour is thus made to pass over into red; this deoxidizing substance is usually bitartrate of potash[b]. It has been found that any other combination which contains carbon would produce the same effect.

Carmine is obtained from copper only; a darker red from a mixture of iron and copper, in which the former is to the latter as three to one. The quantity of iron is diminished, if it is intended that the tone of the colour shall approach nearer to that of carmine. The glass must be worked as soon as the proper red colour makes its appearance, otherwise it would speedily disappear.

The red which is obtained from copper is so intense that it is necessary to conduct the operation with the greatest care, in order that the glass may not lose its transparency, for it is often in danger of becoming perfectly opaque. Our object must therefore be, to find out a method by which this risk may be obviated. Now this method consists in overlaying the white glass with an extremely thin coating of red glass (*flashed glass*)[c]; it is only in this way that transparency can be combined with a beautiful colour.

[a] Goldsauren Salzen. [b] Saures weinsteinsaures Kali. [c] Ueberfangglas.

The ancients only mixed crude tartar, soot, or other deoxidizing bodies with the mass which had been coloured by copper, for the sake of obtaining the red. But it is best to use protoxide of tin, in order to obtain copper in the state of protoxide. The action of protoxide of tin is not so transient as that of the vegetable substances, whose action naturally terminates with their combustion, and in using which we are liable to a double disappointment; for if they are not sufficiently consumed, the glass will not be so clear, nor the colour so bright, and as soon as the colour has come out properly we must proceed to work up the glass as quickly as possible, because the colour is exceedingly liable to disappear. But all this is avoided by using protoxide of tin. According to Dr. Engelhardt's experiments, the red continued equally fine throughout the whole process, and he never found himself obliged to add deoxidizing bodies. He also met with oxide of tin in all the ancient kinds of glass which he examined, and this oxide was for the most part present in greater quantities than the protoxide of copper itself.

Now, since the colour imparted by protoxide of copper is too intense to admit of its being worked up alone, and the plate which has been coloured throughout would be opaque and appear dark brown, and since it would be necessary to blow it exceedingly thin, in order that the red may become transparent, we can only obtain manageable red plates of glass by flashing a white plate with a very thin coating of red glass. There is, moreover, this advantage in flashed glass, viz.; that the red coating may be ground off in different places; thus we obtain white sketches, or, by melting other colours on the surface, sketches of various colours.

That this was the method employed by the ancients is apparent from all the painted windows of the middle ages.

In order to make flashed glass two crucibles are necessary, one containing the red and the other the white glass; the workman first dips his pipe into the red mass and brings up a small globule at the end of it; he then covers this with a proper quantity of white glass. The cylinder which is produced by blowing will exhibit a flashed glass of a beautiful red colour. It is necessary for the purpose of thoroughly uniting the red coating to the plate of white glass, and preventing it from peeling off in the cooling, as happened in Dr. Englehardt's first attempts, that the composition of white glass should be similar to, if not the same as, that of the red glass; but it is best to make the red glass a little more fusible than the white.

Moreover the ingredients of the red glass must contain no oxidizing substances.

Dr. Engelhardt, who has satisfied himself upon this subject at the glass-houses, proceeds as follows:—He places between the large crucibles for the red glass a small crucible, and into this he introduces 4 oz. of protoxide of copper and 4 oz. of protoxide of tin in addition to the usual ingredients, for every 5 lbs. of the latter, if they happened to contain minium.

But if they do not contain minium, he takes 3 oz. of protoxide of copper, and 3 oz. of protoxide of tin for every 2 lbs. of salt which the ingredients contained. If the protoxide of copper is not immediately added to the frit[a], but is introduced into it afterwards, when the latter is beginning to become clear, a much smaller quantity must be added.

For scarlet he uses for every 25 lbs. of frit $\frac{1}{2}$ lb. of protoxide of tin and $1\frac{1}{2}$ oz. of finely levigated protoxide of iron: these are added just at the beginning of the operation.

As soon as the glass has become clear, he mixes with it $1\frac{1}{2}$ oz. of protoxide of copper, and the whole is well stirred up together. Especial care must be taken to avoid bubbles, which are extremely liable to be formed, and specks of sand[b], as also that the white and the red mass be ready at the same time to admit of their being worked up together.

It is clear from what we have just stated, that to succeed in obtaining a beautiful plate depends very much upon the workman, for the overlaid glass always remains thicker at the mouth of the tube than at the opposite end of the bulb of glass; the plate is therefore always darker on one side than on the other, and only the middle is uniform; indeed the flashing is sometimes so thin at one end, that the colour disappears and passes over into white. Dr. Engelhardt has in his possession several ancient pieces of glass in which this transition from dark to light has been made of the greatest use in producing certain effects; among others, in the satin drapery of a Judith. However, the workman may with some practice acquire the knack of making tolerably uniform plates of glass, and Dr. Engelhardt hopes soon to obtain this result in a glass-house with which he has become connected for this particular purpose.

A frit containing lead seems more likely to preserve the red than any other frit; Herr Engelhardt, however, says that his experiments are not decisive upon this point.

OF THE YELLOW GLASS.

There are several compounds with which glass may be coloured yellow, if they are mixed with it at the time of its manufacture. Among these are sulphuret of antimony, antimonite of lead, and chloride of silver. The method of colouring with the

[a] Glassatze.

[b] Körner, lit. *grains.*

latter has, in this case, nothing in common with the production of the silver yellow. The employment of chloride of silver, however, requires a very well refined glass which does not contain an excess of alkali. Without this precaution the chloride would be decomposed, the silver which is in the melted mass of glass, being now reduced to the metallic state, would suffer a rapid agglomeration of its minute particles, and the colour would in consequence disappear. Chloride of silver is not used on account of its being very expensive. Sulphuret of antimony and antimonate of lead [a] are the only colouring materials in general use. But as the yellow which is burnt in gives a fresher and clearer colour, yellow pot-metal is not much manufactured. We merely wish to mention one other yellow here, which is obtained by an admixture of a carboniferous substance with the pot-metal. This imperfect method, which gives a glass of a disagreeable shade of colour and full of small bubbles, has now fallen entirely into disuse.

In order to colour the glass *blue*, black oxide of cobalt is employed, which causes the formation of the protosilicate.

Violet glass is obtained by means of peroxide of manganese with or without an admixture of oxide of cobalt.

A *green* is imparted to glass with oxide of copper, oxide of chromium, or a mixture of antimonite of lead and oxide of cobalt. Oxide of chromium gives a less transparent colour than oxide of copper.

Black glass is prepared from oxide of manganese, oxide of iron, oxide of copper, and oxide of cobalt, in combination with one another. This colour depends upon the mixture of the three colours which are produced by these oxides; that is to say, the mixture of green, blue, and violet, which in proper proportions will give a black.

Finally, glass is made *white* and *opaque* with stannic acid or phosphate of lime, obtained by calcining bones.

Phosphate of lime, or calcined bones, is also used in the manufacture of *opalescent* [b] glass. The exact receipt for the mixture will be given below. Opalescent glass is employed with advantage in every case where the direct rays, or even the reflected light of the sun, is prejudicial to workmen. This, for instance, is the case in the workshops of goldsmiths, jewellers, &c., in government offices, banking offices, &c., which are situated on the ground floor, where it is often necessary to use ground glass. So also this glass is of great service for all kinds of lamp-glasses, since the

[a] *Antimonsaures Blei*, probably put by mistake for *antimonigsaures Blei* (antimon*ite* of lead), which occurs a few lines above.

[b] Opalescirenden.

grinding of concave or convex surfaces is attended with difficulty, and makes such glass expensive.

We will now give several receipts for the ingredients of coloured glasses :—

MIXTURE FOR ROSE COLOURED GLASS.

White sand	100	parts.
Potash	48	”
Slaked lime[a]	8	”
Purple of Cassius	6	”
Peroxide of manganese	4	”

Or,

White sand	100	parts.
Minium	78	”
Caustic potash	35	”
Nitrate of potash	7	”
Purple of Cassius	8	”
Peroxide of manganese	4	”
Sulphuret of antimony	4	”

RED GLASS.

White sand	100	parts.
Minium	60	”
Caustic potash	30	”
Nitrate of potash	5	”
Purple of Cassius	12	”
Peroxide of manganese	6	”
Sulphuret of antimony	6	”

YELLOW GLASS.

White sand	100	parts.
Potash	50	”
Slaked lime	8	”
Antimony-yellow, coloured with oxide of lead	6	”

Or,

White sand	100	parts.
Potash	40	”
Lime	10	parts.
Antimony-yellow, coloured with oxide of lead	10	”

Or,

White sand	100	parts.
Minium	80	”
Caustic potash	36	”
Crystallized nitrate of potash	12	”
Antimony-yellow, coloured with oxide of lead	8	”

BLUE GLASS.

White sand	100	parts.
Minium	150	”
Caustic potash	35	”
Calcined borax	10	”
Oxide of cobalt	4	”

Or,

White sand	100	parts.
Potash	50	”
Slaked lime	6	”
Oxide of cobalt	1	part.

Or,

White sand	100	parts.
Minium	80	”
Caustic potash	40	”
Nitrate of potash	8	”
Oxide of cobalt	1	part.

GREEN GLASS.

White sand	100	parts.
Refined pearlash	50	”
Slaked lime	8	”
Green oxide of chromium	2	”

[a] An der Luft zerfallener Kalk, i. e., *lime slaked in the air*, which, for the sake of brevity, we have called *slaked lime*, here and elsewhere in this table.

Or,

White sand	100 parts.
Refined pearlash	50 "
Slaked lime	9 "
Yellow oxide of antimony	4 "
Oxide of cobalt, or zaffre	2 "

Or,

White sand	100 parts.
Minium	75 "
Calcined potash[a]	38 "
Nitrate of potash	4 "
Green oxide of chromium	2 "

Or,

White sand	100 parts.
Minium	60 "
White pearlash	40 "
Oxide of arsenic	6 "
Glass of antimony	9 "
Oxide of cobalt	5 "

Or,

Whitewashed sand	100 parts.
Minium	85 "
Calcined potash	38 "
Nitrate of potash	8 "
Yellow oxide of antimony	4 "
Oxide of cobalt	2 "

VIOLET GLASS.

White sand	100 parts.
Pearlash	48 "
Slaked lime	$7\frac{1}{2}$ "
Oxide of manganese	4-10

Or,

Whitewashed sand	100 parts.
Minium	78 "
Calcined potash	35 "
Crystallized nitrate of potash	8 "
Peroxide of manganese	1-2 "

BLACK GLASS.

White sand	100 parts.
White pearlash	66 "
Slaked lime	8 "
White glass, pulverized	70 "
Oxide of arsenic	6 "
Oxide of cobalt	10 "
Peroxide of manganese	10 "
Acetate of iron, or even iron in the highest state of oxidation	5 "

Or,

White sand	100 parts.
Pearlash	48 "
Lime	6 "
Oxide of cobalt	4 "
Peroxide of manganese	3 "
Oxide of copper	3 "
Black oxide of iron	4 "

Or,

White sand	100 parts.
Minium	82 "
Calcined potash	38 "
Nitrate of potash	8 "
Oxide of cobalt	8 "
Peroxide of manganese	8 "
Black oxide of iron	12 "
Oxide of copper	12 "

OPALESCENT GLASS.

White sand	100 parts.
Refined pearlash	50 "
Slaked lime	16 "
Oxide of silver	3-6 "
Phosphate of lime, or calcined bones	6 "

Or,

White sand	100 parts.
Purified soda	450 "

[a] Another name for *pearlash*.

Slaked lime . . .	160 parts.
Calcine[a], or white broken glass	500 „
Hydrochlorate of silver .	10 „
Phosphate of lime from mutton bones . .	60 „
Oxide of arsenic . .	30 „

WHITE OPAQUE GLASS.

White sand . . .	100 parts.
White pearlash . .	66 „
Slaked lime . . .	8 „
White glass, pulverized .	50 „

Oxide of lead . . .	100 parts.
Oxide of arsenic . .	3 „

Or,

White sand . . .	100 parts.
Calcined potash . .	50 „
Slaked lime . . .	16 „
Oxide of tin . . .	60 „

Or,

White sand . . .	100 parts.
Minium	78 „
Calcined potash . .	30 „
Nitrate of potash, in crystals	8 „
White oxide of tin . .	62 „

[a] A calcined mixture of oxide of lead and oxide of tin in the proportion of 4 of the former to 1 of the latter.—(*Author's Note.*)

A BRIEF ACCOUNT

OF THE

ANCIENT BASILICÆ,

WITH A DESCRIPTION OF

THE CHURCH OF SAN CLEMENTE,

AT ROME.

By ROBERT W. MYLNE, Architect.

Among the many important events recorded in the sacred and civil history of the world, few perhaps have led to more remarkable changes in Architecture than the conversion of the Emperor Constantine to Christianity.

The fine arts, at all times so intimately connected with religion, received a fresh impulse, to which in a great measure may be attributed the various developments in the Architecture of succeeding ages.

The magnitude and danger of an attempt to change the national religion may probably account for the vacillating conduct of the emperor in the early part of his reign, but he so far facilitated and encouraged the promulgation of Christianity, that new laws were enacted for maintaining the rights of his Christian subjects as a body, while perfect liberty was afforded to them as individuals to follow whatever mode of worship they considered the most advisable.

For centuries, Rome had been increasing in wealth and power, and her public structures had attained to a height of the greatest magnificence, attesting the splendour and luxury of successive emperors. Her temples, too, for the celebration of idolatrous worship were still flourishing in all their glory, and surrounded with majestic columns, formed a prominent feature in the architectural decoration of the city.

But of all the public edifices of ancient Rome, none were more worthy of notice than the vast halls or basilicæ, erected for the double purpose of affording a tribunal for the administration of justice, and an exchange for the negociations of her merchants. Externally they presented little to admire, but the interior was richly adorned; and their general plan was well adapted to the objects for which they were intended: their principal interest, however, is excited from the fact of the basilica having been selected at a later period as the model of numerous buildings dedicated to an entirely different object.

To the Greeks, the Romans were chiefly indebted for the taste they had acquired in the fine arts, and while their temples were copies of those on the shores of Greece, the basilica was in like manner suggested by the *στοά βασίλειος* in the Athenian capital.

From the writings of Pausanias and other historians, we learn that this court was situated within the Cerameicus, and that the second archon, who was styled *βασιλεύς*, there sat for the administration of justice.

It is doubtful whether the idea of the Athenian court may not be traced to a very remote period, as having originally been brought from Asia by the inhabitants of the island of Lemnos. The Lemnian Pelasgi were among the first people that colonised Attica, where they long maintained themselves, though ultimately defeated and expelled by the Hellēnes.

The Roman appellation of basilica is manifestly compounded of the Greek words, *βασιλεύς* (a king) and *οἶκος* (a house).

After the reduction of Greece to a mere province, the Romans at once became the imitators of her style of Architecture. Greek artists were employed to construct their edifices, who, with their native ingenuity, soon engrafted the various modifications rendered necessary by the different customs of a foreign country.

The earliest basilica erected in Rome, was founded by Porcius Cato, about two hundred years before Christ, hence denominated Basilica Porcia[a]. The second was founded about twenty years later, and named Fulvia[b], after Marcus Fulvius Nobilior. Others were erected at subsequent periods, and at the accession of Constantine, A.D. 306, their number had increased considerably.

The Basilica presented the form of an oblong building divided longitudinally into three unequal parts by two rows of columns, the central avenue being wider than the lateral divisions. A succession of small arches spanned the intercolumniations on each side, supporting elevated walls, which were perforated with openings for the admission of light: these two walls were connected by the tie-beams of a wooden

[a] Liv. xxxix. 44.

[b] Liv. lx. 51.

roof, covering the area of the central avenue :—the lateral divisions were also roofed over at a lower level.

The several divisions terminated in a transverse wall, extending across the building of which that portion forming the end of the central avenue, swelled into a semicircular niche with a coved ceiling, similar to a conch or shell, and called the " *βῆμα* " *Apsis* or Tribuna.

The pavement immediately in front of the apsis was considerably above the general level of the hall. Here, on a semicircular bench, sat the magistrates, and at the back of the recess, raised a few steps higher, the chief prætor presided.

A portion of the area below, which obtained from the Latin word *cancelli* (rails) the name of " locus intra cancellos " was separated or railed off for the use of the assessors, advocates, and notaries.

One of the lateral divisions was allotted to the men, and the women, who were always kept apart, no doubt in imitation of the prevailing custom in the east, were placed on the opposite side of the hall. In front of the building was the " *στοά*," *porticus* or porch, usually entered from the " *αὐλή* " or *atrium*, consisting of an open court surrounded by a colonnade.

Such were the arrangements and form of the basilica when Constantine embraced Christianity. His ardour for the new religion was at first evinced by giving up to Pope Sylvester the hall and palace of the Lateran, but no sooner had the imperial protection been conceded, than thousands came forward to proclaim their faith, and it soon became a matter of necessity to provide additional accommodation for the converts.

Heathen temples were deemed unacceptable, and besides being situated in the more prominent and crowded quarters of the city, were, from their internal disposition, altogether inapplicable to the ceremonies adopted in Christian worship.

On the other hand, the internal convenience of the Basilica was at once apparent: probably too from the rapidity with which Christianity had increased, there was no time, perhaps little ingenuity, to invent an original design, and thus the secular Basilica of heathen Rome was selected as the model of the Christian church.

But although at that time many basilicæ existed in Rome, yet it is to be remarked that none of them were immediately converted to this purpose; which may in part be accounted for by the antipathy the early Christians entertained towards any thing that had been instrumental to paganism; perhaps, however, the better reason is to be found, in the affection they bore to those secluded spots where the persecuted brethren had offered up their daily prayers to the only true Deity.

These sanctuaries were in the subterraneous quarries in the country adjoining

Rome, and had been long made use of as places of sepulture, of which practice many traces are to be seen at present in the Roman catacombs. The places where the bodies of the principal martyrs were deposited, were generally distinguished by the excavation of an underground chapel, dedicated to their memory.

Old associations naturally induced their followers to select the ground situated over these chapels, as the most appropriate sites for the erection of new churches, and it is to this cause that the existing churches of S. Paolo, S. Agnese, S. Lorenzo, &c., owe their position beyond the walls of Rome.

After the death of Constantine, the advancement of Christianity received a considerable check by the return of his successor to the errors of paganism; nor was it until the reign of Theodosius, A.D. 380, that Christianity was again publicly protected and at length permanently established.

Theodosius issued many severe edicts, utterly abolishing the worship of idols, confiscating the property of those who still adhered to pagan superstitions, and sequestrating all their buildings to the use of the state.

Under such circumstances, the beautiful statues and sculptures in the temples of Rome were soon mutilated and destroyed, and the temples themselves by degrees fell into disuse and ruin, and such portions of them as were likely to prove useful in the erection of the new churches were made available for that object.

Hence we discern, in many of the early churches at Rome, various columns of different size and design placed in juxtaposition, for the purpose of supporting the side-walls of the nave, evidently the spoils of former temples, from which they had been transferred without reference to either taste or skill.

Among the existing primitive churches at Rome, there are seven only that are entitled to rank as basilicæ, and these still retain their classic name, and enjoy certain privileges beyond other churches. Of these, *six* were the work of Constantine, viz. S. Giovanni Laterano, (the mother church of Rome,) S. Paolo, S. Pietro, S. Lorenzo, S. Sebastiano and S. Croce di Gerusalemme; the remaining one being that of Sta. Maria Maggiore. But there are many others, which though built but a few years later, afford a better opportunity of judging of the simplicity and elegance of the design than the Basilicæ above-mentioned, which have been adorned and beautified by almost every succeeding pontiff.

Of the later examples, the church of San Clemente may boast at the present day of retaining more of the primitive form and attributes peculiar to the basilica than any other church throughout the city of Rome.

The drawings annexed to this paper represent the plan, section, interior view, and ambones, of that interesting church, and the following particulars give a general description of the edifice, with a brief outline of the purposes to which its internal arrangements were applied.

DESCRIPTION OF SAN CLEMENTE.

This church is situated in the Via di San Giovanni, leading from the Colosseum to the S. Laterano. It was erected in the fourth century, on the spot where, according to tradition, stood the house of Clement, who was the fellow-labourer of St. Paul[a], and identical, as many suppose, with the Pope of that name, A.D. 65.

It is uncertain whether Clement suffered martyrdom; his name, however, is enrolled among those of other saints, and occupies a distinguished place in the calendar.

His remains were brought from Pontus by Pope Nicholas I.[b], and deposited under the high altar, where his shrine still exists, the church itself having been dedicated to his memory.

The church was rebuilt A.D. 790, on the same foundations by Adrian I., who strictly adhered to the original plan; and Pope John VIII., about a century after, erected the ambones in the nave.

Paschal II. made some extensive renovations; and Clement XI., under the superintendence of the celebrated Carlo Fontana, about the year 1700, effected a thorough repair; but with the exception of some slight alterations in the walls of the upper part of the nave and side altars, the church did not sustain any material change.

The "αὐλή" or *Atrium*, consisting of an open court, surrounded by a covered colonnade, with a series of small arches spanning each intercolumniation, is entered from the public road in the centre of the end furthest from the main building, by a flight of steps ascending to the level of the court, and a small canopied porch projects beyond the exterior wall, supported by four isolated columns of granite. Opposite this entrance into the atrium is situated the "στοά" *Porticus* or narthex, which divides the colonnade into equal portions, and immediately adjoins the principal entrance to the church.

The atrium was at all times open to the public indiscriminately; the side colonnades and porticus afforded shelter to the catechumens and penitents, and such others as were not allowed to advance beyond the threshold of the church itself. The atrium was also often used as a place of burial for persons of high distinction.

In the centre of the Porticus, corresponding to the outer porch of the Atrium, is

[a] Phil. iv. 3. [b] Platina.

the principal door opening into the body of the church, called the Porta Speciosa (ὡραῖαι πύλαι).

The church stands longitudinally east and west, and is divided into three unequal parts; the centre division, called the "ναῦς," *Navis* or nave, is separated from the two aisles by a row of eight columns on each side, the eastern end terminating in a circular recess. The columns are of different antique marbles and vary considerably in their diameters; some are fluted while others have plain shafts; some have been shortened while others have been added to, evidently proving that they once belonged to a more ancient structure. The capitals of the columns are all of one style, and were possibly supplied at the time of Fontana's renovations, as also was probably the case with the enrichments and panelling in the upper walls of the nave, which occupy the place of the ancient openings for the admission of light. The length of the nave is 118 English feet, the breadth 38 feet, the northern aisle is 13 feet wide, and the southern 20 feet. The altar, as at St. Peter's, stands *west.*

In accordance with the ancient ecclesiastical custom, the men and women were at all times kept separate, and to each sex a distinct place in the church was allotted; to the men usually belonged the aisle on the south side, and for the women was set apart the northern aisle. Portions of both aisles, at the ends nearest the altar, were appropriated to persons of distinction and noble birth; the portion on the women's side was called the Matronæum, and that on the men's side called the Senatorium. The intercolumniations on the sides of the nave were also hung with curtains, for preventing one sex from gazing on the other. At the western extremities of both aisles are small apsidal chapels, which are of modern date.

At the eastern end of the nave were admitted those of the catechumens who were allowed to hear the Psalms and Scriptures read and the sermon [a], but their presence was restricted only to this portion of the service; and as soon as the deacon exclaimed "Ite, Catechumeni!" they immediately retired into the porticus and atrium.

The *Cancellum*, chancel or choir, occupies a portion of the nave, equal to one-half its width, extending westward as far as the *cancelli* which encloses the sanctuary, and eastward to half the length of the church. It is surrounded by a low marble screen, or cancelli, the area within being raised one step higher than the ordinary pavement; this place was destined exclusively for the assembly of the clergy and choristers.

On each side of the enclosure is situated an *Ambo* (ἄμβων), pulpitum or pulpit; the one on the south side was used for the reading the Gospel, that on the north for reading the Epistle.

[a] Bingham.

The southern or gospel Ambo is ascended from the choir by two flights of steps, one from the east and the other from the west, and is more elevated than the ambo on the opposite or northern side. From the former the Gospels were read by the deacons, looking towards the north, as also were read the diptychs or books of commemoration[a]: at times the bishops also preached from thence, and here episcopal ordinances were delivered, together with anathemas, excommunications, and other ecclesiastical proclamations.

East of the ambo, beautifully wrought in white marble, and inlaid with rich mosaics, is a small pillar, which supports the paschal candle, the symbol of enlightened Christianity.

From the opposite Ambo on the north, the Epistles were given out by the subdeacons; it is ascended by only one flight of steps, from the east, with the desk facing the altar. On the landing of the first two steps there is also another small reading desk looking towards the porch, whence lectures, admonitions, &c., were delivered by the clergy[b], and where also the choristers chanted the responses[c].

Beyond the Cancellum to the west is situated the "*βῆμα*," the *sanctuarium* or altar space, including the *Apsis* or semicircular recess; it extends the width of the nave, and is elevated five steps above the pavement of the cancellum.

On the marble bench which follows the sweep of the Apsis, were seated the several presbyters, and in the centre at the back of the recess is situated the bishop's throne, which displays a more elevated and distinguished position by having an additional rise of four steps. The throne is of plain white marble, with a round-headed back to it, and bordered with the following inscription:—"Anastasius Presbiter Cardinalis hujus tituli hoc opus cœpit et per fecit."

From this central eminence the bishop was able to command a view of the whole of the congregation on both sides of the church. It appears, also, that the bishop generally preached from the apsis, instead of the ambo, as St. Austin informs us that he was used to preach from the exedra or apsis of the church.

The high altar stands in front of the episcopal throne, raised one step above the area of the sanctuarium. Immediately under the altar lies the shrine of St. Clement, and the *ciborium* or canopy which overhangs the altar is supported by four marble pillars and surmounted by a cross.

The use of Mosaics as a means of adorning the interior of churches, appears to have been practised by the Romans from the date of the earliest Christian basilicæ;

[a] Rondinini. [b] Ibid.

[c] It appears from Ciampini, that about the year 1309, after the papal government was transferred to Avignon, many of the ambones were removed from the churches at Rome as being useless.

many of them exhibit splendid specimens of this species of embellishment, and among the finest examples, (though of a much later date,) those within the Church of San Clemente may claim particular attention.

There are three descriptions of mosaic work. The mosaic for the pavement of the church being subject to great wear, is composed of small pieces of the hardest marbles, cut into square and rectangular shapes, and inlaid with cement. Porphyry and serpentine, as the most durable, were in general made use of; their deep colours contrasting well with broad margins of white marble, and often intermixed with the richer colours of rosso antico, verde, and giallo.

On the walls and other portions of the building, where the surface was not so liable to injury, a different description of mosaic was to be seen; panels or large slabs of precious marbles were inserted in various parts of the altar and screens, surrounded by borders, similar to the specimens on the cancelli and ambones (Plates 2 and 3).

Another species of mosaic, more beautiful, yet equally durable, was used for decorating the walls of the apsis and other distinguished positions. It is composed of minute pieces of marbles and coloured stones, interlaid with others having a coat of gilding; glass, too, was extensively inserted to increase the glittering effect of the mass. Such are the component parts of the elegantly inlaid pillar supporting the paschal taper and the enamelled surface of the walls of the sanctuarium.

Symbols were so extensively used by the early Christians, that almost every device or ornament to be found in their churches may be traced to the representation of some emblem of Christianity.

In the church of San Clemente there are numerous symbolic representations; particularly the cross, the instrument of the suffering of Christ and the chief emblem of the Christian faith, which is displayed in various forms in many parts of the interior. On the panelling of the cancelli, the plain Latin cross, analogous to the Greek cross, (which resembles the first letter of the word Χριστὸς,) is often to be seen encircled in a ring, (Plates 2 and 3,) typical of Christ, and the circle an emblem of eternity; also on the panelling on the left of the entrance into the cancellum (Plate 4) is a cruciform figure of a different design, being that of the two first letters of the words Ἰησοῦς Χριστὸς, which are blended together, emblematic of Jesus Christ, surrounded also with an aureole, or circle of glory.

The symbol of our Saviour in his beatified state, is derived from the Greek ΙΧΘΥΣ, (*a fish,*) being a word composed of the first letters of the well known inscription, Ἰησοῦς Χριστὸς, Θεοῦ Υἱὸς, Σωτήρ—(Jesus the Anointed, Son of God, the Saviour.) This symbol, which commonly assumes the shape of two curved lines, meeting in a point at their extremities, called the *vesica piscis,* may be seen in the arms of the cross on the panel to the right of the entrance into the cancellum, and surrounded with an aureole or circle, and outer ring, or wreath.

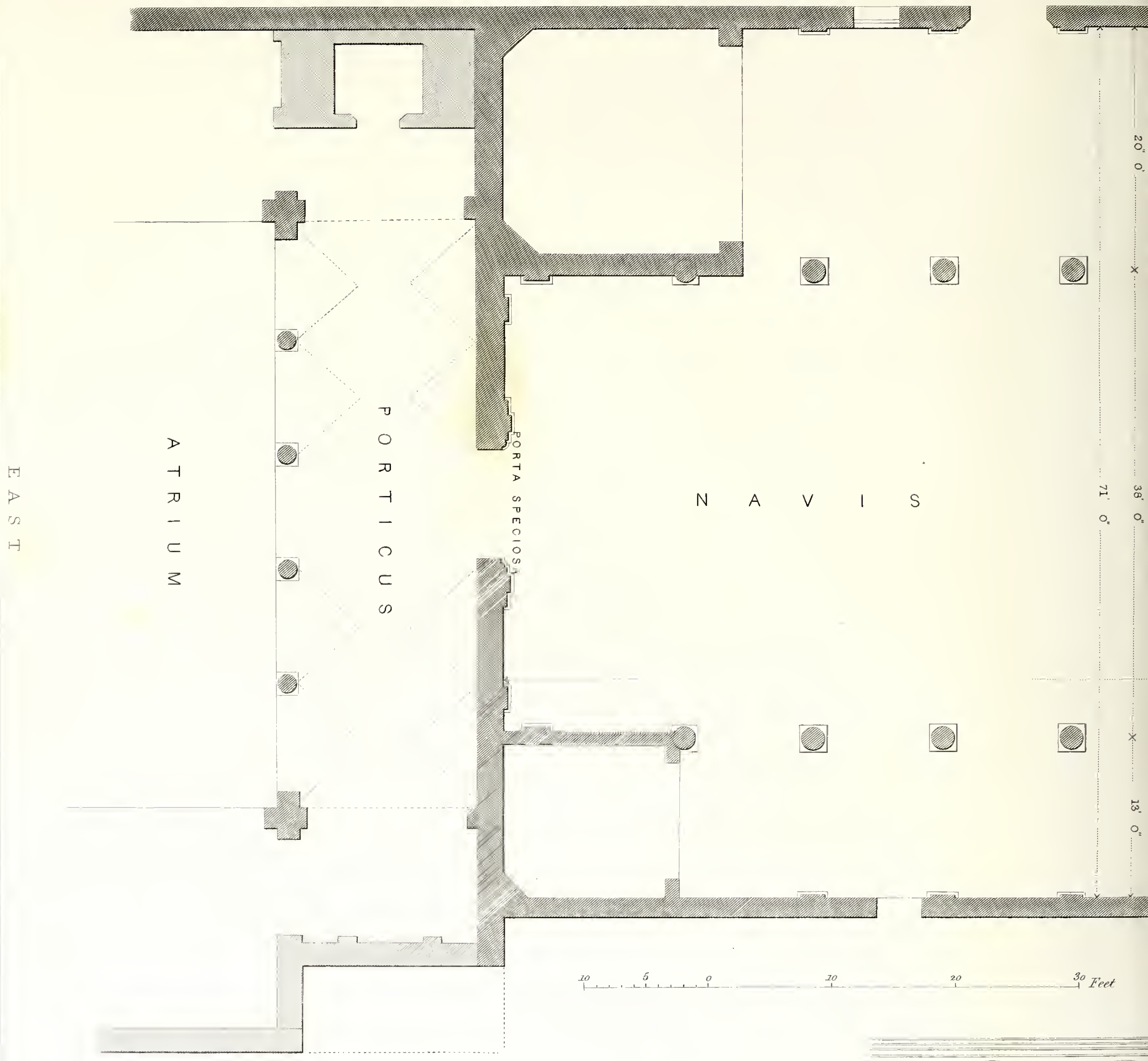
The beautiful enamelled mosaics which adorn the hemicycle, or apsis, of the sanctuarium, appear from an inscription in the church to have been the gift of Cardinal Tomaso, nephew of Boniface VIII., in A.D. 1299. In the lower portion of the apsis are represented the twelve apostles, each with a palm tree by his side. Over these in the centre is a lamb, having a nimbus, and bearing a cross on its shoulder, surrounded by thirteen others—the centre lamb being emblematic of "the Lamb of God that taketh away the sins of the world"—and the others, his apostles. In the conch, or coved ceiling, our Saviour is represented on the cross, with the Virgin Mary standing on one side, and the Apostle John on the other. The entire expanse of the conch is filled up with a series of scrolls representing branches of the vine springing from a single stem at the foot of the cross, and the names of four doctors of the church are inscribed amongst them, besides various birds, &c. On the north side of the apsis are the seated figures of St. Peter and St. Clement, the former having a palm tree on his right side with the words AGIOS PETRUS—at his feet is the following inscription, "Respice promissum Clemens a me tibi XPM." Peter is pointing upwards to the Saviour, who is represented on a medallion at the apex of the hemicycle. Below, is the figure of the prophet Jeremiah, and around the apsis are written in large letters, "Gloria in excelsis Deo et in terra pax hominibus bonæ voluntatis." On the opposite or south side of the apsis are seated also the figures of St. Paul and St. Lawrence, the former having a palm tree by his side with the words AGIOS PAULOS. At their feet is inscribed the following verse, "De cruce Laurentii Paulo famulare docenti," and below is the figure of the prophet Isaiah. At the top of the apsis on either side of the medallion of our Saviour, are represented the four evangelists in the allegorical figures of the face of a man and of a lion, on the right side, and the face of an ox and an eagle, on the left side.[a]

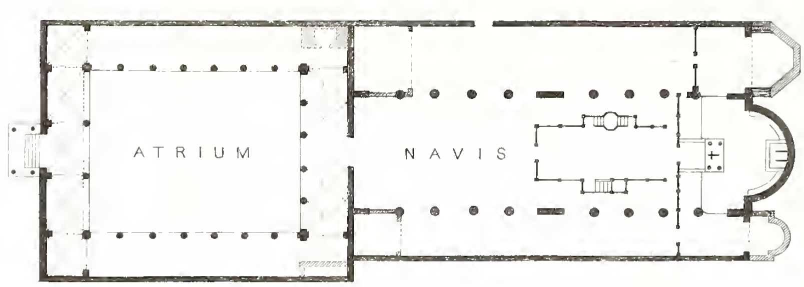
Much more might be said upon this interesting, though abstruse branch of ecclesiastical ornament, but in a paper of this description, having for its object a brief and general account of the most interesting portions of the church, it is unnecessary to enter further into detail. Those who are desirous of acquiring additional information on the symbolism displayed, might with the annexed drawings consult the valuable works of Durandus and M. Didron's Iconographie Chrêtienne; as also Bingham's Origines Ecclesiasticæ, which would supply valuable explanations on the customs of early Christians.

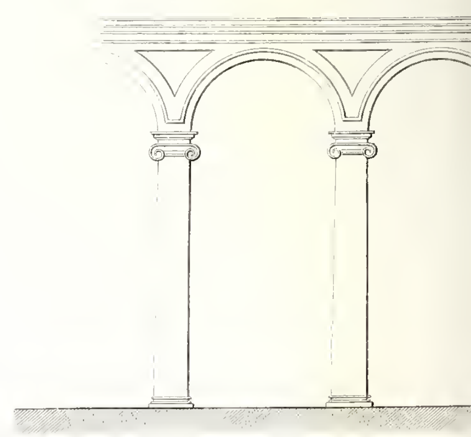
[a] Ezek. i. 10.

The various scrolls and monumental inscriptions with which the church abounds, are fully set forth in the old work of Rondinini, which gives a copious history of the life and church of San Clemente.

In one of the side chapels in the church, there are some fine frescoes by Masaccio, of the fifteenth century, which, though much injured by time, are still valuable specimens of the art of that age.







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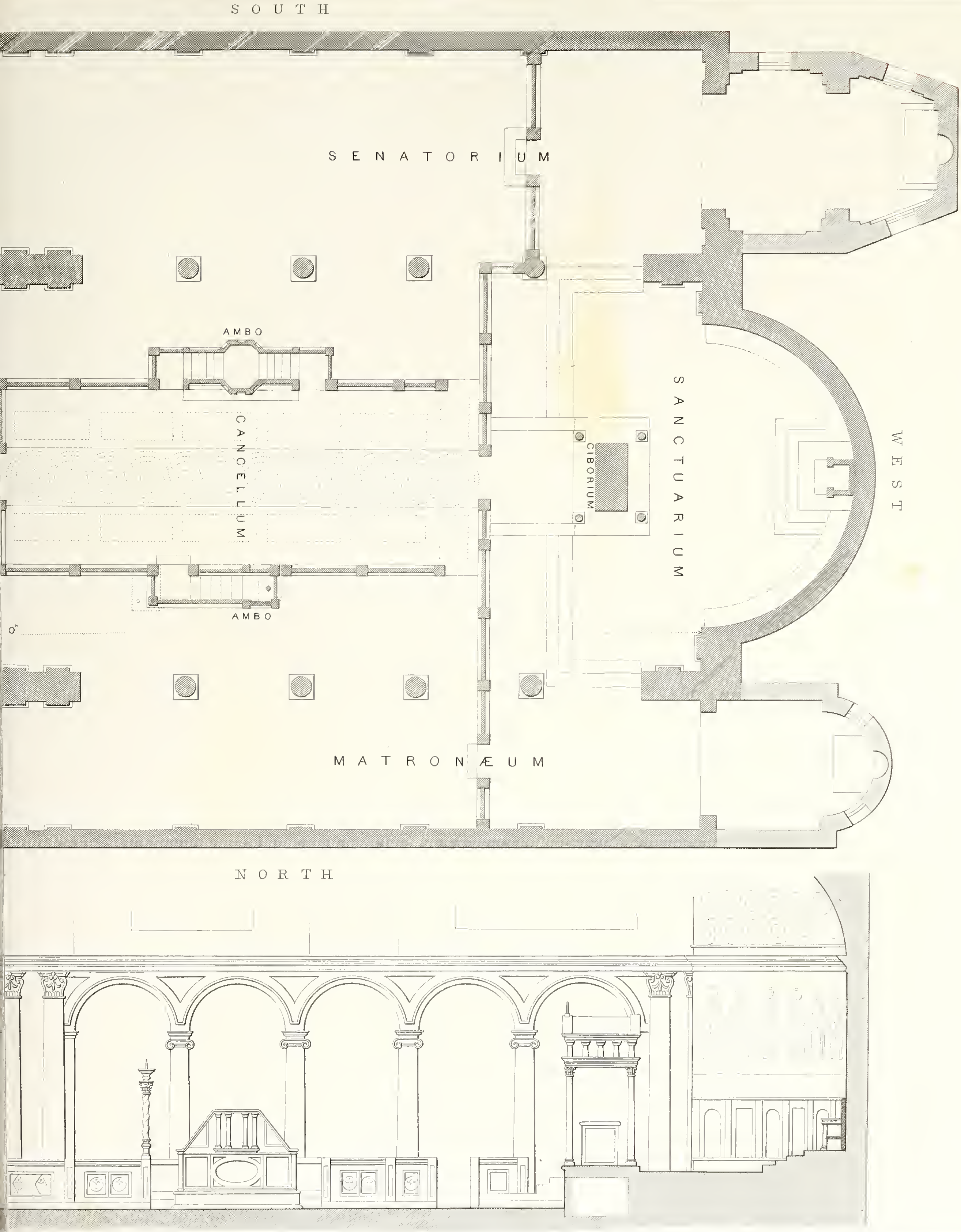
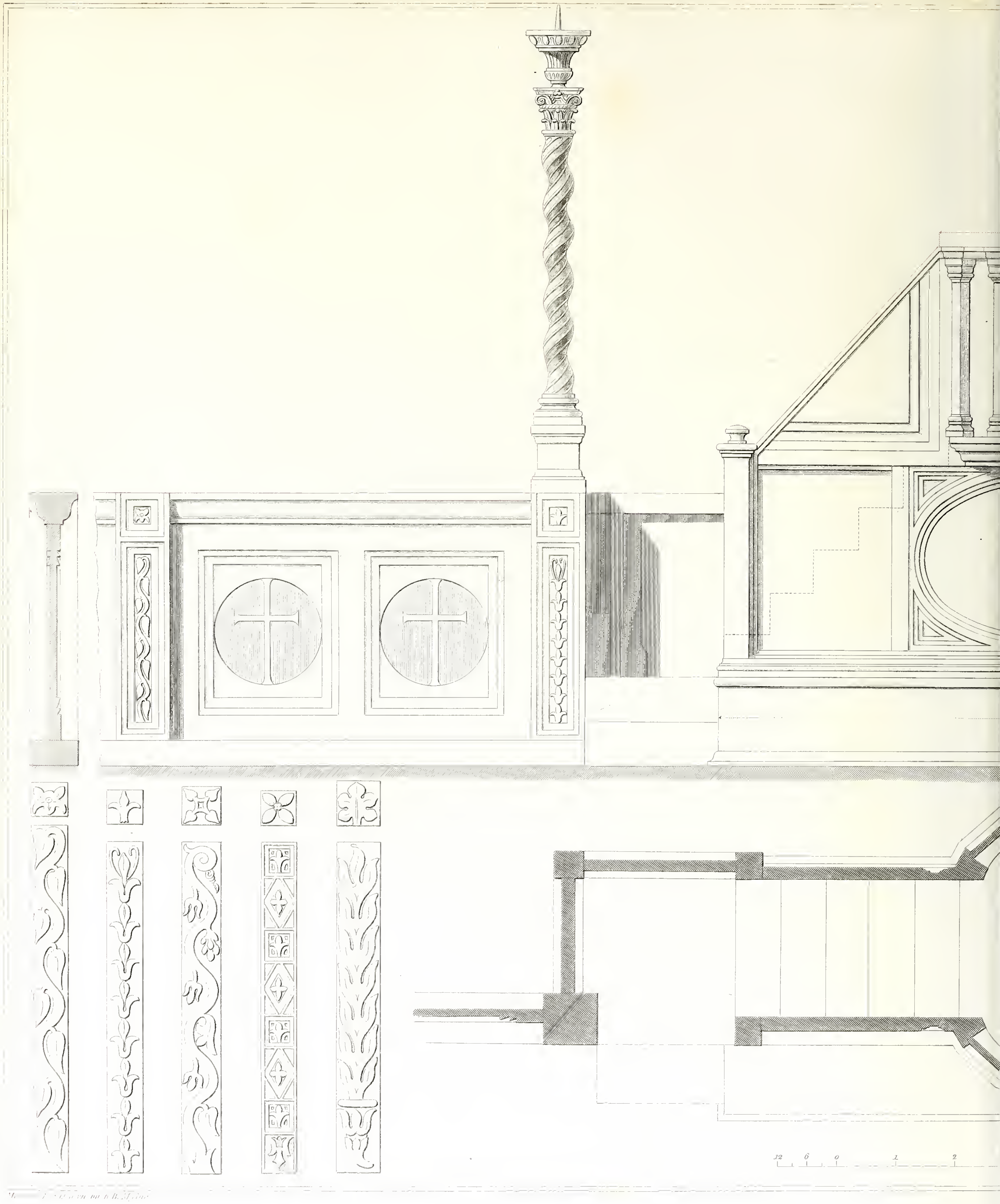


PLAN OF SAN CLEMENTE, ROME.

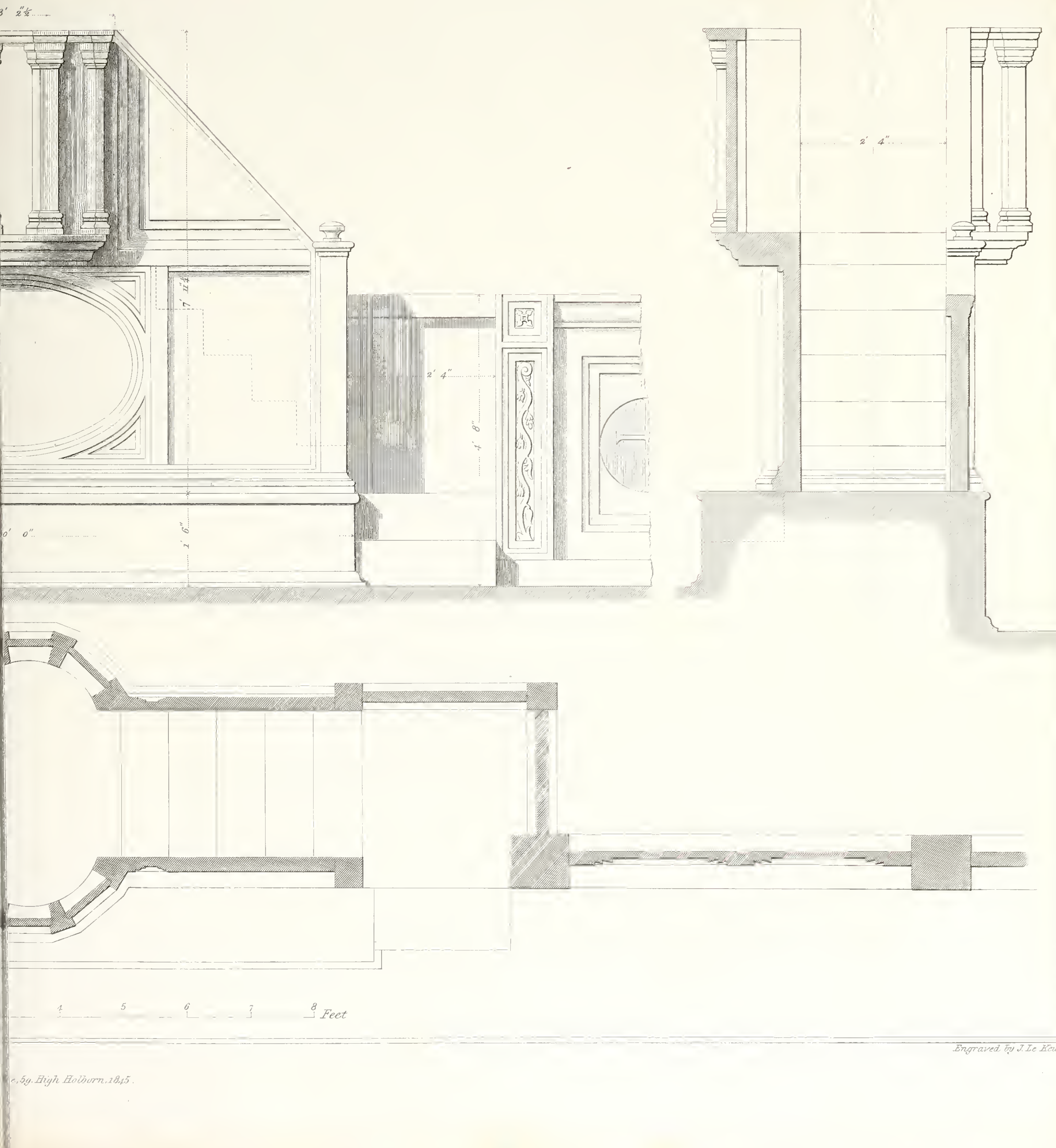
Engraved by J. Le Keux

59, High Holborn, 1845.



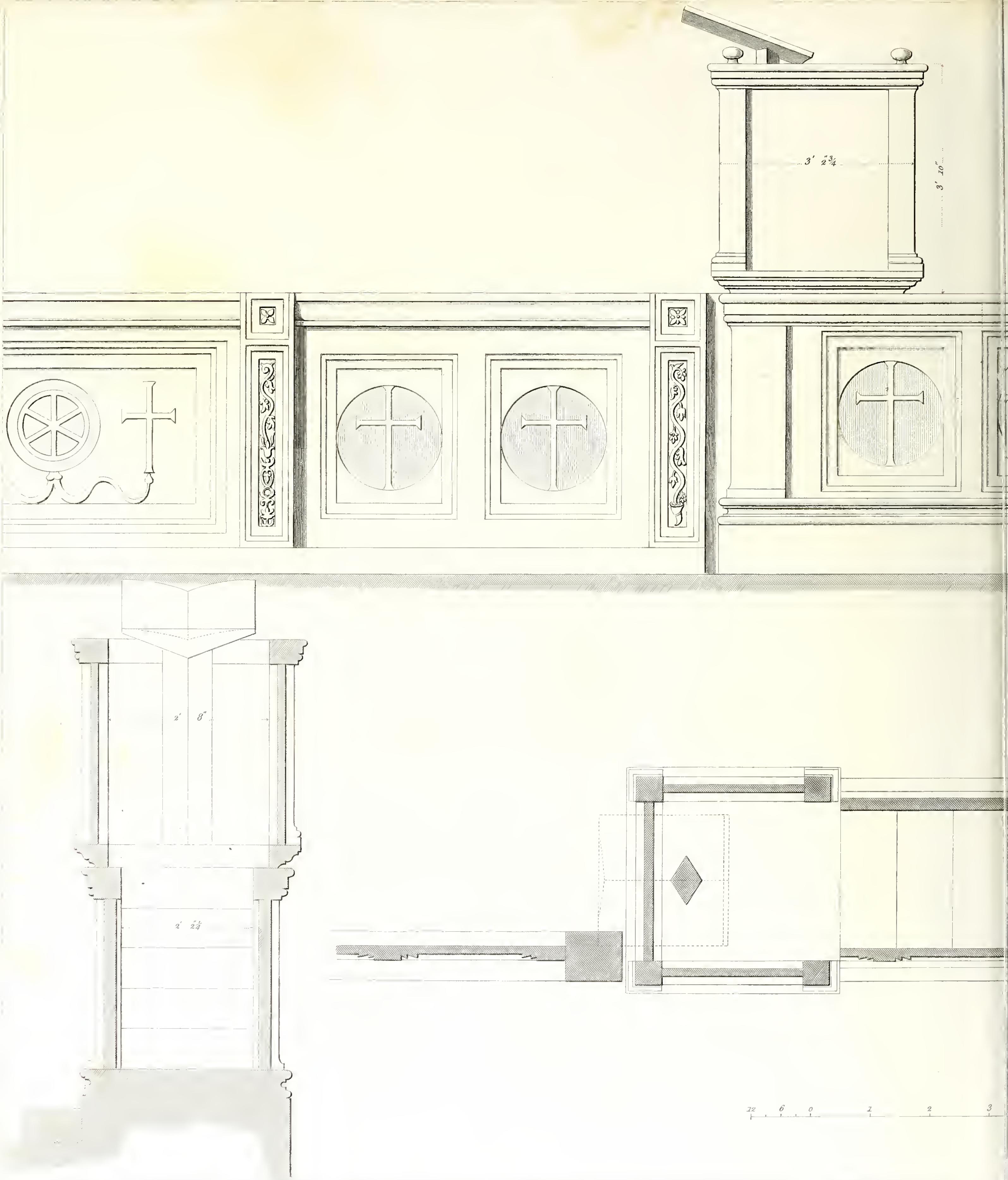
London. Published by John

ELEVATION, PLAN, AND SECTION, OF THE GOSPEL AMBO.



Engraved by J. Le Keux.

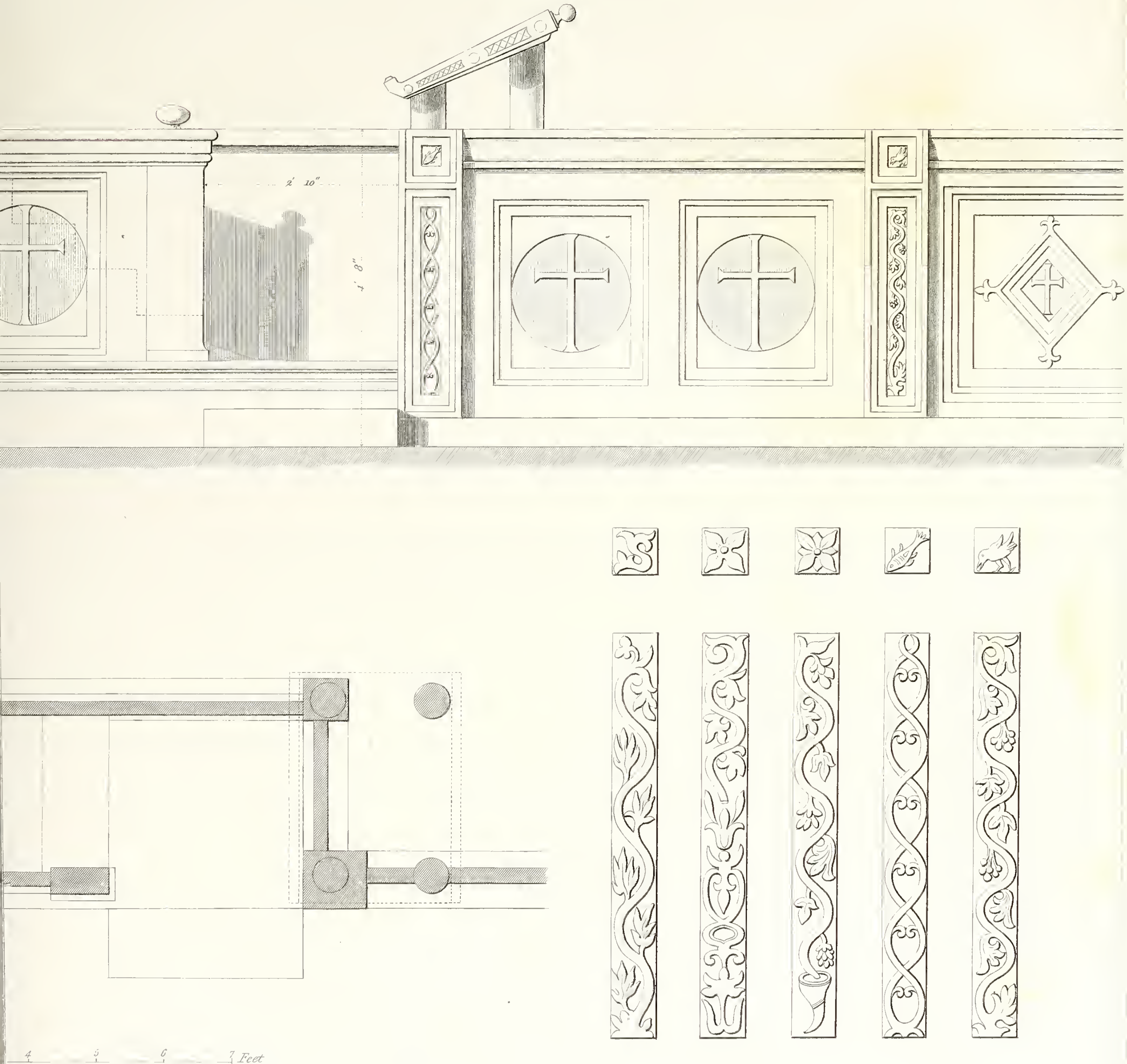
c, 59, High Holborn, 1845.



R W Mylne

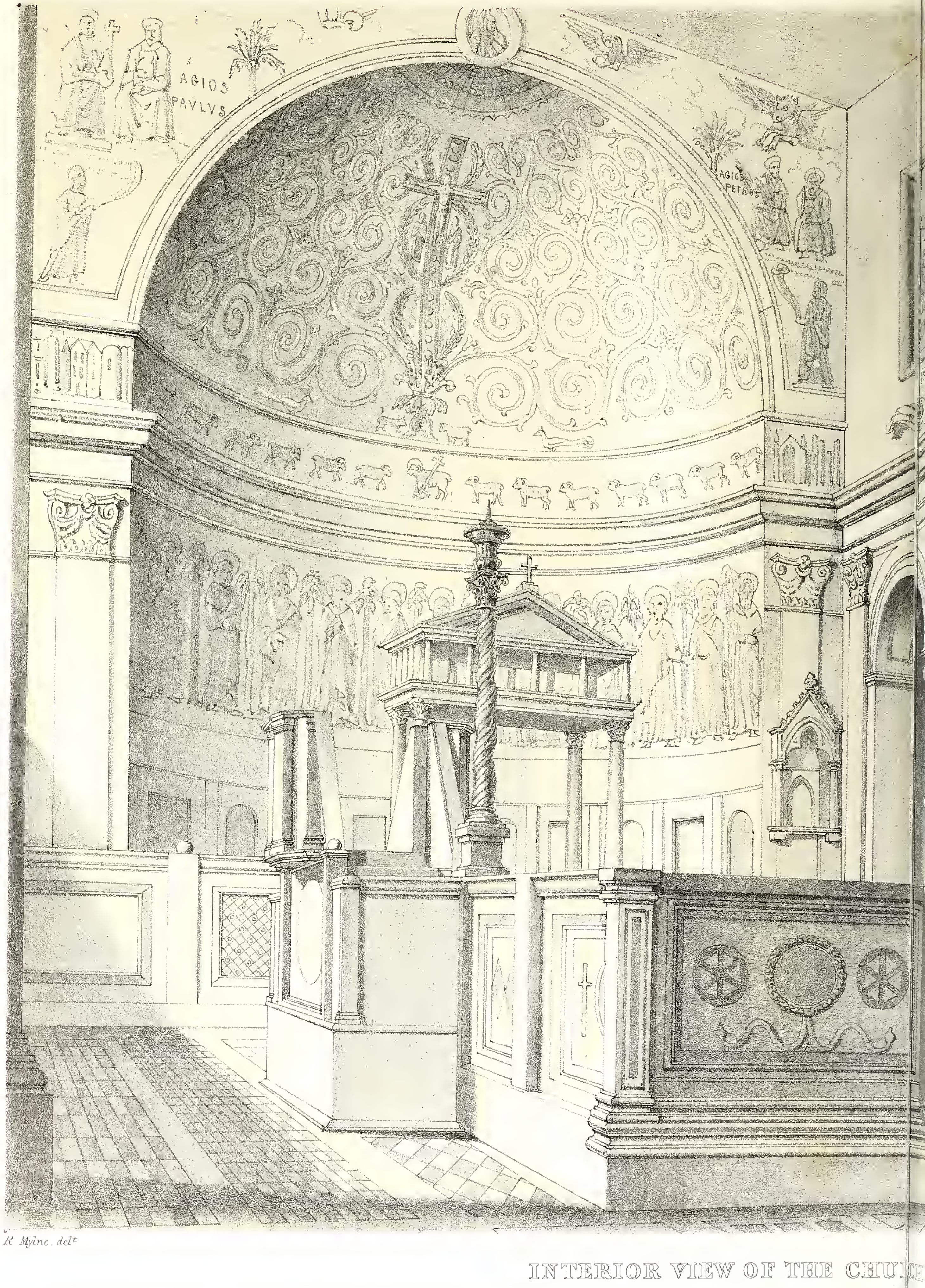
London. Published by John

ELEVATION PLAN AND SECTION OF THE EPISTLE AMBO.



Engraved by J. Le Keux.

59, High Holborn. 1845.

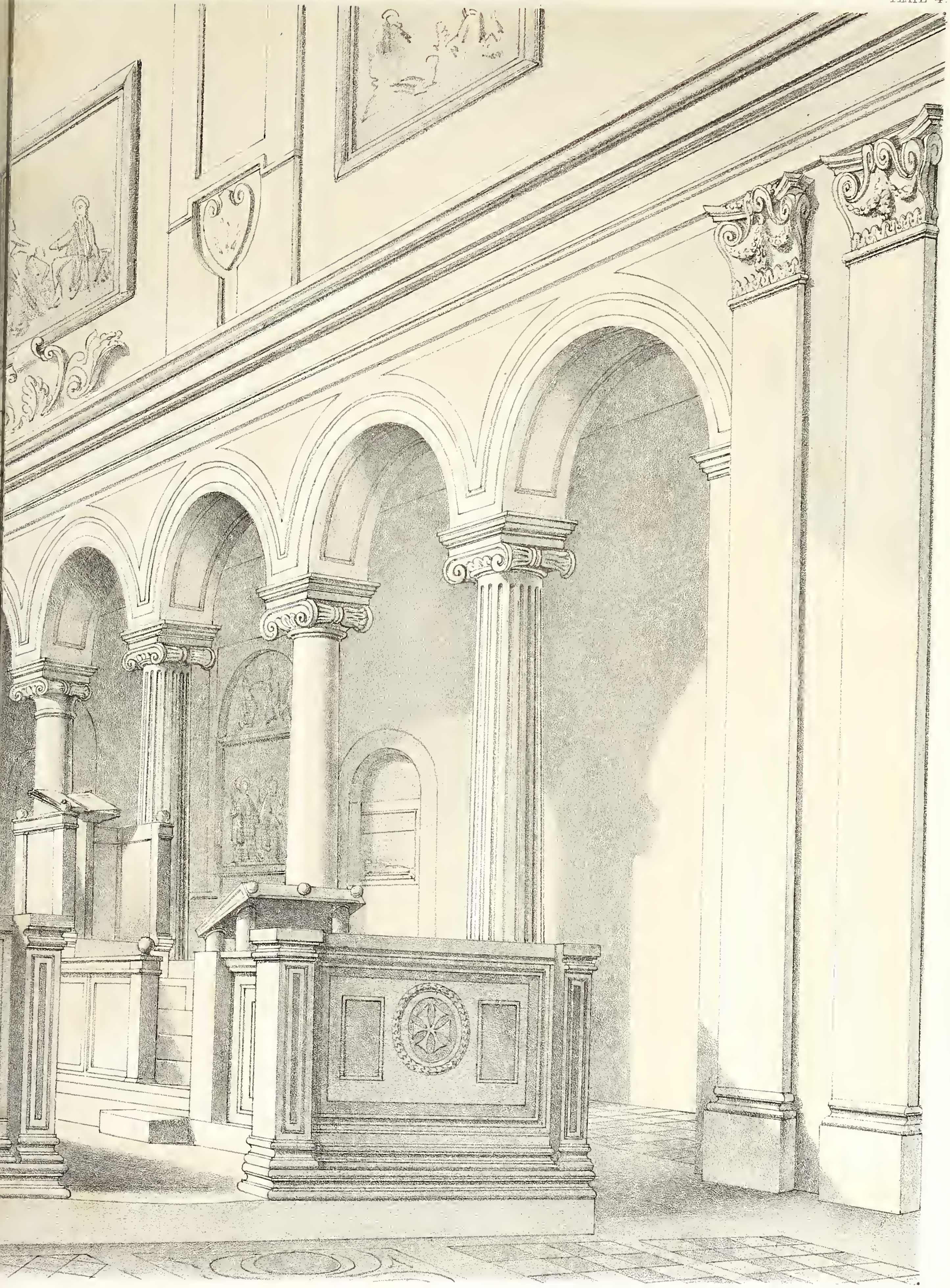


R. Mylne, delt

INTERIOR VIEW OF THE CHU[RCH]

John Wea[le] Lon[don]

Printed by St...



F. Bedford, Litho.

CH OF SAN CLEMENTE, ROME.

London.
e & Co. London

ST. MARIE'S ABBEY, BEAULIEU.

ENCAUSTIC TILES,

COPIED FROM EXAMPLES REMAINING IN VARIOUS PARTS OF THE ABBEY.

By R. J. WITHERS, Architect.

The advantages to be gained by a thorough knowledge of Architecture in its most minute parts is too apparent to the architect and antiquarian to need any preface in thus devoting a short space to the illustration of the beautiful specimens of Paving Tiles so commonly used when ecclesiastical architecture had reached its zenith, and until its downfall at the Reformation. But alas! how seldom do we now see the floors of our modern or of our more ancient churches—as time and wanton destruction have nearly annihilated what few were left us—glow with the rich colour of these superb examples of the skill and ingenuity of our forefathers, whose minds were so devotedly attached to the cause for which they laboured.

It is with pleasure I am enabled to state, that the manufacture of these tiles is now being carried on in several places with the greatest success[a], and it is to be hoped that, wherever practicable, parts, if not the whole of our churches, may soon be found where the eye may rest with satisfaction on the different patterns used, being correct copies of ancient art.

The examples here given are fac-similes of several very perfect specimens found at various times in different parts of the Abbey of Beaulieu, and which I am gratified in saying have been carefully preserved and relaid, under the directions of the present Lady Montagu, in the old abbatial house, now the occasional residence of her ladyship.

R. J. WITHERS.

[a] More particularly by Mr. Richard Prosser, C.E., of Birmingham, whose patent has been successfully applied under the able superintendence of Mr. Blashfield, of the firm of Wyatt, Parker, and Co., of Holland Street, Blackfriars.—Ed.

PLATE I.

St. Marie's Abbey + Beaulieu

ENCAVSTIC · TILES FROM · VARIOVS · PARTS · OF · THE · BVILDING.

SCALE_HALF THE ACTUAL SIZE.

R. I. WITHERS, ARCHT. DELT.

F. Bedford Litho London

London. John Weale. 1845.

Printed by Standidge & Co.

PLATE 2.

St. Marie's Abbey + Beaulieu

ENCAVSTIC · TILES · FROM · VARIOVS PARTS OF THE · BVILDING.

SCALE _ HALF THE ACTUAL SIZE

R. I. WITHERS. ARCHT. DELT.

F Bedford litho London

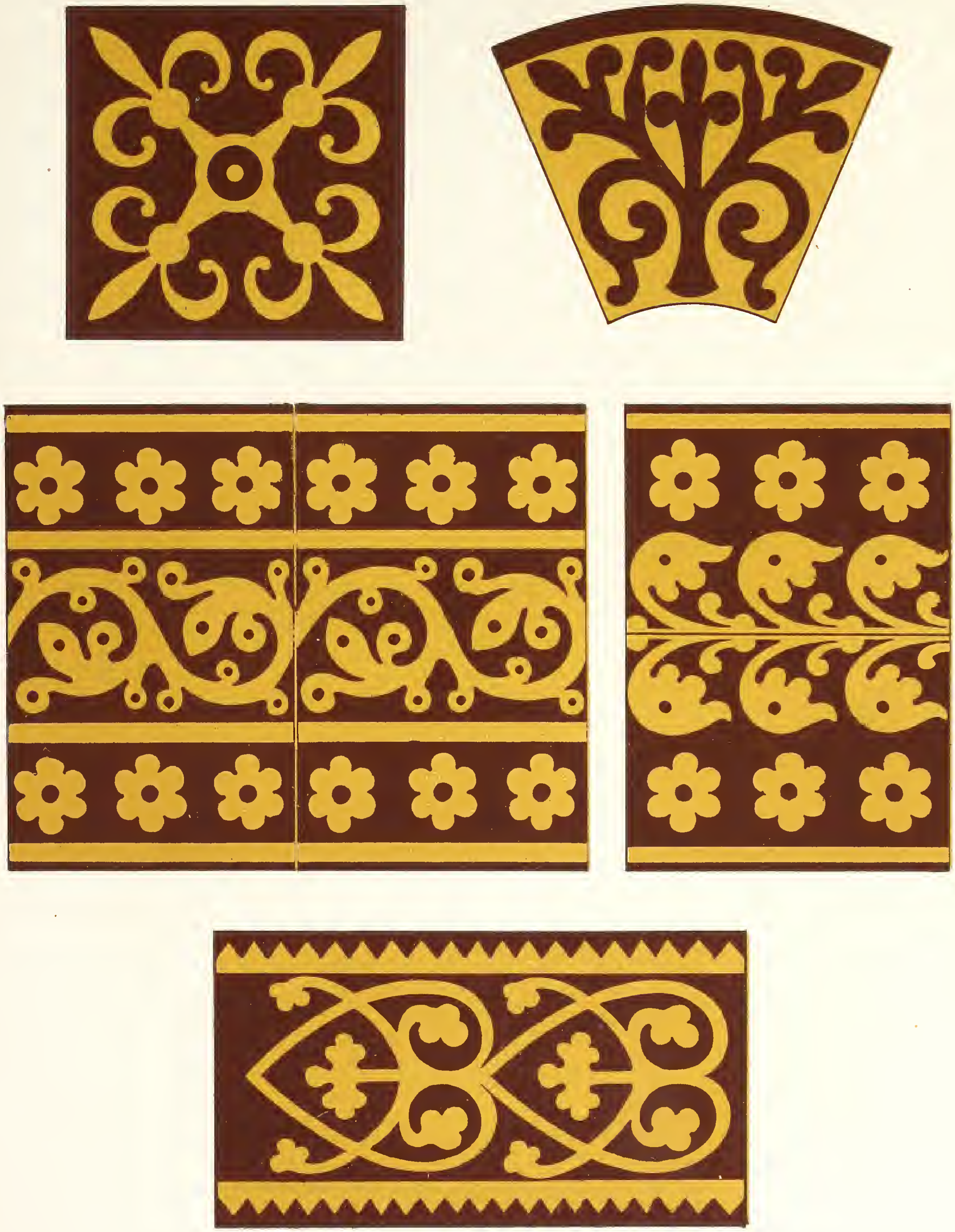
London. John Weale 1845

Printed by Standidge & Co.

PLATE 3.

S^t Marie's Abbey + Beaulieu

ENCAVSTIC TILES FROM VARIOVS PARTS OF THE BVILDING.



SCALE _ HALF THE ACTUAL SIZE.

R. I. WITHERS. ARCH^T DEL^T

F Bedford Litho London

London John Weale. 1845

Printed by Standidge & C^o

St. Marie's Abbey + Beaulieu

ENCAUSTIC · TILES FROM VARIOUS PARTS · OF THE BUILDING.

SCALE HALF THE ACTUAL SIZE

R. I. WITHERS ARCHT. DELT.

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FOUR VOLUMES OF QUARTERLY PAPERS ON ARCHITECTURE.

(COMPLETE.)

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