Ironwork

BY

STARKIE GARDNER

SOUTH KENSINGTON MUSEUM ART HANDBOOKS.

IRONWORK.

TO THE END OF THE MEDIÆVAL PERIOD.

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FROM THE EARLIEST TIMES TO THE END OF THE MEDIÆVAL PERIOD.

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J. STARKIE GARDNER.

WITH FIFTY-SEVEN ILLUSTRATIONS.

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PREFACE.

ALTHOUGH the literature of iron is extensive, its history, either as a craft or a fine art, has not been written—a fact which, contrasted with the number of works devoted to gold and silver, appears remarkable. Monsieur F. Liger, who has kindly lent many illustrations from *La Ferronnerie*, made a serious effort to deal exhaustively with it, but he only brought the history down to the time of the collapse of the Western Empire; and as no further volume has been issued since 1875, it would appear either that he has relinquished the task or that the difficulties in his path are exceedingly great. Dr. Ludwig Beck published, in 1884, what might almost be regarded as an abridged edition of Liger's work, with a short addendum on the ironwork of the Middle Ages. The Bibliothèque des Merveilles includes a small volume on *Le Fer*, by M. Jules Garnier, 1878; and ten years later, Professor Meyer, of Carlsruhe, published a handbook on *Schmiedekunst*. In England there is a text-book on *Blacksmithing* in Weale's series; and Mr. Parker, of Oxford, to whom I am indebted for the loan of several illustrations, published, in 1858, the *Serrurerie du Moyen Age*, by Raymond Bordeaux—a work consisting of a series of interesting plates of mediæval hinges in England and France, with descriptive text. With these exceptions, the subject can only be studied in stray chapters and illustrations in periodicals, works on metallurgy and art, and the portfolios of illustrations that have appeared on ironwork, especially in Germany, and in recent years. While this paucity of

literature has rendered the preparation of a handbook a matter of some difficulty, the fact may not detract from its interest.

Though the collection in the Ironwork Gallery of the South Kensington Museum is perhaps the most extensive and comprehensive extant, it has yet been necessary to take most of the illustrations of mediæval work from among the fixtures in ancient ecclesiastical buildings, where many of the types can alone be seen. Several of these illustrations have been lent by the Austrian Government Printing Office, and Messrs. Murray have kindly allowed the use of two of their woodcuts from Du Chaillu's *Viking Age*. In addition to these, my sincere thanks are due to many of the clergy, and to friends in the architectural profession, for the trouble they have taken in affording or procuring information, which the condensed character of the book has rendered it impossible to acknowledge individually.

The present volume breaks off at the end of the Mediæval period. A second, in course of preparation, will carry the subject on through the Renaissance to the present day.

November, 1892.

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*** Of these illustrations, Nos. 1 to 16 are from M. Liger's *La Ferronnerie*; 23 and 24, from Du Chaillu's *Viking Age* (Murray); 25, 26, 33, 39 to 45, from Raymond Bordeaux's *La Serrurerie du Moyen Age* (Parker, Oxford); and 48 to 57 from publications of the Government Printing Office, Vienna. The others have been engraved for this work by Mr. J. D. Cooper.

IRON.

INTRODUCTION.

No material subject is more worthy of study than iron, for no substance on earth has more profoundly influenced the destinies of the human race. In intrinsic value it ranks lowest among metals, for copper is twenty times more costly, and even zinc and lead are three to four times dearer by weight. Yet, though it is the cheapest and most ubiquitous of metals, lacking, moreover, many of the intrinsic qualities of the precious metals, it nevertheless immeasurably surpasses the whole of them together in interest and in its value and utility to us. It stands, indeed, as regards its principal attributes, precisely among the metals as the working masses stand in a civilised community, and has ever proved a most mighty instrument for good or ill.

Clean iron is in colour a metallic steely grey, but it oxidises, or rusts, on exposure to damp air so rapidly that its real colour is seldom apparent in works of art, unless the surface has been pressed or polished, when it presents a bright metallic lustre, glistening and reflecting light. Of purely scientific interest are its well-known peculiarities towards magnetism, its electrical conductivity, biological functions, and therapeutic uses; whilst the pigments, stains, and mordants produced from it do not concern us here.

Iron chemically pure can only at present be produced by electro-

deposition, and is almost unknown in the arts, but so, practically, are alloys of iron with other metals. Small quantities of aluminium, manganese, nickel, chromium, wolfram, and even gold and silver, have been experimentally added, or may be accidentally present, some of which confer remarkable properties; but the truly valuable alloy of iron is carbon, which converts it, under certain conditions, into steel. The presence of silicon, phosphorus, and sulphur, also considerably affect its quality, the latter especially being usually injurious.

It may be that artists at the present day would seldom select iron as the best material in which to execute any purely artistic conception, and when we find great artistic skill lavished upon it in the past, it usually proves to have been from necessity rather than choice. The most exalted prince, like the humblest man-at-arms, found it expedient to don steel in battle, but in ages of luxury common steel would not be worn by the magnifico, unless wrought by a Cellini until it rivalled gold in preciousness. We certainly meet with iron crowns, iron crosses, and iron jewels; but the material is here intended to symbolise power and strength, or grim earnest, and this symbolism is usually implied when the metal is put to such inapposite uses. Occasionally we may find a statue or a throne carved in iron, as a sculptor would sometimes carve in porphyry, but the use of iron and cold steel has in all ages been habitually associated with strength and with menace, too often with suffering and death. Thus, when we find art bestowed on iron, it is almost invariably where the strength of the material serves an end, and, though the sense of utility may be sometimes obscured in the lavishness of the decoration, the most admirable works in iron are precisely those which show most distinctly the purpose they are to serve.

But to form any really adequate conception of the capabilities of iron, we must turn to works in which art, in the restricted sense, has no place whatever. It is only in such that its true power and strength at the present day are exhibited, and that it is

seen to stand out among metals as a Colossus among pigmies. In the roaring furnace, the rushing train, and the leviathan steamship we have manifestations of its destiny, for having lain as a dormant seed in the Bronze Age, and a baby in the so-called Iron Age, it has suddenly burst in the Victorian era into a manhood absolutely astounding in its strength and vigour. For we build our ships and engines of iron; the skeletons of our houses, our bridges, our weapons, and nearly everything we use or wear is directly manipulated by its touch. The very ground and air of our great manufacturing centres seem to pulsate with the masses of iron and steel in motion, and in our great cities iron spreads its wire meshes above our heads like a vast web, and the hidden pipes ramify beneath our feet like the huge mycelia of a gigantic fungus. More than sixty million tons of iron or steel must be absorbed in railway lines, from which six hundred tons must be ground off every day and dissipated as impalpable powder. We are consuming iron at home at the rate of 299 lbs. per head of population, and exporting it to the value of twenty-four millions sterling a year; and with stupendous and ever-increasing engineering works like the Forth Bridge, absorbing iron individually by the hundred thousand tons, it is well that, unlike coal, the raw material is practically inexhaustible. Should attempts be made hereafter to illustrate the uses of iron in England in the nineteenth century, as adequately as the Naples Museum illustrates its use in the first, a large space indeed will be required, for the Victorian era will be remembered for the extraordinary development of the use of iron and steel, when all else concerning it is, perhaps, forgotten.

No study abounds in the marvellous like that of metallurgy, and no other branch of science presents us at every turn with such totally unexpected, and in many cases inexplicable, results. The old idea of the transmutation of metals was, no doubt, induced by some of these, and is not merely an idle dream of the alchemist. The spectroscope has more than hinted that some of

the metals may not be the elementary substances they seem, but compounds, only to be disassociated by methods of an intensity which it has not yet been possible to apply. Metals exist, without any known change in composition, in widely different states. Certain forms of lead and copper, pure though they be, oxidise with great rapidity in air, while ordinary sheet lead or copper does not. Professor Roberts-Austen mentions that ingots of tin, exposed to severe cold, have fallen to powder; and that many metals, including iron, on being released from an amalgam of mercury, are left in such an extraordinary state that they take fire.

But the most remarkable changes in the properties of metals are effected by the addition, sometimes, of even the faintest trace of an alloy. A thousandth, or even a ten-thousandth, part of antimony suffices to ruin copper for commercial purposes; a thousandth part of bismuth almost destroys its conductivity; and a five-hundredth part of bismuth in gold causes it to crumble under pressure. No metal is more susceptible than iron to such influences; and one of these mysterious and striking changes, induced by an apparently altogether inadequate amount of alloy, is the condition of iron known as steel. The addition of but three-fourths per cent. of carbon to pure iron will increase its weight-carrying power, from nineteen tons per square inch, to twenty-eight or thirty tons, and but an extra per cent. doubles this capacity to sixty tons per square inch. How and why such minute quantities of carbon should confer such properties is even now but very imperfectly known, but science can at least apportion the exact amount requisite to produce steel adapted to different purposes. Thus, while two-tenths per cent. will fit steel excellently for the Forth Bridge, it requires eight-tenths to render it fit for cutlery. Nature, moreover, indicates the quality for us by causing the surface to assume a blue, straw, or mottled colour, according to the temper. The value to us of this mere added pinch of charcoal may be imagined from the fact that £120,000 has been estimated to be

saved by it every week in the replenishment of railway lines alone. Additions of aluminium, chromium, manganese, and tungsten also produce modifications of hardness, the value of which is scarcely yet known. Cast iron is the crude metal derived from the smelting furnace, and imperfectly freed from impurity; and, though it happens to be a nearly identical alloy of iron with carbon, has almost opposite properties to those of steel. It contains from two to five per cent. of carbon, the different proportions conferring hardness, softness, and closeness of grain. In art, great fluidity in the molten metal is of more consequence than strength, and this can be obtained through a relatively high percentage of phosphorus. Discoveries, such as that the twentieth part of one per cent. of aluminium in molten wrought iron reduces the fusing point, so that the most intricate castings can be produced with ease; and the process of annealing castings in ovens, by which the carbon is absorbed and the iron rendered malleable, should greatly facilitate its artistic use in the future. Its proper use in art is, like that of bronze, of which it is an inexpensive substitute, most appropriate when on a grand scale.

Wrought iron, however, is the purest form of the metal, and is that with which we are mainly concerned.

The presence of the vapour of iron shows that the metal is an important constituent of the sun, and of most of the heavenly bodies. It is no less common on earth—how common few adequately realise. The vegetable mould, the clay, and the gravel of our soils owe their colour mainly to it, and the vast majority of rocks are impregnated with it; for iron, unlike the more precious metals, is rarely found in a native or pure state. The ores are, as a rule, dull and earthy, and it is only when crystalline that they present a brilliantly metallic or attractive appearance. We derive our iron almost wholly from stratified sedimentary rocks, instead of from crystalline rocks, which means that it is not in its original condition, but has been extracted from older rocks, and sorted and redeposited by the agency of water.

Our supply is consequently not limited to rocks of any particular geological period, and we can use the ores indifferently, whether formed millions of years ago, or within the lives of living people. The Iron Mountain of Missouri is formed of the oldest Archæan rocks; the rich ores of Lake Superior and of Canada belong to the remote Huronian and Laurentian periods. In Sweden and many other parts of Europe specular and magnetic iron are extensively worked from Palæozoic gneiss, mica, and horneblende slates. The spathose ores of Devonian age excavated in Germany and elsewhere, and in our own Brendon Hills, and the Weardale spathose ore of the Carboniferous, are all older than the coal; but the richest ores in England, like the famous ores of Essen in Prussia, and most of the Belgian iron ore, occur in association with the coal measures. Thus the iron of the Forest of Dean in Gloucestershire, the Ebbw Vale and Dowlais in Wales, the renowned Low Moor and other ores of North Yorkshire, Derbyshire, Staffordshire, and Scotland, are interbedded, if not actually mixed, like the famous "Black Band," with the coal used to smelt them. Among the ores belonging to the middle ages of geology are the Cleveland, Northamptonshire, and many of the ores of France and Germany. The Tealby, and the soft, rich, purple Biscayan ores of Bilbao, are Cretaceous; and the red ores of Antrim, and most of those of Burmah and the Deccan, belong to the newest, or Tertiary, period. Iron ores are indeed still forming by land and sea, but most rapidly in still water. In the shallow parts of Swedish lakes a stratum of four to six inches is deposited in fifteen to thirty years, constituting one of the chief supplies of the famous Swedish iron. That dissolved from soils, on coming into contact with carbonic and other acids produced by decaying vegetation, is extensively precipitated (as it was in the time of the coal measures) in stagnant water as limonite or bog iron the action being denoted by the occasional rise of bubbles of carbonic acid and a thin iridescent film on the surface. The iron pans or crusts so often found at the bottom of peats and

gravels are produced in this way, and were extensively smelted by the Romans, while in Canada ores of equally recent origin are still largely used at the present day.

The ores vary as much in appearance and composition as in age. We can choose for our manufacture iron in combination with oxygen, such as hæmatites, limonites, and bog ores; or with carbon, such as clay-ironstone or spathic ore. The choice is great, for all the resources of nature's laboratory—heat, pressure, solution, precipitation—have been at work for countless ages, resulting in endless combinations with the varied elements with which the iron has been brought in contact, so that the existing varieties of oxides, carbonates, silicates, phosphates, and sulphides, are almost innumerable.

The ores are thus mere rusts, so to speak, mechanically or chemically precipitated in the outer crust or shell of our earth, beneath which masses of pure metallic iron may exist.

Nearly pure native iron has been brought to the surface in the basalt lavas of those deeply seated bygone eruptions, which far surpassed in magnitude any of those witnessed by man. Lumps of native iron, up to fifty thousand pounds weight, were found on the beach of Disko Island, which were unquestionably derived from the adjacent basalt cliffs; whilst the samples from other bodies in space, which reach us in the form of meteorites, sufficiently prove that the abundant iron in them has not undergone changes due, with us, to the presence of oxygen. The known density of the earth, the composition of the sun, the magnetite and titanic iron of our lavas, go far to indicate the possibility of the existence of masses of perhaps native iron at some depth towards the interior of the earth, if, indeed, its solid nucleus, which possesses the rigidity of steel, is not largely composed of the perhaps still incandescent metal. The lavas we see erupted would, on this supposition, be the mere slags of a metallic nucleus, like those from a smelting furnace, the analogy being heightened by the occasional reproduction in the latter of

quartz, compact silica, garnets, augite, and other natural products, familiarly met with in erupted rocks.

Thus the iron, such as we find it, has been perhaps originally brought to the surface in erupted rocks, dissolved out by rain and organisms, and reprecipitated again and again, or accumulated by the abrading and sorting action of the waves.

The quantity of ore mined annually in this country now stands at between thirteen and fourteen million tons; but the discovery of immensely rich ores of iron in almost every part of the world, and of fuel fit to reduce them, has already inaugurated a period of decline; and should lead us to prepare for the inevitable change, from the raw-product mart to the art-product mart of the world, which must ensue if we are to maintain our trading supremacy in the future.

I.

THE MANUFACTURE OF IRON.

The ores of iron are dug at no great depths, unless associated with coal, and are frequently obtained on the surface or in shallow pits and tunnels. In former times the mine was abandoned and the works removed whenever the increased difficulty in working rendered this advisable. The impure ores or accumulated rusts are brought back to the relatively pure metallic state by the process of smelting, or application of artificial heat. The operation in its simplest form, as it is still conducted by many of the savage races of Africa, or semi-barbarous peoples of Asia, consists in filling a closed or partly closed oven, or even an open hearth, with the ore and charcoal. The combustion is aided by currents of air produced by bellows of skin or wood, or force-pumps, whose pistons are fashioned from bamboo or other hollow stems; or by simply fanning with palm leaves. In ancient days, in Britain and Gaul, the air-currents seem to have been obtained by selecting sufficiently exposed situations, and leaving holes in the furnaces on the windward side. The remains of such mines and smelting hearths are everywhere met with, especially in wild and isolated districts, furthest from seats of civilisation and agriculture; and in such situations as the remote and densely wooded valleys of the Jura they can be traced by the hundred. Down to late Roman times the reduction of iron from the ore seems to have been everywhere given over to savage or half-savage denizens of caves and woods, and to semi-barbarous races. Those familiar with our

own charcoal-burners can realise how—being of uncouth aspect, dwelling far from beaten tracks, shunning intercourse with men, working strangely with fire, appearing and disappearing into dark holes of the earth—the presence of early iron-smelters everywhere gave rise to legends of gnomes, and elves, and other mysterious beings. The tools used in obtaining the ore, even from the hardest rock, were originally of stone and wood: and for long ages after iron was in use for weapons, the masons' and woodmen's tools, and even the blacksmiths' anvils and hammers, continued to be of stone. In Borneo timber is still felled with adzes of stone, though the natives possess beautifully finished and decorated steel weapons. It was only under the Romans that iron became common enough to be used in mining operations, and we cannot be sure until the beginning of the Christian era that a near approach was made in the fashion of the smith's tools to those of our own time. It is only at Pompeii that we find the Roman smith lacking nothing of importance that we possess, except the vice and the metal saw.

The iron itself reached civilised communities either in the "bloom" direct from the furnace, or more commonly as rudely shaped ingots small enough to be easy of transport; and in this state it formed, like gold and silver, a current article of barter. The smiths who worked these up were, in Gaul, either important citizens or formed separate and honoured communities. The discoveries at Bibracte show an entire town given over to the craft, the members of the guild being buried, like warriors, with their implements around them.

One of the most primitive of the furnaces for the reduction of the ore was still in use in India, when described by Dr. Percy. It consists of a hearth two to four feet high, set up against a rock, with three sides, fashioned of carefully dried clay, in which are two holes for the earthen pipes or tuyers conveying the blast, and another on the opposite side for the removal of cinder. It is lighted with charcoal, and fed with layers of ore and baskets of

fuel until the full charge is reached. The bellows are worked the whole time, and at the end of four to six hours a small mass of malleable iron results, and, if sufficiently hot, is at once hammered into a bloom. There is no division of labour, and the smelters are itinerant, going from village to village, and setting up their furnace wherever a demand exists and a supply of iron and charcoal can be obtained. The heat is not sufficient in any of the more primitive furnaces to actually liquefy the iron, but it is brought into a pasty lump, sufficiently free from impurity to be at once malleable. Of the many forms of furnace in which malleable blooms were directly produced, one is still in use in remote spots in Europe, and is distinguished as the Catalan. This is a rectangular hearth in a permanent building, without a chimney, but with a hole left in the roof, and employs about ten men. The furnace is heated with a layer of charcoal about eighteen inches deep, and almost reaching the tuyer, and the charge is made up and renewed with alternate layers of sifted ore and fuel. The blast, produced by manual labour until the seventeenth century, is now obtained by the downward suction of air in a falling column of water; and is directed on to, instead of through, the incandescent mass. Six hours after the blast is turned on, the iron is found separated, and is manipulated until it coalesces into one lump at the bottom; which is then lifted over the edge of the furnace by levers, and is ready for hammering into shape under the helve hammers close at hand. Until these formed part of the plant of European iron-works, the rude labour of fashioning the object direct from the ingot or bloom, fell directly on the smith. The hammers weighed from 1200 to 1500, and even 2500 lbs., and were worked by a rough cog-wheel driven by water power. Their use was to beat the rough bloom into bars on a slightly tapering anvil, thus relieving the smith of the most laborious part of his task. They were very common in Surrey and Sussex, the name "hammer-pond" still denoting, in many places, the artificial pond which supplied the water. The furnace-masters who smelted, and the forge-master

who beat the bars out by mechanical means, became distinct callings in England, and had nothing to do with the smith who produced the finished work. Little is actually known of the process of manufacture until recent times, when an account of the ironworks in the Forest of Dean was communicated by Henry Poole to the Royal Society in 1676, in which, after describing how the pig iron was taken from the high-blast furnace to the open-hearth charcoal finery, and was softened and worked into a lump: "this," he continues, "they take out, and giving it a few strokes with their sledges, they carry it to a great weighty hammer, raised likewise by the motion of a water-wheel, where, applying it dexterously to the blows, they presently beat it out into a thick short square. This they put into the finery again, and, heating it red hot, they work it out under the same hammer till it comes into the shape of a bar in the middle with two square knobs at the ends. Last of all they give it other heatings in the chafery, and more workings under the hammer, till they have brought their bars into several shapes and sizes, in which fashion they expose them to sale." The existence of slitting and rolling mills at a later period is shown in the account of the manufacture of iron in 1725, reprinted in the Journal of the Iron and Steel Institute for 1885, from which we learn that the bars were called "palasades." The finished bars were classified as "merchant bars" and "mill bars," the latter being subsequently passed through the slitting and rolling mills, where they were reduced to nail rods or thin plates. These latter mills were worked by water power to save the expense of charcoal and human labour. The establishments in many cases only produced forty tons of iron per annum, and the largest in England produced no more than six hundred and fifty tons. No doubt the excellence of its quality in mediæval times was chiefly due to the subsequent manipulation it underwent in the smithy.

In estimating ancient work, we must remember that, down to perhaps the fourteenth century, iron could not be bought by the

smith in the bar; and that down to perhaps the seventeenth century, the bars that came into his hands were probably at best analogous to the "puddle bars" of to-day, that is, very elongated ingots ready to be fashioned into finished bars, but not available to be cut up and used without the bestowal of labour, like the bars from the rolling-mills at the present day. The aversion to straight bars seen in the oldest smiths' work, was probably due to the fact that perhaps the most difficult task that could be set was to handle and beat out a long and heavy ingot into a bar with mathematically true angles.

The erection of a shaft over the Catalan forge, by increasing its draught, converted it into a blast furnace, in which the iron could be liquefied and run off into moulds. This liquefaction marks one of the most momentous periods in the history of ironworking, for "cast iron" produced in this manner differs in its properties as much from "wrought iron" as if it were a distinct metal. Thus "white" cast iron, which contains most carbon, is fine-grained and brittle, and so hard that it sometimes cuts like a diamond; the "mottled" kind is coarse-grained and hard; and the "grey" assimilates most to malleable iron, being softer and rather tough. The step was so obvious that we can scarcely believe that it was not taken until late mediæval times. Dr. Percy, indeed, regarded it as not improbable that cast iron was first intentionally produced in China, perhaps at a very remote period; and a passage in Aristotle renders it likely that, in the fourth century B.C., the Greeks knew that iron could be liquefied by heat. Theodorus, a Samian, has been credited with being the discoverer of the art of casting statues in iron, several of which are mentioned in Greek and Latin writers. Lastly, M. Liger, in his remarkable work, *La Ferronnerie*, has brought forward evidence to show that iron was produced in blast furnaces all through the Roman, and even the Greek, period, and that it was run into pigs at the pit's mouth and sold in this state, to be worked up in the centres of iron industry. He contends, indeed, that the same process was

employed in Gaul and even in Britain; but the total absence of any objects in cast iron of great antiquity is strong evidence against its use. The cast-iron tombstone in Burwash Church proves, however, that the art was known in Sussex in the fourteenth century, long prior to the date given by Percy, who considered that blast furnaces originated in the beginning of the fifteenth century at Siegen, in Prussia. The Prussian stückofen, described and illustrated in the sixteenth century by Agricola, was a Catalan forge extended upwards into a shaft; capable of either liquefying the iron or of producing malleable blooms, by varying the proportion of ore to fuel in the charge. The blooms were divided into four or five parts by hammer and chisel, and drawn out into bars ready for use on an ordinary anvil. No great value seems to have been attached to the discovery of casting in England, for almost the only objects produced until nearly the close of the seventeenth century, except cannon and shot, were rather heavy andirons and fire-backs. The oldest really important work existing is the exterior railing of St. Paul's Cathedral, which was contracted for at the high rate of sixpence per pound, and cost £12,000. Cast iron only came into general use for such purposes at the beginning of the present century. One of the best specimens is the gate at Hyde Park Corner, produced in 1841 at a cost of £5712. Though works of utility, rather than of art, are usually associated with the material, the most delicate filigree jewellery imaginable has been produced for nearly a century at Isemberg, in the Harz. The manufacture is kept secret, but the bog ore, rich in silica and phosphorus, and the fine quality of the loam used for the moulds, are exceptionally favourable elements.

There will be little further occasion to speak of cast iron in the progress of our work. As long as charcoal was used, as it is even yet in Sweden, malleable iron could be produced direct from the ore, and in contact with the fuel by continuous working; it being unnecessary to separate the refining process from the smelting. It is improbable that early fineries turned out more than from two

to four tons of metal per week, and the production of iron in England was never, in the days of charcoal, estimated at more than seventeen thousand tons per annum, and, owing to the growing scarcity of wood, fell in 1725 to a little over twelve thousand tons.

Though the first patent for smelting iron with coal was taken out in 1611, very little seems to have been actually used till Dudley succeeded in working the invention profitably in 1620. The merit of completely solving the problem belongs, however, to Darby, in 1720; though its use still continued to be restricted, since a pamphlet, published in 1756, relates that charcoal alone was used in all the processes of manufacture up to the finished bar, but that all further work upon it to fashion it into implements was performed with pit coal.

The use of coal as a fuel leaves the pig iron too full of carbon, sulphur, and other impurities to be workable, and these have to be burnt out by the action of oxygen at a high temperature. Existing processes are therefore directed to this end, and are considerably complicated.

The ore is, as a preliminary, roasted in heaps or in kilns to free it from a part of its impurities. It is next melted in flask-shaped furnaces, which may be eighty, or even a hundred feet in height. These are fed from the top with calcined ore and coke, the mixture falling on to a cone which distributes it so as to prevent clogging. Blasts of air, seven times hotter than the boiling point of water, are blown in from the base. The iron and the earthy impurities alike melt in presence of the intense heat, and trickle in a ceaseless stream to the bottom, limestone or clay being often added to combine with the impurities, so that the mixture may become more rapidly fusible. The liquid iron, being the heaviest, forms a substratum, and the slag floats upon it, so that they are drawn off at different levels, the one being a glassy waste product, still but imperfectly utilised; while the other is run out into open sand-moulds, and left to consolidate into pigs, the gutters in the sand bearing an imperfect resemblance to a sow with her pigs sucking.

These pigs are rough bars of iron about three feet long and four inches in diameter, and are in condition for use in the foundry. The furnace is kept in continuous action until it needs repair, and will contain from thirty to forty thousand cubic feet, so that the operations are on a Cyclopean scale. To bring them to their present perfection the brightest intellects have been ceaselessly exercised, and reams of patents taken out, the result being that where eight tons of coke were required to produce a ton of iron in the lives of our fathers, one ton can be made to suffice now; while so simple a matter as heating the blast with waste gas has saved a million tons of coal in the Cleveland district alone.

About twenty million tons of pig iron are being produced annually, and for the production of cast iron the process stops at this point; but for wrought iron a purer quality is required. For this it is puddled, an invention first patented in 1784, which means that it is boiled and stirred upon a hearth, or in a chamber, until all but mere traces of its impurities are burnt out by oxygen from the air, or from rusty cinder added during the process. The iron leaves the puddling furnace as a spongy, fiery, and dripping mass, and is hurried to the squeezers, which are steam-hammers, or other mechanical contrivances to press out the cinder and squeeze the metal into blooms. This is the process formerly called "shingling," for which the lever or tilt, and helve hammers worked by water power, were used; until the introduction of the stamp-hammer with vertical action, and particularly of the Nasmyth hammer in 1842. The blooms, being reheated, are put under the rolling-mills, which draw them into puddle bars, and these are again rolled until they acquire the merchantable form of bar iron. In these processes about four hundred and fifty tons of coal to the hundred tons of bar iron are consumed; the result being that the iron has become soft, fibrous, and tough, instead of brittle and granular—the "wrought iron" of commerce, of which some seven and a half million tons are now put annually on the market.

Steel, the third of the chief merchantable conditions of iron, is in composition a connecting link between "cast" and "wrought" iron. While resembling cast iron in containing carbon, it differs from it in being a carefully purified, malleable iron, to which a definite proportion of carbon has subsequently been added, the amount varying from the fraction one-fifth to one per cent., according to whether the result is required to be mild or steely in quality.

It is difficult, or rather impossible, to trace its origin, for the early references to it merely mean a steely quality of iron produced in the bloom, or iron hardened by rapid cooling, and perhaps by tempering. The fact that hard rocks could be carved has continually been adduced as proof that steel was known to nations of antiquity, but no evidence of any value has ever been brought forward to support this proposition. A manufacture of something like steel is described by Leih-Tze, a Chinese writer about B.C. 400, when Aristotle also described a method of converting iron into steel by melting and refining. The most celebrated steel of antiquity was, however, the Indian wootz, which had a world-wide reputation, and was made from iron mixed with finely chopped wood and heated for three or four hours in small closed crucibles. The Chinese method, which appears the one practised in Greece and in mediæval Europe, was to melt some iron with a flux in a crucible, and to immerse and boil pieces of wrought iron in it with charcoal, for several hours, until the requisite amount of carbon had been absorbed. The process was repeated twice or more, the iron being withdrawn and well hammered each time, and plunged while hot into cold water. English steel was, until quite recently, all made by the cementation process, which consisted in packing pieces of bar iron with powdered charcoal in little fire-clay or iron boxes, and keeping them at a red heat for a week or two, during which the iron became unequally impregnated with carbon vapour. Uniform quality was obtained by breaking the bars into small pieces, judging and

sorting them by the eye, and remelting the lots in crucibles. The quality, which was uncertain, chiefly depended upon a further process—that of heating the article to redness and quenching it in cold water to harden it, and then tempering the hardness by careful reheating until it became fitted to cut either metal or wood, or elastic enough for springs. The highest degree of tenacity was obtained by heating to a dull red and simply chilling rapidly in oil. The manufacture was empirical, and it was not known till 1781 that the properties of steel were dependent on the percentage of carbon present. Its use was a luxury and untrustworthy for large masses, until the introduction, twenty-six years ago, of rapid steel-making processes by Bessemer and Siemens. These entirely revolutionised the industry, increasing the production to over seven and a half million tons annually, of which one-third is contributed by this country.

The present process consists in melting the pig iron in a huge flask, and blowing superheated air violently through it, until every trace of impurity is burnt out. To the resultant almost pure iron the precise amount of carbon and manganese required is added by mixing "spiegeleisen," which is a carefully prepared iron containing the requisite alloys. The introduced carbon sometimes acts on the mass of iron oxide with almost explosive violence, and an impressive pyrotechnic display results; the peculiar roar of the blast is lulled, lambent greenish flames play over the mouth of the gigantic flask, which bends over as if its task were accomplished, and delivers its contents in a dazzling flow of silvery whiteness.

The manufacture of steel is still probably in its infancy. Already the rivalry of nations and their ceaseless armaments necessitate the use of ingots of forty tons weight for armour plating, and the 143-ton Krupp guns have for the moment eclipsed our monster Armstrongs. But the Italians have surpassed all by producing, in their new works at Terni, an astounding anvil of steel in a single casting, weighing a thousand tons.

To witness the manufacture of iron and steel we must travel to those hives of ceaseless human industry in the "black country," a scathed and almost treeless district, which, under a smoky pall by day and lit up with a red glow like Hades by night, has contributed more than its share to the greatness of our country: though destined when its task is accomplished, perhaps within a few years, to revert once more to green parks and meadows.

II.

THE EARLY HISTORY OF IRONWORK.

The inquiry into the origin of the use of iron is a purely academic one. Iron rusts so rapidly that the delicate gold enrichments of a sword or cap may be exhumed in perfect preservation, whilst the blade or helm is only traceable in a trail of rust. But though the great bulk of the objects in iron belonging to remote antiquity have totally disappeared; yet in no instance are we justified in assuming that iron implements have been in use where no traces of such exist. The evidence of the objects themselves, as well as of tradition, leaves no doubt whatever that the knowledge of gold and of copper preceded, in a general way, that of iron; and we find that any extensive use of the latter implied, as a rule, a high degree of civilisation. The fact that the use of iron is nearly always found to be coeval with the most ancient written history has been advanced as proof of the contrary, but it can prove nothing more than that the art of working iron and the art of writing language are two stages in the progress of civilisation which have often been reached concurrently. The use of iron is indeed seldom found to antedate history or human tradition; and we can nowhere regard iron weapons or tools, as we can bronze or stone, as prehistoric, except in a restricted and local sense. Whenever the superficial deposits of countries in which the works of man are preserved have been scientifically and at all exhaustively explored, we are at once aware of long periods, about which history is wholly silent, in which the use of

iron was utterly unknown; and even in the traditions of the great civilisations of antiquity, we get unmistakable hints that the age of bronze was too recent to have been wholly forgotten. The first impulse of man would be to arm himself and make use of implements and weapons of stone, wood, and bone; and the Stone Ages, when the use of metal was practically unknown, are shown by the most unequivocal evidence to have been of enormous duration. The proficiency attained by the prehistoric inhabitants of Europe in the use of stone weapons, in which those of our own island fully shared, must have been prodigious, for they fought and slew the mammoth and the woolly rhinoceros, the bison and the auroch. An infinitely shorter period in which use was made of copper or its alloy, bronze, seems invariably to have preceded the use of iron. Only those countries which are the home of the advanced scientific culture of to-day have yet been regularly surveyed and examined, and in these we find that the Stone, the Bronze, and the Iron Ages preceded each other as inevitably as the night and the dawn precede the day. Yet there could no more have been a universal Bronze or Iron Age than a universal age of infants or of grown men, for races have been in the past like individuals, some in infancy, whilst others are in decay. Thus the use of iron was known three thousand or even four thousand years ago where civilisation existed; whilst the races of Australia, Polynesia, and the Oceanic isles were in their age of stone when they first came in contact with Europeans; and in the whole American continent, the most powerful civilisations had alone reached the age of bronze.

In tracing the history of iron we should be peculiarly cautious in accepting remote traditions of a knowledge of its existence as proof of a knowledge of its manufacture and use. Interesting bodies called meteorites are continually falling on the earth from space, and though the vast mass of those which enter our atmosphere are entirely dissipated by friction, and only reach us imperceptibly as cosmic dust, yet the fall of hundreds of solid masses has actually

been witnessed. Those which have thus run the gauntlet reach us as remnants, seared, scorched, and wasted, but priceless lumps, which are occasionally composed of almost pure metallic iron. Now, the fall of a heated mass, crashing apparently with terrific violence, whether as a bolt from the blue by day, or a hissing, blazing meteor by night, is a startling event, even when witnessed in these newspaper days; and how much more awe-inspiring and miraculous would it have appeared in the dark ages of superstition! It was inevitable that such falls should have attracted notice from the very earliest periods of human history,[1] and the stones, when recovered, been deemed fit objects of idolatry; like one which fell in India as recently as August, 1884, which was decked with flowers and daily anointed with much ceremonial.[2] No metal except iron ever reaches us in this way direct from the sky, and this fact alone must have invested it with a singular and mystic interest, before ever its utility to man was perceived. Thus we find in an age of copper, ornaments and pieces of meteoric iron placed on the altars of the Turner Mounds of Ohio. Now, some of the meteorites of native iron—called siderites, to distinguish them from the stony meteorites—are of such magnitude that they could not have failed to excite attention, an exceptionally large mass in the Argentine Republic being said to contain thirty thousand pounds of solid malleable iron, whilst many others found in America and Australia are several thousand pounds in weight. The fact that none of any size have been discovered in countries of ancient civilisation in the Old World is very like proof that they were utilised, or not neglected; and if a doubt could be

[1] No less than sixteen falls are recorded in Chinese literature prior to A.D. 333. The earliest fall recorded in Europe happened in Crete, B.C. 1478; a fall noted by Plutarch, B.C. 705; another by Livy, B.C. 654; another, B.C. 466, is chronicled on the Parian marbles; and so on.

[2] A black conical stone which fell in Phrygia was worshipped as Cybele, the mother of the gods, by the Phœnicians; and the Diana of the Ephesians and a Venus at Cyprus were, there is reason to believe, like the stone of Mecca, of the same nature.

entertained as to whether they existed as abundantly in our hemisphere, it is disposed of by the fact that seven of the nine siderites actually seen to fall, fell in the Old World. The most ancient name for iron, the Egyptian, signifies, in fact, "stone of heaven," or "stone of the sky," and the Greek name seems to betoken a not dissimilar derivation. Though meteoric iron is not readily malleable, owing to the presence of phosphorus, nickel, and cobalt, the Mexicans, the Indians of La Plata, the Esquimaux, and other semi-barbarous peoples contrived to use it when they were totally unacquainted with any means of obtaining iron from the ore. Some recent analyses of the iron of prehistoric weapons have disclosed that many contain an appreciable percentage of nickel, an alloy that is not obtainable by smelting any known ores, but which is invariably present in siderites. It is, moreover, actually recorded that sabres and poignards were made in Persia from a siderite which fell in 1620. It is thus hardly conceivable that peoples of remote antiquity should have been totally unacquainted with the existence of iron long before they had learned to recognise its earthy-looking ores, or to extract the metal from them.

Many nations share the tradition that the discovery of the production of iron from the ore by smelting resulted from forest fires. Immeasurably the most ancient of these, if we could trust Chinese chronology, is found in the Book of Historical Documents, in which Fuh-he, some 3200 years B.C., accidentally smelted iron out of a brown earth when clearing away forests, and fashioned spear-heads from it, with which he taught his people to hunt and fish. The Chinese, however, so exaggerate the antiquity of their industries, that their dates, previous to Confucius, are quite unreliable. We must thus take for what it may be worth the date—equivalent to B.C. 2000—of a tribute list, in which words occur translated as "hard" and "soft iron," in company with "stone" for making arrow-heads; and also the story that soon after this date iron swords superseded those of bronze. Hardly any further

mention of iron is found in Chinese annals until Leih-Tze, B.C. 400, describes the methods in use for making both iron and steel. There is, however, no reason to doubt that the industry is at least as old in China as elsewhere, and that it was practised almost universally in Asia in prehistoric times. That the Chinese excelled in it may equally be believed, though scarcely any early specimens of their ironwork are to be seen in Europe, for they still practise an art unknown elsewhere—that of welding patches into their thin cast-iron vessels.

The working of iron in India also dates back to a remote antiquity, though preceded, as in Europe, by ages of stone and bronze; for the Aryan colonisation found the indigenous races already acquainted with its production. The partial Aryan conquest of India commenced somewhere about B.C. 1500, and it is clear from the Rig-Veda that they brought a well-developed iron industry with them. The celebrated wootz, from which the Damascus blades were probably made, is of unknown antiquity, but the thirty pounds of iron presented by Porus to Alexander shows that he possessed iron, or probably steel, which was regarded as of no ordinary value. Steel, or iron of a very steely quality, appears to have been largely exported from the shores of the Ganges by Western nations, and the *sericum ferrum*, said by Pliny to have been the best imported into Rome, sometimes supposed to be Chinese, was very possibly wootz from India. There are some iron implements in the British Museum from tumuli at Wurree Gaon, of unknown antiquity, which have been supposed by their discoverer to be almost as old as the Aryan conquest.

Though it is abundantly evident that Egypt cannot be ranked as a country making any extensive use of iron until the last centuries of its autonomy, the fact that the Egyptians were able to carve granite and syenite has been regarded as evidence of the use of iron as far back as about B.C. 3000. The Mexican and Peruvian civilisations, however, quarried and even carved porphyry, greenstone, diorite, basalt, and gabbro on a very exten-

sive scale, and we have the most positive statements that when discovered they were ignorant of the use of iron. The precise accounts of their weapons and implements of bronze, jade, and obsidian, and their thick, quilted, defensive armour, leave no doubt on this point. No word for "iron" is known to have been in use, no iron has been discovered in their tombs, and neither the remains nor the tradition of ironworking among them. Like several other peoples of America, they made use of what meteoric iron they became possessed of, and highly prized it; but their quarrying and stoneworking is circumstantially described as having been effected with wood and stone tools, which latter were found to cut through even iron with ease. We should find it difficult to kindle fire with two sticks, or to accomplish many operations which uncivilised man can readily perform; and there is nothing inherently improbable in the account that stone was carved with still harder stone, shaped for the purpose and wielded by practised hands. If the Peruvians and Mexicans could carve basalt and granite without the use of steel, it would be futile to deny the same skill to the Egyptians; and Mr. Bauermann, a practised observer, most distinctly states that the inscriptions in the neighbourhood of the copper and turquoise mines at Wady Meghara were, up to the last, dressed with flints. The single plate of hoop iron found forty years since near the mouth of an air-shaft of the Great Pyramid, and now in the British Museum, has frequently been cited as evidence of the use of iron during its building, but the find is so entirely exceptional, the shape of the iron so useless for any building purpose, and it is so fresh-looking, that, in spite of its discoverer having certified to its removal from a position in which he believed it could only have been placed contemporaneously with the building, we must wait further evidence before regarding the use of iron in the fourth dynasty, perhaps some three thousand years B.C., as an established fact. The pyramid has been stripped and ransacked for ages by people with iron in their hands, and instances abound showing how easy

it is for objects of metal, such as a broken sword-blade discarded or lost, to find their way into what appear quite inaccessible positions. There is nothing else to lead us to believe that iron was in use until fully a thousand years later; and cutlery, weapons, and carpenters' tools were of copper or bronze. Small objects of iron are said to begin to appear in tombs and on mummies supposed to date back to B.C. 2000; and it seems quite certain that iron had come into at least partial use by the eighteenth dynasty—perhaps about B.C. 1500. Weapons are then depicted, sometimes in red and sometimes in green and in blue, while an inscription records that thirteen basins of iron came into the possession of Thothmes III. among the spoils of Ouan. Iron cramps found in the walls of Heliopolis may be of later date, but in the nineteenth dynasty the chariot of Rameses II. was of iron, and his bronzes are found with iron core wires. This brings us to about the date of the Exodus, and it is significant to find the opinion expressed by such an authority as Sir John Evans that the Israelites were then unacquainted with iron. The painting representing a heap from which flames are issuing, of the date of Thothmes, with a man on either side working bellows, often supposed to be a forge, more probably depicts gold or copper smelting. Bauermann found only hammers and tools of stone and wood in the mines of Wady Meghara, which were the most important held by the Egyptians, and representations of metal-working show stone and copper anvils and hammers, but never iron. Although Mr. Hartland has reported the existence of remains of vast ironworks in this neighbourhood, situated on some hills at a place called Surabit-el-Khadin, it is probable that the undoubted evidences of great antiquity belonging to the copper and turquoise mines have been unduly appropriated to these. The bulk of the objects in iron recovered in Egypt date under any circumstances from the Roman occupation. Under the Ptolemies, statues were made of iron, and even its magnetic properties were understood, for Pliny relates that it was proposed

to make the roof of the burial-vault of Arsinoë of loadstone, so that her effigy might remain suspended without support.

The use of iron was not confined to the Egyptians in Africa, for their inscriptions tell that the Ethiopians, who were little better than savages, possessed iron; and their troops in the army of Xerxes wore helmets of iron and bronze. In some districts of Africa iron occurs in a condition which enables it to be wrought by the most primitive methods, and its production seems all but universal among the uncivilised tribes of the interior. It is still frequently worked with stone hammers and anvils, and numerous practices survive which would no doubt well illustrate the working of iron in the remotest antiquity. As in ancient Chaldea, iron rings and bracelets are much worn by many of the native races.

Chaldea may have preceded Egypt in civilisation, and an early use of iron has been inferred in both instances on analogous grounds. It has been assumed that engraved seals, thought to date back to B.C. 1600, were cut with iron or steel gravers. Otherwise there is no evidence that iron was used even in Babylon, where bronze was employed on the largest scale, until the time of Nebuchadnezzar, B.C. 561, when bolts and hangings of gates and the cramps of the stone bridge across the Euphrates were of iron. The Chaldeans made the most limited use of the metal, and little else than rings have been found, which appear to have been symbolic. It was more extensively used by the Assyrians, who were skilled metallurgists, and exported iron from Nineveh to Egypt. We know nothing definite about it earlier than the inscriptions discovered at Nineveh, which show that under Sardanapalus III., about B.C. 900, large quantities of iron were included in the treasury of princes, as much as five thousand talents having been captured at one time in Damascus. Though apparently scarcer than bronze, both this king and Sennacherib covered the framework of buildings and fortifications with it. The very interesting discovery in the palace of Khorsabad, built by Shalma-

neser in the eighth century B.C., of a hundred and thirty thousand pounds weight of iron in a room supposed to have been the treasury, shows that iron was stored in rough wedge-shaped ingots, with holes through them to facilitate transport. These may, like many of the iron objects brought from Nineveh, belong to the Sassanian period, but the great iron bolt in the British Museum, which barred one of the bronze gates, must be genuine Assyrian. One among the conical helmets there is but slightly different from the form represented in the bas-reliefs of Sennacherib, and though in the most advanced state of decay, shows that the lines so invariably present on them represent bronze fillets. It may be of the time of the destruction of Nineveh, B.C. 606, and seems to have been beaten out of one piece, like the morions of the Renaissance, and is thus of more difficult work than the Sassanian helmets, of several pieces riveted together, found in the same locality. Layard also states that he found innumerable plates of iron, two or three inches long, shaped like those of the scale armour in the bas-reliefs, but the ring armour actually brought away seems undoubtedly Sassanian. Iron was used, as in other countries, for strengthening objects of bronze, such as the handles of shields, the rings and feet of tripods, the legs of couches, etc.

The relative frequency of the use of iron and bronze among the Hebrews may be gathered from the fact that "iron" occurs only thirteen times in the Pentateuch, whilst "bronze" is mentioned forty-four. The Philistines are stated to have deprived the Israelites of their smiths, and in the time of David, B.C. 1000, iron was in somewhat general use. The iron bedstead of Og has been interpreted as a bier fashioned of black basalt rock; but Ezekiel speaks of an iron pot, in the sixth century B.C., when such utensils were almost everywhere of bronze. The Chalybes of Pontus, from whom the Greek and Latin words for "steel" were derived, appear to have been a race of smiths, and produced a metal so renowned for weapons, that it is conjectured to have been steel; this they exported as tribute to Nineveh. Their part

of Pontus has always been regarded by classic writers as the mother country of the iron industry, which even now is everywhere carried on by the inhabitants in something like its old form. Chalybon, a town of Syria, was also the centre of an iron district, and iron vessels formed part of its tribute to Thothmes III. The Phœnicians equally claimed the discovery of the art of working in iron, paid tribute of iron vessels to Egypt, and traded largely in it, especially with Carthage. They possessed, in common with other peoples of Asia, wooden statues covered with iron plates. In Homer we read that the Sidonians were incomparable chasers of iron, and a considerable trade in that metal passed through Tyre down to the time of its destruction. Strabo states that the town of Cibyra, in Asia Minor, was famous for chiselled ironwork, and the Scythians appear to have used iron from very remote times, and are credited with having introduced it into Greece during the first Theban War. Yet, though the district thus appears to be the very "black country" of antiquity, the Massagetæ just to the south, according to Herodotus, and the Sarmatians to the north made no use whatever of iron.

We know nothing in this connection regarding the Medes, except that they paid a tribute of iron to the Assyrians. The Persians in the army of Xerxes, in the fifth century B.C., wore iron as well as bronze scale armour, and the sword-smiths of Meshed and the Korassan afterwards became world-renowned. The Turanian peoples of Central Asia must also have been great ironworkers, for we read that the King of Samarkand paid a tribute of iron mail and locksmiths' work to China as early as B.C. 713.

As it is conceded that iron was in use in Asia in pre-Homeric times, it is unnecessary to debate whether the evidence as to its use by the Greeks before Homer's time is or is not conclusive; Hesiod, who was almost his contemporary, arms the gods with iron, but writes as an eye-witness of the passage from the Bronze to the Iron Age, lamenting the evils that the fatal discovery is destined to inflict on the human race. The Parian

Chronicle, among many legendary dates, records the first discovery of iron, in Mount Ida, Crete, in the year B.C. 1432, in the reign of Minos, after the date of Cadmus, Danaus, and the Amphictyonic League. This shows that a rooted tradition existed of a time when iron was unknown to Greek civilisation, and that it was introduced within what may be considered their historic period. This is confirmed by the important excavations of Dr. Schliemann at Mycenæ, the contemporary of Troy, and at Hissarlik. Iron was only represented in the latter by decomposed nodules which he called "sling-bullets," doubtless of iron ore, like the plummets so commonly found among relics of the mound-builders in America; and by a small knife which he assigned to the Alexandrian period: whilst the peculiar keys and knives found in the former he considered not to be older than the fifth century B.C. Excavations in Cyprus also confirm the existence of a copper or bronze age, when iron was unknown. We glean from Homer that its use was exceptional, the most remarkable of the objects mentioned being the mace of Areithöus and the arrow of Pandarus, both, significantly enough, presents from the gods; the axletree of Juno's chariot, regarded as a unique object; the twenty funeral axes of Patroclus; and the large ingot of Achilles. Iron seems to have been used, much as in Assyria, for the cores of objects of bronze, such as tripods, the handles of bronze shields, and inlays; but since the *Iliad*, as handed down, probably contains the work of various hands and ages, we may not unreservedly accept all its technical references. Bronze weapons had not fallen wholly into disuse in Greece down to B.C. 400, since Plato states that both bronze and iron were the metals of war. From the fact that bronze continued to be everywhere in use for swords and cutlery so long after iron was introduced, it has been inferred that it could be hardened, and formed into knife and razor edges of great keenness.[1] Whilst others who had used iron, merely regarded it for its strength, and often

[1] Sharp knives from Travancore are in the Indian Museum.

overlaid it with bronze and more precious metals, the Greeks recognised the beauty of the material, so that it came under the artistic influences already lavished by their sculptors on gold and bronze. Though no work of Greek art in iron has come down to us, passages in their literature indicate that they practised the arts of casting, forging, welding, embossing, polishing, inlaying, and tempering iron. The discovery of the art of casting statues in iron is ascribed to Theodorus of Samos, who lived, according to Aristotle, in the fifth century B.C. Pliny, writing in the first century A.D., reports that the iron statues of Athamas and Hercules were still extant in Thebes; and Pausanias, in the next century, saw the iron statue of Epaminos. He was also greatly struck by the representation of the combat of Hercules with the hydra in iron by Tisagoras, as well as with the heads of a lion and a wild boar in iron, consecrated to Bacchus at Pergamos. Numerous statues of cast iron at Athens and Corinth are mentioned. The discovery of the art of welding, or perhaps soldering iron, is attributed to Glaucus of Chios, B.C. 690, who is said by Pausanias to have hardened and softened the metal at will. One of his works was the openwork iron pedestal of a large silver crater-shaped vase, given by the Lydian king, Halyattes, to the temple of Minerva Pronæa at Delphi. This pedestal was constructed, according to Herodotus, of small plates of iron, beaten and joined together in so marvellous a fashion as to be worthily ranked above all the gifts to the temple at Delphi. It must have been a striking work of art, for Pausanias again describes it as shaped like a tower, tapering from the base, each side being formed of bands echeloned above each other, the highest recurved outwards, and fastened together neither by rivets nor joints, but by solder only. Hegesander, again, speaks of it nine hundred years after its original production, and seems to indicate that it comprised figures and foliage. The art of polishing iron by the Greeks is referred to by Ezekiel, B.C. 588, in his denunciation of Tyre; and the magnificent helmet

executed by Theophilus for Alexander the Great was, according to Plutarch, polished and shone like silver. The art of hardening iron by plunging it in cold water while hot, is spoken of by Homer, and Sophocles compares an obstinate man to iron that has been so treated. This art was especially practised by the Corinthians, and is redescribed in Pliny's *Natural History*. Iron was extensively used by the Greeks in the construction of ships, chariots, engines of war, agricultural implements, etc., though it never seems to have been used so largely as bronze. In Sparta, however, especially, there was an iron currency, and much iron jewellery was worn.

The Romans sooner or later assimilated the arts of the Greeks, who seem to have left little further to be discovered in the manipulation of iron for the purposes of art. In the reign of Tarquin, weapons of iron were in partial use, but by a clause in the treaty with Porsenna, iron was reserved exclusively for agriculture, and re-remained so down to the second Punic War. In B.C. 530, during the consulate of Flaminius, iron weapons were reintroduced, and Polybius informs us that short two-edged Spanish swords of excellent temper were adopted in the army. The rams of ships were fitted with iron, and an immense use was made of iron chains for engines of war, ships' cables, and securing prisoners. It is a singular fact, however, that the Romans did not themselves manufacture iron until a very late period, but procured it from Etruria, Norica, Styria, and many other places.

Roman metalwork is probably but a continuation of that of Greece, with something less of simplicity and refinement, and more of elaboration; though the brief appreciation of the intrinsic beauty of iron by the Greeks is not traceable in Roman or even in Etruscan art. The excavations at Pompeii have shown that the uses of iron in A.D. 79 were nearly identical with our own, except that little artistic use was made of it; but it must be remembered that the town never had any importance, except that conferred upon it by the beauty of its situation on the shore of the Gulf of

Naples. Though placed, as it seemed, in one of the most favoured spots of the earth, it was severely shaken by an earthquake in A.D. 63, and sixteen years later entirely buried under a layer eighteen to twenty feet thick of ash. The crest of the sunny and cultivated mount, under which it had safely nestled from its foundation, was suddenly blown miles high into the air, descending in a rain of mud and burning cinder, and barely allowing the inhabitants to escape with the most portable of their valuables. Very little in iron would have been removed, for already its position as a baser metal was defined. Innumerable, however, as are the implements, tools, etc., disinterred from Pompeii, we cannot fully gauge the use of iron by the Romans, since the age of palatial buildings and luxury had not yet reached its zenith. Thus from Pompeii we might infer the total absence of constructive ironwork in Roman architecture, yet Professor Aitchison claims that, in the Baths of Caracalla, a large ceiling was supported on iron girders.

Of the objects actually recovered, those of chief interest to us are the iron window-bars, exactly like those still used in London basements; the iron casement windows with glass panes retained by movable buttons; and the iron grilles that separated the arena from the auditorium in the amphitheatre. The entrances to the forum appear to have been closed with iron gates, but the spot was rifled in early days, and, with the marbles, they were perhaps carried away. Grilles, called *cancelli*, though extensively used in temples, courts of law, etc., were merely of trellised bars, like the filling in of the space over the doors of the Pantheon, or as represented on the Arch of Constantine. An illustration, in Liger's *La Ferronnerie*, shows a combination of trellis with a scale pattern in a door within the portcullis of one of the gates of Wiesbaden.

The more highly decorated jewel and money chests, three of which are illustrated by Liger from Pompeii, were combinations of bronze, wood, and iron, the workmanship of the latter being poor, as far as can be judged from the rusted remains. The best,

supposed to be the *arca* in which the quæstor kept the public money, is sheathed with iron fixed with brass-headed nails, like those still in use for the purpose in Naples, and lined with copper, and stood on a marble plinth. The largest measures about three by two feet and a half, but in Rome they were more considerable, since it is related that men could hide in them. In Pliny's list of ironwork, two iron vases and a chiselled table occur among the consecrated objects of Roman temples, perhaps spoils from Greece; though rings, tripods, lamps, and other partly decorative iron objects are occasionally disinterred in Pompeii. The largest and most difficult forgings were undoubtedly those required for offensive engines of war, particularly the beaks of vessels, one of which, in form of a ram, has been recovered while dredging Genoa harbour. Iron and steel armour was extensively used, and may have been richly embossed, though the embossing was more probably confined to an overlay of bronze or gold.

We glean from Pliny, Strabo, Plutarch, Tacitus, Diodorus, and Cæsar, that the use of iron was general in Europe before ever its barbarian peoples came in contact with Rome. Thus the Catti possessed it in great abundance, the Germani threw iron axes attached to cords, the Cimbri wore iron breastplates and used large swords and javelins, the Gauls wore iron ring armour, and the Britons used iron rings and bars as money; but history fails to throw any light on its origin or manufacture among these peoples. It is only through the opening of graves, and by means of other excavations and accidental discoveries, that we know that, whether in Gaul, Spain, Germany, Britain, or Italy itself, there were periods which, though prehistoric, cannot be regarded as very remote, in which all traces of weapons or implements of iron are absent. There is nothing to justify the assumption that its use anywhere in uncivilised Europe antedates its use in more civilised Rome. Even Spain, the greatest metalliferous country of antiquity, whose Celtiberian swords of iron were adopted in the Roman army as early as the second Punic War,

presents the most distinct evidence of a native industry in copper and silver, and the knowledge of bronze, before the discovery of iron.

The Phocian colony of Marseilles, founded about six hundred years B.C., possessed iron-mines in Spain, and manufactured weapons from them, and it was perhaps through this circumstance that the Gauls became acquainted with its use at a very early period. When first subjugated by Rome, they excelled in its working, and the industry was held in such esteem that only freemen, who formed an important corporate body, were permitted to exercise it, and these were buried with their implements, as warriors were buried with their arms. The excavations at Bibracte revealed a town given over to the working of metal where all the buildings round the *oppidum*, or centre, were smithies or foundries; in which gold, bronze, iron, and even steel were manufactured, and the surface-decoration of metals carried to a point that has hardly been surpassed. The magnitude of the iron industry is shown in the extent of the mines, which excited the attention of Cæsar, and in the prodigious quantities of slag used in the Roman roads. Tinned iron vessels, the *incoctilia* of Pliny, were imported to Rome from Gaul, Alise being celebrated for the industry, as well as for coating iron with gold and silver, so that it was difficult to recognise the original metal. The beautiful swords discovered at Alise differ remarkably in weight and ornamentation in every specimen, and are masterpieces of the smith's art, fashioned by the hammer and smoothed and polished by grinding. The associated iron scabbards are smooth on one side, and richly ornamented on the other with dotted and lined, wavy, and trellised patterns, and even with animals like those on Gaulish coins. It was on the trappings of their horses and chariots, however, that the Gauls lavished their choicest metal-work, and Pliny states that at Bourges, which rivalled Alise, chariots, at first only plated with tin and silver, came to be entirely gilt and decorated with beaten gold ornaments. A beautiful iron mask is a fine example of embossing, but still more remarkable is

the claim by Liger that he has detected traces of enamel on iron, and that the Gauls and Britons, as well as the Romans themselves, were able to cast in iron. That so high a degree of technical skill should have existed in a nation whose history is a blank, and whose swords in the first half of the fifth century B.C. were so soft and flexible as to lead to their discomfiture by Flaminius, is almost incredible.

The skill of the Britons in metallurgy was probably little inferior to that of the Gauls, and slag-heaps with Roman coins have been found in such widely separated localities as the Forest of Dean, Sussex, York, and Oxfordshire. Cæsar narrates that iron rings passed as currency in both Gaul and Britain. But the most surprising, and most likely exaggerated, statement as to the use of metal in Britain is by Pomponius Mela, who says that the army of Cassivelaunus included four thousand chariots armed with scythes, and a cavalry armed with shields, swords, and spears. It appears that during the Roman occupation large ironworks and an arsenal were established at Gloucester, and in other towns near to where ores were smelted.

The metalworking of Gaul no doubt passed to the neighbouring Franks and Goths, and from the similarity of the ornaments on the swords and scabbards found at La Têne, Tiefenau, and Hallstadt, its influence must have extended eastward as far as Tyrol. The fragments of war-chariots and ring armour discovered at Tiefenau, near Berne, seem actually of Gallic manufacture.

That the arts of Gaul were also carried by the Goths into Denmark and Scandinavia, in the Iron Age, appears no less likely. In that new home they were again subject to the influence of Roman art, which penetrated by peaceful barter *viâ* Gotland, where thousands of Roman and Byzantine silver coins have been found. Reference to the Danish and Scandinavian handbooks shows how rapidly classic emblems and forms became assimilated and transfigured by an intensely superstitious race. The drapery, laurel wreaths, and inscriptions, which seemed to them meaning-

less, became snakes, birds, and quadrupeds, and other symbols of deep import in pagan hieromancy: grafting on the ancient art a set of forms and devices which, though constantly modified, were not departed from until the adoption of Christianity in the eleventh century.

In those inclement climates, in which it may be supposed man did not take up his abode until driven to it by overcrowding in more genial lands, all is so relatively recent that we get a perfect conception of the development from the Stone into the Bronze and the Iron Ages, the latter being supposed to hardly antedate the conquest of Gaul. The custom of depositing the most valuable possessions and the spoils of war as gifts to the gods, in lonely bogs, where they became safely enveloped in the preserving folds of peat, has made Scandinavia and Denmark one vast storehouse of antiquities. Moreover, the warriors of the Iron period were buried in great state, with horses and chariots, attendants, weapons, supplies of utensils and food, and even of large wax candles; and we thus ascertain that they were picturesquely clothed and armed, immensely rich in gold, and skilled in the arts. The damascened and inlaid objects of iron have been admirably illustrated and described by Worsaae and Hildebrand, in the handbooks on Danish and Scandinavian Arts.[1] They suffice to show that the arts of ironworking, gilding, damascening, inlaying with gold, silver, copper, and tin, chasing, forging chain-mail, practised by the Gauls until lost in the fall of the Roman empire, were preserved and developed by the Goths of the north, who remained hemmed in and isolated by the sea, while the rest of Europe was one vast scene of battle and conflagration. Restless and tired of inactivity, this fierce people, turning at first into mere pirates, became intoxicated with the spirit of adventure, fanned by the sagas of their bards, until their whole manhood poured out as the dreaded Vikings, to devastate and ravage the coasts of Europe and Britain; but reintroducing, at the same time, forgotten arts which were destined to influence the course of ironworking throughout Europe.

[1] *Danish Arts*, Figs. 231, 232; *Scandinavian Arts*, Figs. 104, 111.

III.

THE AGE OF THE BLACKSMITH.

The jewellery and weapons of the Angles, Saxons, or Jutes, who conquered Britain, show that they practised the arts of working metals to the fullest extent then common to the barbarian peoples of Western Europe. They were pagans, who beheld perhaps for the first time such buildings, streets, and cities as they were busy in ruining; but scarcely were their conquests becoming consolidated, than St. Augustine, followed by other missionaries from Rome, appeared upon the scene, and began to re-establish a Christian Church. The sacred buildings would no doubt be erected on Roman lines, just as our own missionaries everywhere build on English models; even if none of the old Romano-British churches and buildings could be utilised. The Romans themselves appreciated ironwork but little, and only used it when they needed its strength; this, however, was not the case further north, as in Gaul, where its artistic working was highly developed; nor in Britain. Though barbarian art faded in these countries on contact with that of Rome, in ironworking the conquered excelled their rulers, and Gauls and Britons may well have produced works under the Romans from which the earliest mediæval designs were taken. Unfortunately, though we are conversant with the weapons and utensils buried with their owners, in which classic models were not altogether followed, the ironwork associated with religion and architecture has perished. A few examples, believed to be of the Roman period, are preserved in provincial museums, and have been collected by M. Liger,

from whose work our illustrations are borrowed. Except in a few instances, these show little Roman influence, while they bear an unmistakable resemblance to later work, either because geneti-

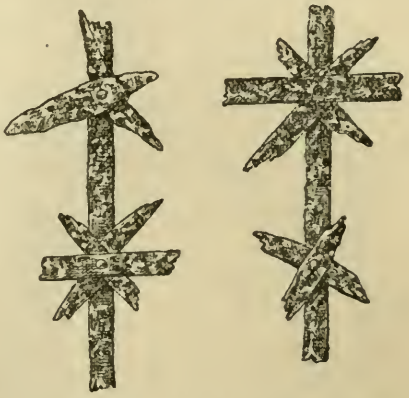
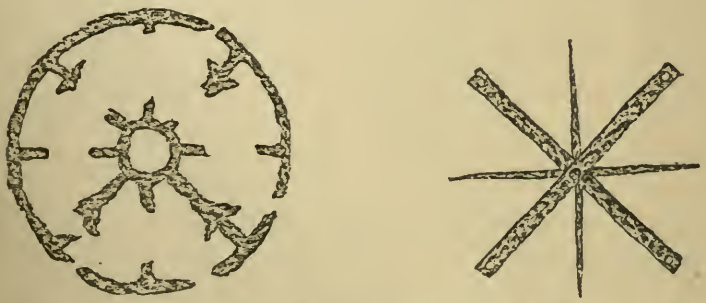


FIG. 1.—Parts of Roman window-frames found at Epinay.

cally connected, or simply that the craft of smithing produces similar results when like conditions are given. This is con-



FIGS. 2, 3.—Examples of wrought-iron window-guards of the Gallo-Roman period. In the Museum of Saint-Germain.

spicuously the case with the grilles illustrated above (Figs. 2 and 3), which show hardly any trace of classic refinement.

The resemblance in the remains of hinges, fasteners, clamps, etc., is again too close to be merely fortuitous, particularly in the

case of the clamps from Saint-Germain (Fig. 7), which, though of bronze, are evidently from an iron original. All these are

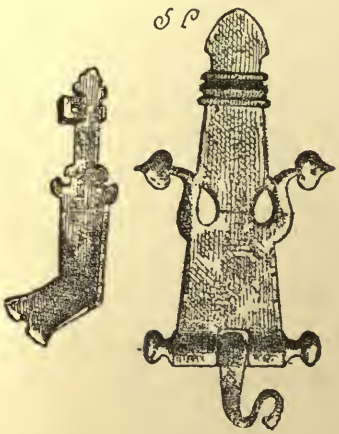


Fig. 4.—Iron hasp from Landunum (Côte-d'Or).

Fig. 5.—Gallic escutcheon of iron. After M. Liger.

probably very similar to the contemporary British work, and are of the greatest importance in tracing the development of mediæval

Fig. 6.—Iron clamps. From the Museum of Saint-Germain.

metalwork. The destruction of Romano-British ironwork, perhaps owing to our climate, has unfortunately been such that we are

unable to find more than a few examples boasting artistic merit in our own country. Excavations, such as those at Cirencester

FIG. 7.—Gallo-Roman clamps of bronze. From the Museum of Saint-Germain.

and Silchester, have been fruitful. The lock-plate (Fig. 8) and fire-dogs from Hartlip (Fig. 9) and Colchester (Fig. 10) are

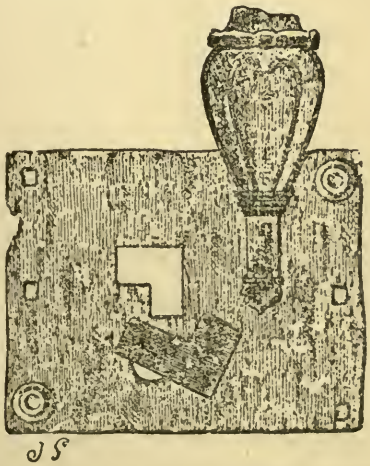


FIG. 8.—Hasp and escutcheon from the Roman Villa at Hartlip.

valuable, even though their date, like that of the iron candlestick from the river Witham (Fig. 11), is not definitely ascertained.

FIG. 9.—Roman andirons found at Hartlip, Kent.

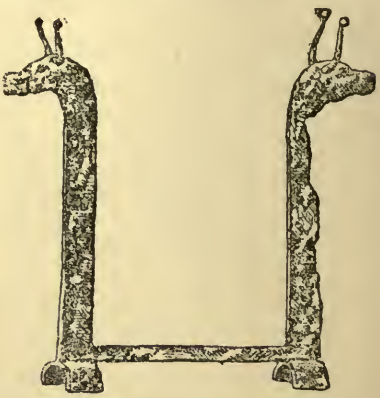


FIG. 10.—Roman andirons found at Colchester

The iron folding-chair with bronze ornaments, found with Roman remains at Ashdon, Essex, is however, a more unquestionable relic of Roman Britain.

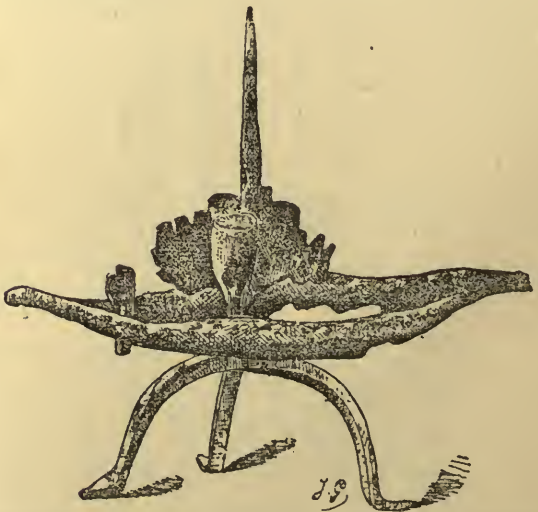


FIG. 11.—Iron candelabrum with pricket and sockets, found in the river Witham, near Kirkstead Abbey.

Celtic art had found a refuge in Ireland, where it had long been maturing into the characteristic Irish art, with its refined and easy yet intricate arabesques, derived from animal rather than from vegetable forms. Almost coincident with a probable revival of art under Roman bishops, this art, already established by St. Columba

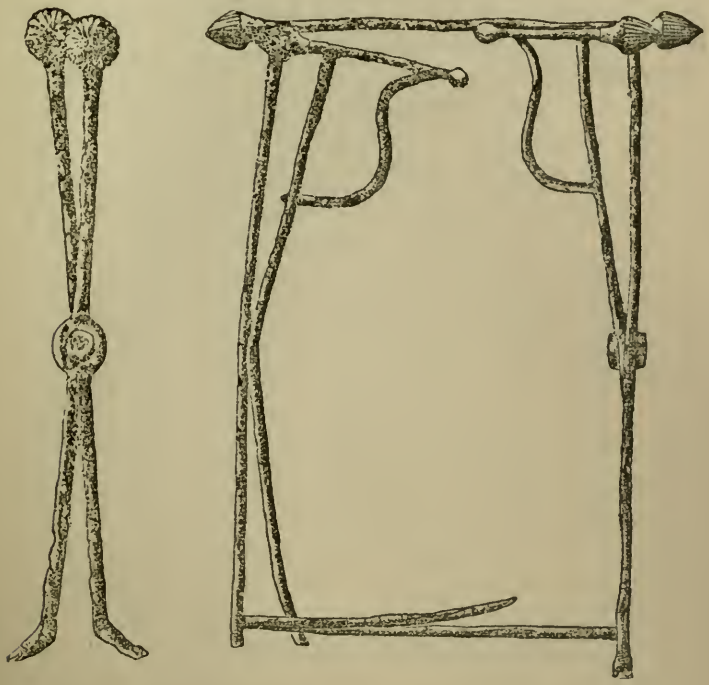


FIG. 12.—Iron folding-chair with bronze enrichments, found at Ashdon, Essex.

in Scotland, was being introduced into England from the North. Such busy prelates as the Northumbrian Aidan of Lindisfarne, 635, and St. Chad, Diuma of Mercia, 656, Finan of Essex, and the Irish monk Fursey, who greatly contributed to the conversion of East Anglia, powerfully aided the dispersion of this Irish ornament. Book, bell, and crozier were their weapons, and iron was

in little request, but the objects of gold and bronze show that the highest pitch of metallurgical skill had been attained. St. Patrick's bell, riveted and brazed together, presents an object of iron with an unbroken record of fourteen hundred years. When, later, the Roman and Irish priesthoods were in process of fusion, some of the less trammelled richness of Irish art must have been grafted on to the more formal Italian, and largely contributed to give English work its special character.

In endeavouring to form an idea of the complex origin of English art, we cannot leave out of account the fact that the whole Christian Church was united in the closest bonds in its early days of struggle. Thus Greek art no doubt reached us in the form of sacred objects from Byzantium, and, moreover, Greeks shared in the work of conversion, like Theodore of Tarsus, Primate of England from 669 to 690, whose labours, undertaken with a learned companion, gave England its intellectual eminence, and actively encouraged literature and the formation of libraries.

A close connection with Frankish art must also have been maintained, Agilbert, afterwards Bishop of Paris, holding the see of Dorchester, in Oxfordshire; while later the English Alcuin was the favoured counsellor of Charlemagne; and Erigena, an Irish Scot, was at once the most intimate and familiar friend of Alfred the Great and of Charles the Bald. England, indeed, at this time, even gave bishops to remote parts of Christendom, as Willibrod, Bishop of Utrecht, 693, and Winifred, the Apostle of Germany and Archbishop of Friesland, 738.

Late in the ninth century a still more important influence arrived to help to build up English art. The Danish Goths, who seem to have treasured and developed the arts that had passed from Gaul, began to settle on, instead of merely ravaging, the English coasts, and to fuse with the Anglo-Saxons, even, in the cases of Archbishops Odo and Wulfstan, giving primates to England. This people, who built ironclad war-ships, must, according to the sagas, have been the most expert blacksmiths the world

has ever seen, their royal princes not disdaining to work as armourers and smiths. Their weapons were of great beauty, and their swords, to which they gave names of affection that have been handed down with their own, almost objects of worship. It is unlikely that the Anglo-Saxon, who so quickly appropriated the terrible Danish axe, would have neglected to avail himself of the presence of such smiths as these, and, with the advent of the Dane, the yeast of which English ironwork was an outcome, is complete. Of the early stages of its development we know little, and perhaps never can hope to know much, but we do know that English metalwork generally stood in high repute. As the accident that Greece was the meeting-place of the arts of Assyria, Egypt, and Asia Minor, in Homeric days, led to the magnificent Greek development of art; so the convergence of such dissimilar styles into a single focus in the hands of the new and vigorous English race, appears to have led to a departure which bore important fruit. Anglo-Saxon manuscripts like the Cædmon, abound in representations of ornament of the most exquisite character, in which foliage of thirteenth-century type, derived from Greece, commonly appears, and from which it would seem that many architectural details, like the capitals and mouldings of pillars, were possibly of metal. Mr. Parker is of opinion that metalwork at this time led the way in art, and was far in advance of contemporary architecture. Indeed, in the crisply curling leaves with dotted stems bound together with bands, the twined and knotted ribbons, scales, and checkered patterns of English ornament, we seem in presence of reminiscences of a metal decoration of the richest character. In the time of St. Dunstan, gables were decorated with finials of simple fleurs-de-lis-like outline, or foliage, and turrets and cupolas bore weather-cocks of forms which tradition has handed down intact.

Nothing, however, is more frequently represented than the door-hinge, wherever any approach to architectural detail is rendered. These are usually straps, with one, two, or three pairs

of simple scrolls; but in the Cædmon MS. in the Bodleian, the types, many of which are figured in Parker's *Glossary*, are more diverse and include leafage. Sometimes a door is represented with ornamental strengthening pieces, and occasionally in English manuscripts the entire door is covered with ironwork of great richness.

No object in iron, moreover, is so frequently preserved as the hinge, so many examples having probably escaped destruction because they were closely affixed to wood, and were efficiently protected from rust by gilding or tinning, and by paint. Their removal was a tough job, presenting little temptation to the iconoclast, whilst, being useful as well as ornamental, they were rescued and applied to new doors when the old woodwork decayed. The simplest form of metal hinge would be a strap crooked at one end into a socket, which could work on a pivot fixed to the door-jamb, but even in the Roman period much

Fig. 13.—Hinge from Roman ruins, Jublains. Now in the Museum at Laval.

more advanced forms were in use. In Fig. 13 we have a strap of iron clasping the front of the door, then passing to the back

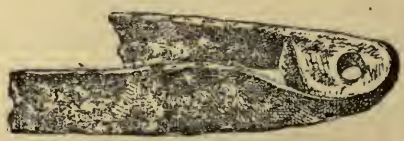


Fig. 14.—From Landunum, near Vertaud.

and bent at the angle to form a socket. This very primitive arrangement, like the curious type in Fig. 14, in which the

pivot is central and let in the slightly hollowed door-jamb, did not survive, but the strongly welded hinges with straps clasping the door both back and front, and the socket fashioned out of a lump of solid iron on one side known as the Flamand (Figs. 15, 16), is even now the best form of hinge in use. The

FIGS. 15, 16.—Found near the source of the Seine.

elaboration of these simple hinge-straps into scrollwork may have originated in the effort to cramp them over as much of the door as possible, like a bird's talon; for Northern pirates were recommencing their descents on the English coasts, and the church door might at any moment be thundered at by hordes intent on pillage and slaughter. One of the most resisting, and therefore prevalent forms, appears to have been a triple strap, the centre straight, and the lateral curved like the horns of a crescent. Its triple form was perhaps regarded as symbolic, but the springing of all three straps being behind the stonework when the door was closed, made it particularly difficult to wrench off. The ends of these straps are often beaten into scrolls and foliage, whose fashion is an indication of age, which the form alone fails to convey. Sometimes one or two additional crescents spring from the central strap, or are butted on to it; in fact, for two or three centuries the ingenuity of the smith was exercised in inventing variations, in which relative rudeness and plainness afford no guide to age. A Saxon carving from Selsey, now in Chichester Cathedral, represents the crescent hinge with split and scrolled ends, but without the centre strap, and dates back to very early in the eleventh century. It does not appear to be derived from the horseshoe, a form sometimes used in homage to St. Martin, the patron of wayfarers.

Two or three of these hinges were used to each door, and further strength was generally gained by the use of bars and straps between them. When space permitted, the central strap took an elaborate form, often a richly scrolled cross. But it is obvious that, however the planks of a door might be clutched by external hinges, the woodwork could be burst in, unless bound together from the inside. Doors must have been so strengthened from an early date, and in the hands of accomplished smiths, this defensive plating no doubt assumed an elaborately ornamental character. When the wood required renewing in later times, this decorative system of interior armour-plating has sometimes been transferred to the outside as ornament.

The frequent occurrence of mystic figures, of ruder character than the ornament with which they are associated, appears to come from the Danes. An early and grim association in the popular mind of the Danes with hingework began when their skins were nailed to the church doors—a custom perpetuated by stretching dressed skins of scarlet hue over the wood and under the tinned or gilt ironwork, to enhance its decorative effect. The Danes scarcely abandoned their superstitions when converted to Christianity, so readily as the Anglo-Saxon; and church doors are sometimes found, not only decorated with hingework, but profusely covered with pagan emblems and signs, perhaps intended, as when the Romans fixed nails on their doors, to dispel evil. The two most interesting specimens extant are at Stillingfleet in Yorkshire (Fig. 17), and Staplehurst in Kent. The former had two crescent hinges ending in serpents' heads, and an interlacing rope-like strap, together with a Viking's ship, two human figures, a swastika, and other signs, some of which, with the sails of the ship, have now disappeared. The door is a rich specimen of Norman work of about A.D. 1145. The Staplehurst example is similar, but the arrangement is more confused, perhaps because the work has been removed from a round and refixed on a pointed doorway. The hinge is of the crescent type, with diapered

FIG. 17.—Hinges, etc., at Stillingfleet Church.

surface, but with a disconnected centre strap and reversed crescent at the end, terminating in the usual types of serpents' heads; and the ornaments still comprise a Viking's ship, fishes, a goose, sea-dragon, snakes, crosses, and other objects of deep import, the whole recalling the ornament on the golden horns figured by Worsaae in his handbook on Danish Art. Though the existing door is now but partially covered, the original door probably resembled those peculiar to Denmark and Sweden of later date.

A door at Skipwith, not far from Stillingfleet, furnishes a rare example of a defensive lining of geometric design formed of intersecting circles, with crosses and knotted swastika-like ornaments in the interspaces. A still more remarkable geometric treatment exists in a Romanesque doorway at Hormead, near Buntingford, and consists of a rich border of small scrolls enclosing two nearly square panels, filled with geometric ornament made up of segments of intersecting circles (Fig. 18). The lower ornament had four dragons and some scrolls in the interspaces, which disappeared about forty years ago, and above the upper one is the reminiscence of a Norse sea-dragon. The great north doors of Durham Cathedral seem to have been entirely covered with vertical bands of the same ornament produced by the intersecting parts of four circles, studded with nails, the marks of which are distinctly visible through the paint. One of the most ancient examples of the crescent form of hinge is at Willingale Spain, near Ongar, in a plain and very early arched doorway, in which Roman tiles have been used (Fig. 19). The hinges are sturdy, the junction of the straps is far behind the door-jamb, as in all old examples in England, and the crescents end in peculiar dog-like heads, flat and in profile. Between them is a narrow strap, bordered with a frill of scrolls welded to it, and swelling out between the scrolls where the nails are driven. Above and below both hinges were straps of the same kind, arranged in threes, with the points converging, forming, when perfect, four great figures like the Government broad arrow. The door is bound

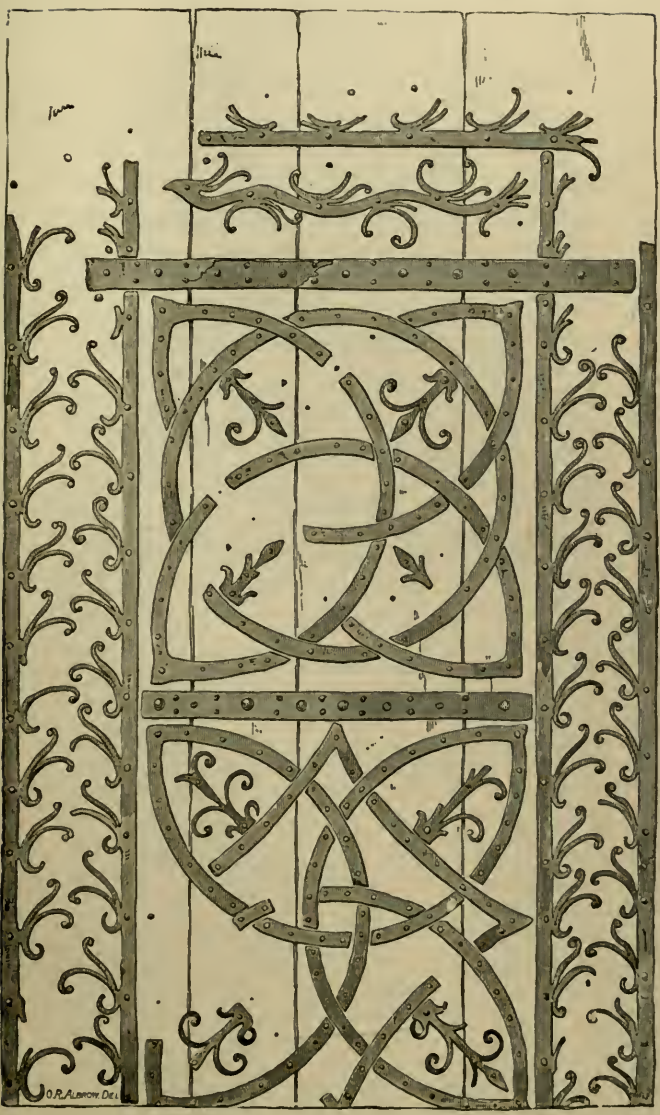


FIG. 18.—Disused door to Hormead Church.

FIG. 19.—Church-door hinge at Willingale Spain, near Ongar, Essex.

round the edges, and the handle encircled with the same frill-like ornament, and wherever possible the surface of the iron is enriched with a cross-hatch diaper. A much richer example of the same type, and only a very little later, is preserved on the double doors of the north entrance to St. Magaret's, Leicester. Its salient feature is, as at Willingale, the javelin-like straps, set horizontally and obliquely between the hinges. Where not ending in spear-points, the straps finish in serpents' heads either beaten in flat profile or modelled on plan, and the whole has been diapered as at Willingale. This work had been removed from an older door and applied to the present one in the fourteenth century, when some later work was added. The fact of so much of the archaic ironwork having been preserved and utilised in the fourteenth century shows, as we shall presently see, that the art of working it into intricate forms had vanished. An aberrant example exists at Edstaston, Shropshire, where crescents face each other at both ends of the hinge-straps, with subordinate ornament recalling other heavenly bodies. Another fine example in which the binding and strengthening straps are perfect, is preserved at Hartley, Kent. Here the central hinge-straps pass across three crescents, the lower of which end in dragons' heads in relief and on plan, and the rest in various scrolls and fleurs-de-lis. Some of the diversity may be due to repairs, and the iron has been rearranged. Other well-known examples of early date are at Erith, Maxstoke, Westcott Barton, Margaret Roding, Compton, Norton, etc., and later ones in Gloucester and Hereford Cathedrals, comprising strengthening pieces with singularly bold trident-shaped ends, which seem peculiar to the West; and in Peterborough and Chichester Cathedrals, which betray slight indications of the coming leaf-work. Two other interesting examples exist at the village church of Eastwood, near Rochford, Essex (Fig. 20). In one we have crescent hinges without a central strap, ending in scrolls, and diapered in the manner of the earliest examples, faced by corresponding detached crescents with fish-shaped straps be-

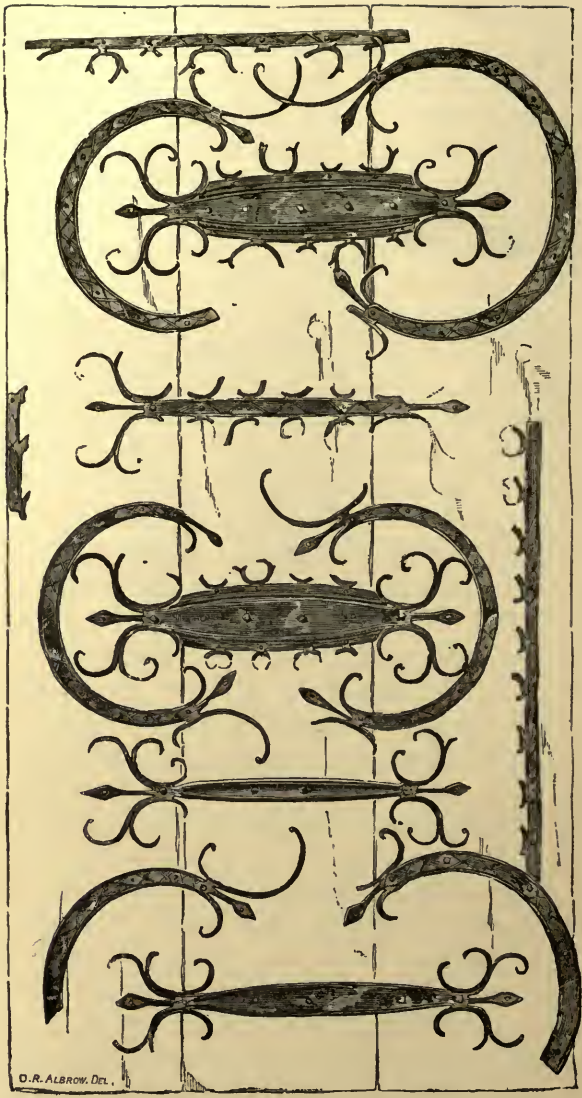


FIG. 20.—Ironwork at Eastwood Church, near Rochford, Essex.

tween them. These and other straps, as well as the binding to the door, are frilled with scrolls as at Willingale. The second door is similar, but the binding has no frilling. As in the case of Leicester and St. Albans, there are fourteenth-century additions to the latter, this time in the form of a scroll design with vine leaves cut out of sheet iron and nailed to the door. The crescent hinges with detached straps, on the door in the north aisle of Canterbury Cathedral, are very similar in fashion to those at Eastwood, and were probably utilised from an older doorway.

Some singular modifications of the crescent hinge, which are certainly not later than the twelfth century, occur in Norman church doorways at Kingston Lisle, and its neighbour, Sparsholt. In the former the reinforcing strap is like a two-headed centipede, recalling the Eastwood ones; and in the latter the crescent ends are continued into scrolls of a quite abnormal type, branching into a form that we see in Germany at a much later period.

A more typical example is that in the Early Norman doorway of Haddiscoe (Fig. 21), in which the crescent straps become almost bent into right angles, and branch profusely into scrolls on both sides. The door is almost completely covered with ironwork: a large Greek cross, elaborately scrolled, and with the characteristic open interlaced centre, occupies the middle, and a similar and much smaller cross is above it. Kenilworth Church possesses a similar example, but spoilt by restoration; and there are less perfect examples, of the same date, at Hales, Raveningham, and several other places, specially in Norfolk and Suffolk.

Reference to ancient manuscripts shows that the crescent was far from the only type of hinge in use. Another consisted essentially of a stout central stem, branching into scrolls, often mingled with foliage. Some remarkable examples of these (Fig. 22) were till recently on the doors of St. Albans Abbey, two of which are now in the Museum. They each consisted of six much-convoluted scrolls, springing from a main stem, with zigzag lines over the surface. In one design a very eccentric and stiff serrated leaf,

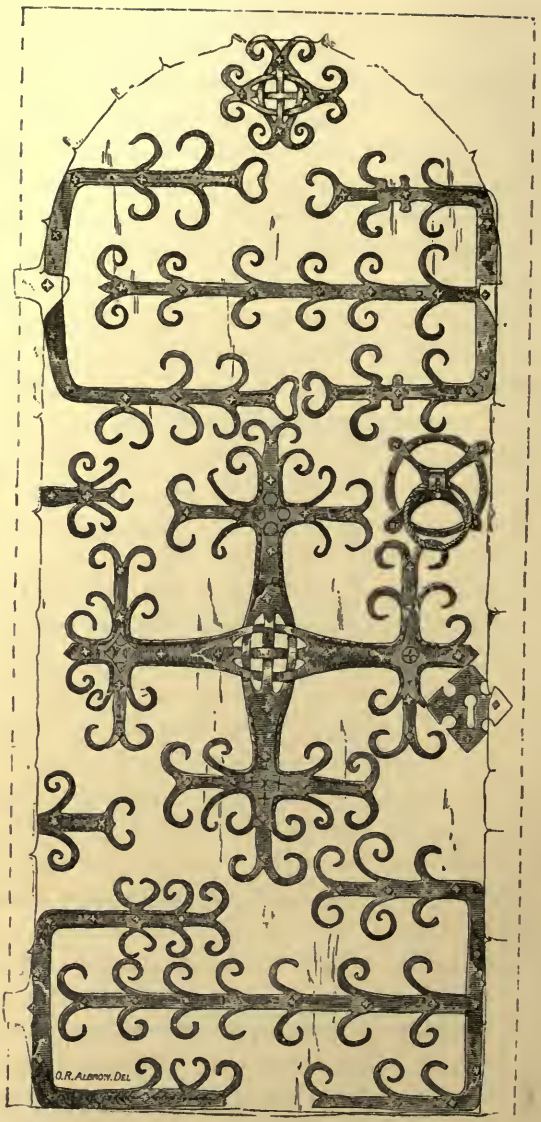


FIG. 21.—Hinges, etc., to Haddiscoe Church.

with incised venation, occurs on either side, and the scrolls end in rudimentary leaves; and in the other they end in ordinary dragons' heads in high relief, except two, which are in profile with distended jaws. The doors on which they occur date, the one from 1160 and the other about 1190, but their design looks very ancient, and they may, like so many others, have been utilised from older doors.

FIG. 22.—Hinge from St. Albans Abbey. Now in the South Kensington Museum.

With the Norman Conquest, the pressing need for defensive armour-plating to church doors passed away, and the mystic, almost hieroglyphic, treatment of the hingework did not long survive in England. In remoter Denmark and Sweden it found a congenial home, and there hingework is for the most part rude and uncouth, though greatly elaborated. Several examples have been figured in the *Oeldre Nord Architectur*, but it is difficult to place them in any chronological order, unless dated. Styles and

fashions penetrated so slowly in the past, that it is impossible, without great local knowledge, to predicate the date of any work from its style, where the style is not indigenous. Thus, until within

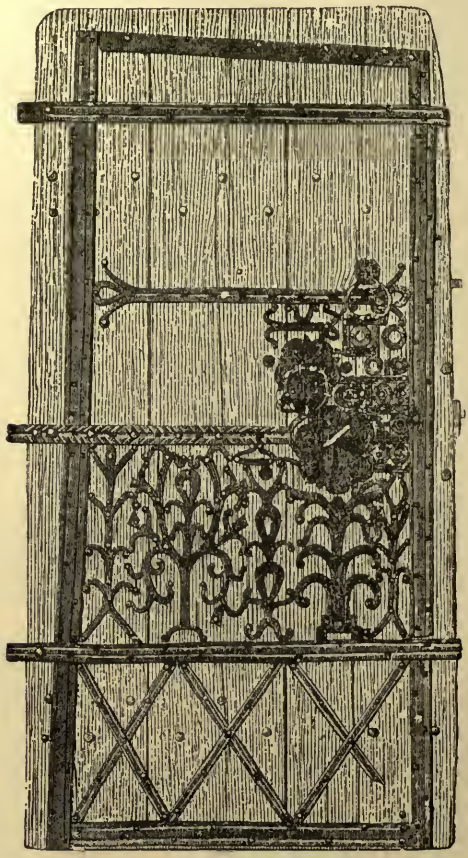


FIG. 23.—Ironwork on a door from Vanga Church.

the last fifty years, the embroidery and wood-carving of Iceland scarcely differed in style from the Bayeux Tapestry; and the iron-work of Denmark, outside the capital, underwent little change

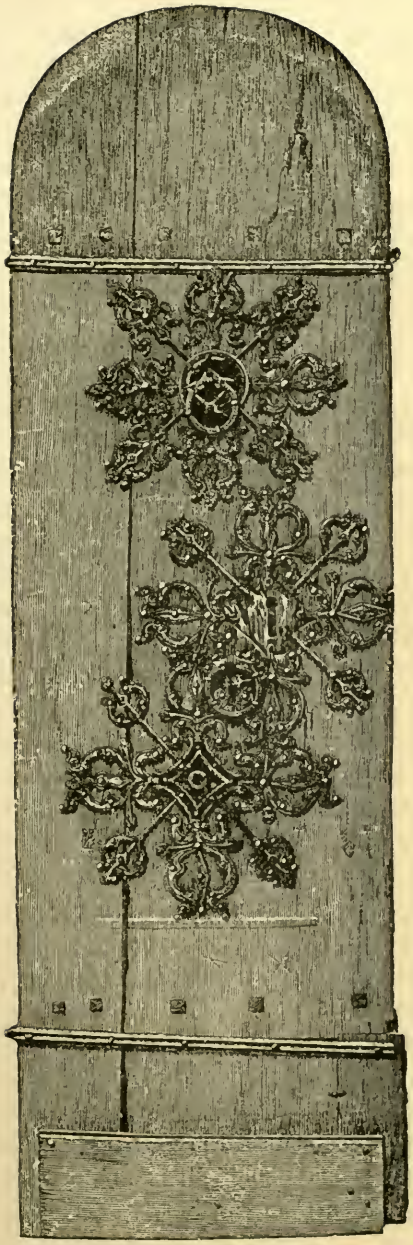


FIG. 24.—Door of Faabergs Church.

until far into the seventeenth century. None of it was defensive, nor very early. That on the granite church of Gronboek, in Jutland, is slender, and appears to date from the fourteenth century. The round-headed doors of Skoneberga, in Sweden, are divided into transverse panels with a border, closely filled with diapered ornaments, crosses, scrolls, an arcade, and the knotted cord of Stillingfleet. Another Swedish door is divided by fleurs-de-lis headed straps into six panels, filled with the date 1489 in black letters, punctuated with men, fish, two-headed eagles, dragons, etc. Others, like Redsted Church, recall hinges from the south of France ; whilst others, again, have a more German aspect. Sometimes the treatment is very plain, and the hinges on one of the most richly carved wooden doorways in Norway are like our most simple fifteenth-century straps. Examples seem to be very numerous and varied, and would deserve careful study, reproducing, perhaps, the spirit of many a design that once existed here, of which there is now no trace. Our two examples are taken from Du Chaillu's *Viking Age*, and represent a door (in the Stockholm Museum) from Vanga Church, in Ostergötland, and that of Faabergs Church, nine feet high, of a type that is extremely rare.

Byzantium and Rome having used little iron in architecture, we look almost in vain for decorative ironwork wherever their styles prevailed in Europe. Doors to the more imposing buildings in France and Germany were in bronze, in the Italian and Greek fashion, or in its substitute, carved wood. Owing to the influence of such great Englishmen as Boniface, the apostle of Germany ; Alcuin, the preceptor of Charlemagne ; and Erigena, the counsellor of Charles the Bald, English fashions may, however, have prevailed in places, and something like English hinges are occasionally represented on doors in Frankish missals of their date. Whether judged from these or from existing specimens, ironworking, whilst it flourished in England, seems to have been in France of the simplest kind. It had no place in the great art revival emanating from Cluny, and no decorative ironwork appears

in the accounts of the building and furnishing of the Abbey of St. Denis, by Suger, 1137–1140. That the earliest designs were derived from England seems clear, since they are all based on the crescent form. In Normandy we find the true English form at St. Lo, and there were remains at Foulebec of some rude work of the Haddiscoe type. But in appropriating our form, they failed to recognise that its value lay in keeping the springing of the crescent and central straps at the very base of the hinge, where the junction would be protected by the door-jamb. Probably on account of the great difficulty in forging it so, we either find the lateral straps forming the crescent, stalked far forward from the butt, and the central strap omitted; or the latter was detached, and became a mere ornament. France at this time consisted of seven or eight independent provinces, differing radically in race and language, and each possessing its own style of architecture, founded more or less on existing Gallo-Roman buildings, or on ideas imported from the East. The distinctions in style are particularly apparent in the doorways to the churches, and it is impossible, according to Viollet le Duc, to confound a Romanesque doorway from Champagne, for example, with one from Auvergne or Poitou. Very little is known of the ironwork of some of these provinces; but, as far as we can see, it differed but little, as if it had spread from a single centre of origin. The hinges and the strengthening pieces, instead of being divided into single pieces as with us, are subdivided into numerous small separate pieces fixed to the doors, and forming a more or less geometric arrangement of small detached ornaments, in which the crescent predominates. Moreover, these pieces, instead of being solid, as with us, are very generally forged or pierced into open-work patterns, like lace, producing a fantastic effect, very foreign to the quality of strength. That the art remained exotic is shown in the fact that, except the cross, the forms had no meaning, either as to strength or symbolic derivation, and neither animal nor even vegetable forms are ever introduced. No meaning attaches to the complex designs, and

we can only regard them as sports from an original stock, which developed no further. On the cathedral doors of Angers, the pieces are placed in random patterns over the doors. In Champagne we again meet with the same small detached crescents and straps, with much piercing, arranged in patterns, with many smaller scrolls. The finest example is at Pontigny (Fig. 25), but the style penetrated to the borders, at least, of Burgundy, at Montréal (Fig. 26), and Chablis; and to distant Cologne, in the Church

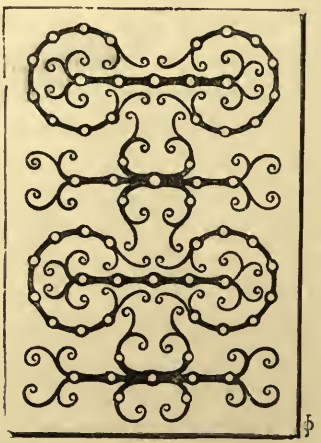


FIG. 25.—From the Abbey Church of Pontigny.

of St. Ursula. Examples, however, are most numerous in Aquitaine, a fairly consolidated kingdom in the eleventh century; and especially in the district of Auvergne, where the churches have not been rebuilt. There are examples at Le Puy-en-Velay, St. Julien de Brionde, Orcival, Auzon, Champagnac, Frugères-le-Pin, St. Georges-les-Alliers, and many villages; all associated with Romanesque doors, and probably as old as the twelfth century. Outside the borders of France, in Alsace, we meet with a single special development. The hingework of the Abbey of St. Jean-des-Choux, splendidly illustrated by César Daly, in the *Revue Générale*

de l'Architecture, is of the richest description. It consists of three bands on each door, each composed of a crescent and a circle of broad iron with upturned edges, between which an intricate filigree pattern is enclosed; like contemporary goldsmiths' work. The horns of the crescents end in a usual Frankish tongue between two scrolls, while other scrolls with similar ends are included, not only within the circles, but in the spaces between them and the crescents. The peculiar twelfth-century hinge figured by Viollet le Duc from Schlestadt, also in Alsace,

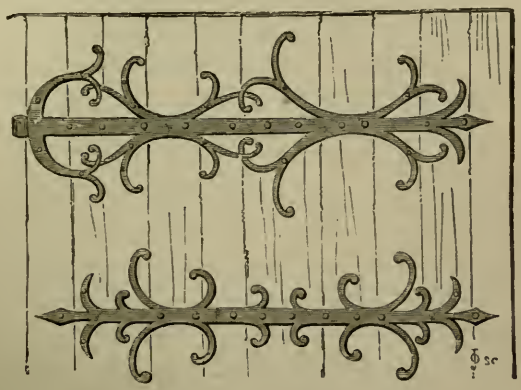


FIG. 26.—Hingework at Montréal, Yonne.

is clearly derived from this example, and we find the crescent and circle reappear near Brunswick a century later.

The rise of laic, as opposed to monastic architecture, which commenced, according to Viollet le Duc, in the Royal Domain, led, perhaps, to a more simple and restrained treatment of the hinge. Examples of such are rare, as most churches of importance were rebuilt or greatly altered during the birth of Gothic architecture. There are some refined crescent hinges, with detached straps and foliated ends, at St. André, Chartres; interesting from their likeness to those on the door of the north aisle of the choir at Canterbury Cathedral, which may have

been inspired by a French architect. From indirect sources, such as representations on carving, stained glass, etc., we gather that in France proper—and perhaps we may add in the provinces in which Byzantine and Oriental architecture was the model—iron-work was very simple, the strap with diverging scrolls and the crescent being used indifferently. But towards the end of the twelfth century a new and beautiful style of work was introduced in Le Berri and parts of Auvergne, examples of which are figured by Le Duc and others, from Neuvy-Saint-Sépulcre, Levroux, Le Puy-en-Velay, Orcival, and Ebreuil. In these we find the hinge-straps and scrolls no longer scored with a graver or chisel, when ornamented, but moulded under the hammer; and this particular type is characterised by the constant repetition of a tongue between two unequal scrolls, for every termination, and a tendency to geometric arrangement. This ornament is commonly met with in France on carving, stained glass, embroidery, etc., as on Becket's robes and mitre; and it is already discernible on some French hinges in a manuscript (Cottonian MS., "Nero," c. iv.) assigned by Parker to about 1125. We have a splendid example of this work on the north aisle door of Durham Cathedral (Fig. 27) leading to the cloisters. It so closely resembles the French hinges in every detail, and is so unlike anything else in England, that we must regard it as a French production, especially as it is in detached pieces, not welded together, but merely nailed separately to the door—a peculiarity never seen in English work, but common in France; and which would in this case have facilitated its transport. The doorway is regarded as dating from about 1135. The hinges are of the crescent type, with a large double scroll springing on either side from near the end of the strap. Between the hinges is a beautiful and uncommon diaper of large intersecting lozenges, interlacing with a cruciform design of scroll-work, similar to the scrolls of the hinges, but on a reduced scale, and producing a rich effect. There is a consensus of opinion in France that the French were capable of producing this

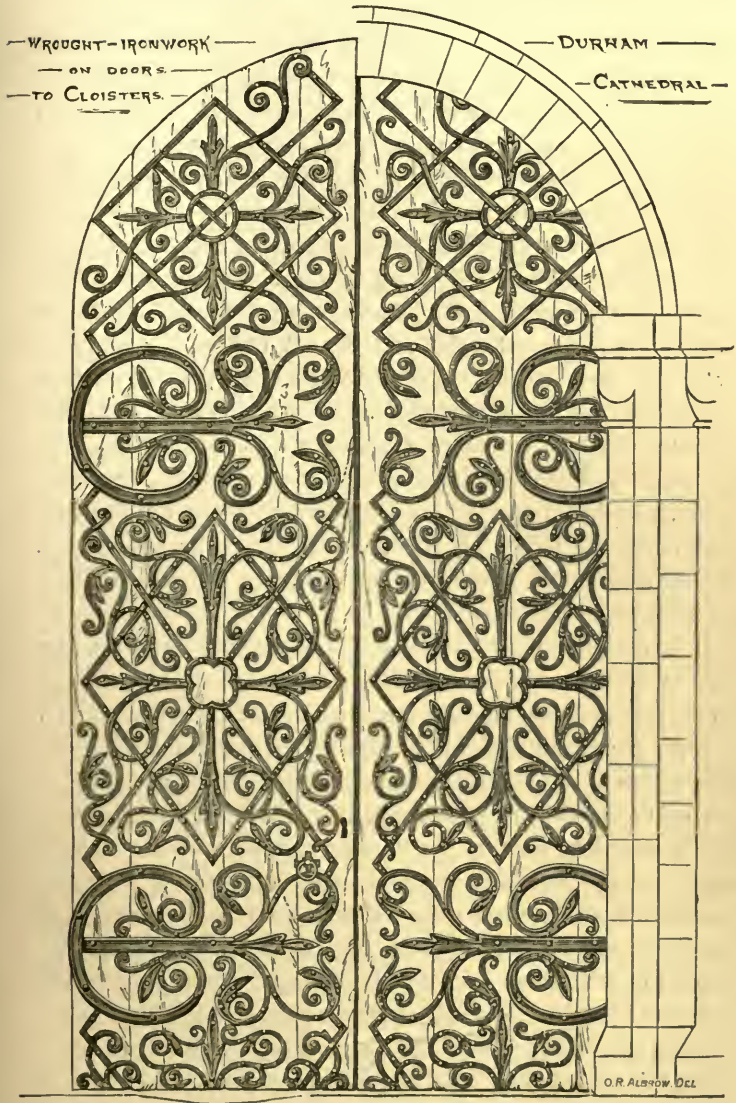


FIG. 27.—Ironwork on north door of Durham Cathedral.

modelled work from quite early in the twelfth century: and its foliated work, beaten in relief with deeply grooved stems, was undoubtedly the precursor of the magnificent stamped ironwork so intimately associated with the vast cathedrals, planned and erected between 1180 and 1240, in the Royal Domain of France. With the exception of some hinges at Ripon, this remarkable specimen appears to have had no influence on English work, and down to the introduction of pointed architecture, English ironwork was scarcely influenced by the Norman-French. The salient features of the English work were strength, independence of architectural style, and designs dictated by necessity or derived from symbols, embellished with ornament taken almost exclusively from the animal world. It is a significant fact, that although Norman craftsmen supplanted ours in every other industry, so that the English names for mason, painter, carpenter, joiner, plumber, tailor, etc., disappeared, this was not the case with either the smith, his tools, or the metals he used. The merely mechanical branch of the craft, the farrier's, is alone associated with his Norman rival.

It is difficult to say whether grilles of scrolled iron were first used in English or in French abbeys and cathedrals, for there are no illustrations implying their use previous to the twelfth century. Though the term "chancel" implies the presence of a grille, the simple plan of early churches would have precluded any extensive use of them. We find, however, that metal grilles of simple design were used even by the Romans in doorways; and as railings in temples, amphitheatres, and public buildings. The earliest instance of a Christian grille is of pierced bronze, repeating the Greek cross within a circle, separating the Church of the Nativity at Bethlehem from the underground crypt or cave, and may date back to the fourth or sixth century. A bronze grille of open scale pattern with the Latin cross, exists in the crypt of Sant Apollinare in Classe, at Ravenna, and is of the sixth or seventh; while the fine bronze grilles to the triforium at Aix-la-

Chapelle date from the ninth century. Some of the doorways and windows of St. Mark's, at Venice, are closed by bronze grilles; and there are many references to grilles of bronze in early writers, and even to the existence of silver grilles at Rome and Constantinople; but the divisions in the interior of basilicas were ordinarily low, and of stone or marble. The fully developed Norman cathedral, with its shrines and reliquaries of precious metals, first necessitated an extensive use of grilles to enclose the choir, and, later on, the added side chapels. The requisite strength and translucency could best be obtained by the use of iron.

No earlier type is known than that at Winchester, which dates probably from 1093. The north of France and Normandy possess none which can claim so great an antiquity, and only at Le Puy do we find one ascribed by Le Duc to the twelfth century. From its richer style, dotted as it is all over with punch-marks, and its greater lightness, it should be the later of the two. Those in Spain of the same style are situated within a triangle to the north of Madrid, and cannot, from the date of the buildings, belong to so early a period; they were perhaps introduced with French architecture.

The Winchester example (Fig. 28), though now reduced to a mere patchwork of fragments against a door in the nave, formerly protected St. Swithin's shrine, and was fixed so as to exclude the pilgrims from the choir, south transept, and nave. It is constructed of groups of C-shaped scrolls, which are elongated so as to admit of a grouping by threes, one within the other; two bundles of three scrolls are strapped together back to back by iron ties, and the interstices are filled with smaller scrolls. The ends of the C scrolls are forged into an open cinquefoil cluster in part of the grille, and a trefoil in the remainder. In the latter the heavy effect produced by the six or more thicknesses of iron bound together is overcome by thinning them down and welding, by which greater transparency is obtained without any sacrifice

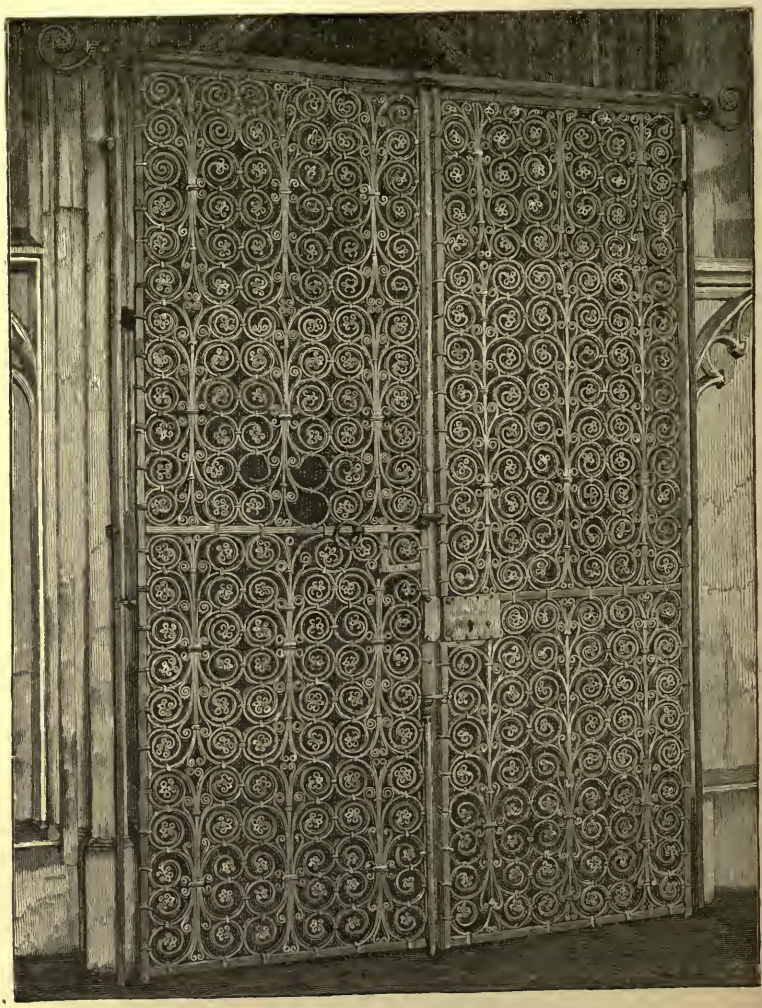


FIG. 28.—The St. Swithin grille, in Winchester Cathedral

of strength. In Spain there is a grille in the north aisle of the Romanesque Church of San Vicente, at Avila, near Madrid, which

has the same cinquefoil clustered termination. A door to the Capilla de Santa Cruz, in the cloister of Pamplona Cathedral, is a better known example of the same type, and has been described by Street. It dates from 1212, and is said to have been made from Moorish chains. Another exists in the so-called Reja Arabe de la Capilla del Sagrario in the cathedral of Palencia; and windows in the façade of N. Sra del Mercado, at Leon, are grilled with similar ironwork. A peculiarity which distinguishes this type of grille, and gives them a singular resemblance to each other, is the number of whorls into which the scrolls are worked, and the persistent way in which, whether large or small, their final terminations form small but complete rings. There can be no doubt about these and the Winchester grille having a common source; notwithstanding that only one of the kind exists *in situ* in France, at Le Puy-en-Velay, in Languedoc. This is the grille just alluded to, on the west side of the cloister, and has been figured by Viollet le Duc and by Gailhabaud. The finest, and probably latest, specimen of the type, however, has been broken up, and pieces, especially one of them, converted into a fire screen, have been figured by many authors. It forms a rich arabesque, like old Venetian point lace, with the scrolls gathered into thick masses under the collars. Two superb panels (Fig. 29) have been acquired by M. le Secq des Tournelles, who exhibited them at the Trocadéro, when they were assigned in the catalogue to the thirteenth century. He states that they came from the great Abbey of Ourscamp, in Picardy, ruined in the Revolution; in which case they may be of the date of its reconstruction, 1201.

A more simple and probably rather later type is seen in the choir grilles at Lincoln (Fig. 30), which, though disfigured by a modern cresting with gas-burners, are still the most perfect of their kind existing. They are composed of a massive framing divided into panels of the whole height of the screen, filled in with a multitude of small C scrolls tied together in pairs. A small pierced sheet-iron border of quatrefoils forms a base, and, as in all

FIG. 29.—Part of a panel said to be from the Abbey of Ourscamp.

screens of this type, the cresting must have been a simple arrangement of spikes for defence. Canon Venables points out the identity between them and some of the screens closing the circular choir of the Dome of the Rock at Jerusalem, which must have

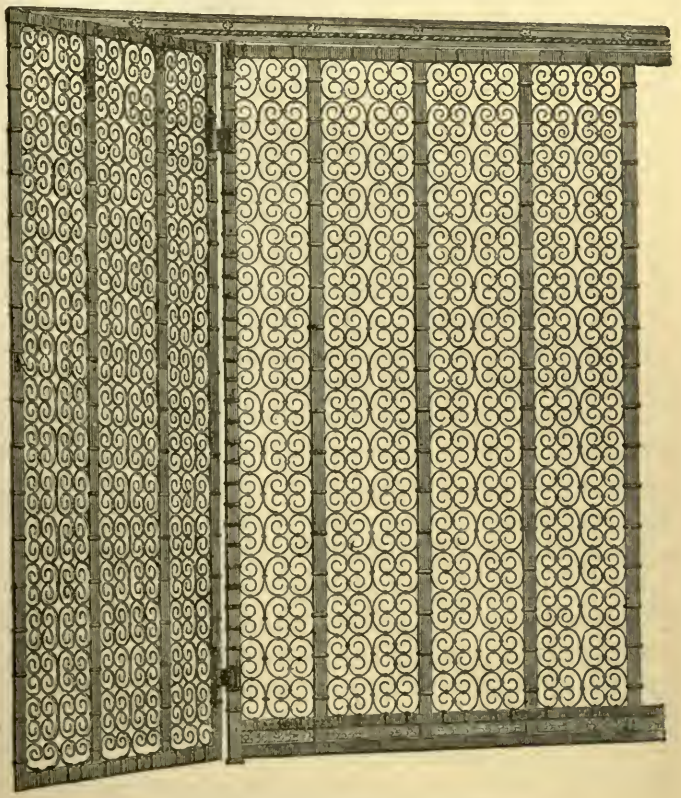


FIG. 30.—Part of the choir grille in Lincoln Cathedral.

been erected by the crusading monarchs between its capture in 1099 and its recapture by Saladin in 1187. The Lincoln example may be of similar age, since the twelfth-century choir and eastern transept, 1186–1200, must have required protection from the

beginning. The type seems to have been very popular, as a picture in the Louvre, by Jean Jouvenet, shows that all the chapels behind the *maître autel* at Notre Dame, Paris, were closed with grilles of this kind; and another is shown in an old view of Arras Cathedral, securing the altar and reliquaries. The destruction of old church grilles in England has been almost complete, not a vestige of any remaining in the Cathedrals of York, Durham, Chester, Peterborough, Ripon, Lichfield, Norwich, Worcester, Hereford, Gloucester, Exeter, Manchester, Bristol, Carlisle, nor in any of the great abbeys or churches. A fragment shows that St. Albans once possessed such grillework, and the grilles to St. Anselm's Chapel in Canterbury Cathedral are late survivals of the type. In France the change of fashion under Louis XV. was even more destructive, and the only choir grilles of the kind remaining are at St. Germer, near Beauvais; though there are fragments preserved from St. Denis, Cluny, and elsewhere. Windows at Noyon, Beauvais, and the fortified church of Béziers, are still protected by the same description of grille; and numerous specimens are to be found in the public and private museums of France. In the Cathedral of Conques there is an ancient choir screen somewhat linking this type with that at Winchester, and remarkable for its formidable spikes.

A third type of early grille is represented in Chichester Cathedral, and is distinguished by its want of symmetrical arrangement; the smith having apparently had licence to diversify the work as he pleased. These were removed when the tower was rebuilt, and for a time lost sight of. The grilles are arranged in two series of panels of small scrolls between upright bars, divided by a horizontal bar in the centre, the vertical bars of the lower and upper series not necessarily corresponding. Its chief peculiarity is that the fashion of the scrolls, particularly in the upper series, change at every few feet in an irregular manner, many of the varieties of C, E, S, and other scrolls being unknown elsewhere, so that it was a perfect storehouse of design.

Fragments of it have been figured; but the only considerable drawing is by Mr. Chas. Baker King, of a piece as it stood in a builder's yard in 1872.[1] Some of the scrolls terminate in rude stamped rosettes—an obvious foreshadowing of the highly enriched grilles of the next century. A fine grille of the same irregular kind, and of early thirteenth-century date, is figured by Gailhabaud from St. Aventin. A later variety, in which the frames are filled with scrolls, welded in pairs to short detached bars with slightly beaten ends, is to be seen in the museum at Auxerre, and in the Porte du Cimetière at Cravan, Yonne.

As we reach the thirteenth century, we see the older diverse elements fusing into one definite style, and, as Romanesque and Norman pass to transition, the unlimited freedom of the smith is curtailed. The birth of Gothic architecture, with its scientific construction and refined ornament, is reflected after a time in the increasing grace and elegance of the ironwork. The need for defence had passed away; Celtic, classic, and Oriental have merged; and the traces of the Dane are barely discernible with us in the occasional dragon or grotesque monster. A rich system of easy-flowing, yet elaborately foliated scrollwork was the first result. One of the most beautiful examples, and probably the earliest, is preserved in one of the entrances to Worksop Priory. It lines the doors, unconnected with the hinges, and completely covers them with its graceful scrollwork. The leading scrolls take bold sweeps, forming six nearly complete circles, which are filled with the lilies and scrolls proceeding from their branching ends. Each leading scroll bears four twelfth-century iris flowers of varied forms, increasing in complexity towards the apex; those at the summit being as rich as any seen in painted decoration. This specimen, which is the finest of its kind, influenced a great deal of work, and there are hinges taken from it as far distant

[1] This piece has now been recovered from the hands of a marine store-dealer, and replaced in the cathedral. The drawing is reproduced in the *Transactions of the Royal Institute of British Architects* for 1891.

FIG. 31.—The hingework at Semperingham Church, Lincolnshire.

as Burford in Oxfordshire, and Abbey-Dore in Herefordshire. Another interesting and unique example of early thirteenth-century design occurs at Wells, in which scrolls spring from the hinge-straps and branch into small lozenge-shaped leaflets, while slender wingless birds, attached in pairs with flowers between them, fringe the straps. It is, of course, impossible to record in a limited space all the exuberant forms that mark the Transition. For a time they were dictated by caprice, though the ideas were probably suggested to the smith, but they soon settled, where foliage was used, into reproductions of the vine, the emblem of the Church; for which its fruit, foliage, and tendrils, its trailing, climbing, and drooping habit, pre-eminently fitted it. The vine, already highly conventionalised in Greek and Roman art, had been incorporated into Byzantine and Romanesque ornament. The form chiefly taken hold of by the smiths had already appeared in bronze on the ninth-century doors at San Zeno, in Verona, modelled in high relief, and is of the type so thoroughly familiar in Anglo-Saxon manuscripts and thirteenth-century carving. Its use in smithing seems to have undoubtedly arisen in England, for we find it in the richly worked Early Norman doorway of Semperingham Church (Fig. 31). The hinges are of the crescent form, greatly enriched with leafwork, and the door is bordered with ornaments like the hinges in miniature; while nine cruciform pieces of similar detail lend additional strength, and under the arch the rude figures of a cock on one side, and a man on the other, are still traceable. The whole effect is clumsy, but distinctly foreshadows the later work to come. A curious set of hinges is to be seen on an early thirteenth-century doorway in Market Deeping Church (Fig. 32). They are slender and of crescent shape, branching copiously into leaves beaten almost flat along one edge, and with something of the simple outline of the peascod. They are associated with rude attempts at bunches of grapes, and a couple of rude human or fiends' heads lurk among the foliage. A slightly later example, perhaps derived from it,

Fig. 32.—Hinges at Market Deeping Church.

occurs in the north aisle door at Lincoln. It consists of two strap-hinges, whose scrolls fairly cover the entire door, and form a centre with only one additional strengthening piece; the scrolls branch twice, and all terminate in a central and two recurved lateral slender leaves. There is quite as beautiful a door at Caistor, and the remains of another in the church at Hunstanton. At both Faringdon and Uffington are Early English doors, covered with rich scrollwork proceeding from their crescent hinges and strengthening pieces, which have numerous terminations in stamped rosettes; and the same stamps occur at Bisham and many other places among work of simpler design. All these are links in the development of the richly stamped ironwork produced later in the century by Thomas de Leghtone, and show that in England the use of stamps crept in gradually, as soon as the smith began to make use of vegetable forms involving much repetition.

To produce stamped work, the smith had to strike the hot iron into prepared dies, as wax is pressed into a seal; and by this means designs for ironwork could be executed with the same minute elaboration as in carving or stained glass. The secret of preparing and using steel or chilled iron dies was certainly known in England quite early in the thirteenth century, but a really lavish use of them appears to have been first made in France, where the secret must have been jealously kept; for, notwithstanding the efforts of the German and other smiths, they never acquired it. When once portions of hinge-straps were moulded in relief, the invention of stamps could not be far distant; yet we meet with nothing leading up to them in France, unless it is in the MS., "Nero," c. iv., already mentioned, and believed to date from about 1125, in which a French type of hinge occurs, consisting of a bundle of stems bound together and springing into a tuft of leaves at the end. These may, however, have been beaten out under the hammer like some of the same form at Rouen. Otherwise, as far as actual specimens go, the work suddenly bursts

upon us in France in fully developed magnificence, and seems to have been closely bound up with the earliest development of the rich pointed architecture of the Ile de France. The typical thirteenth-century vine is generally used, but another trefoil or cinquefoil vine (as in Fig. 35) often takes its place, and these are always mingled with rosette-like flowers and sometimes fruit. The lobes of the leaves are sunk, and the divisions representing the larger veins and the periphery are raised, and the stems usually grooved. Extensive use was made of it at Noyon Cathedral, in hingework for the presses, chests, and for the

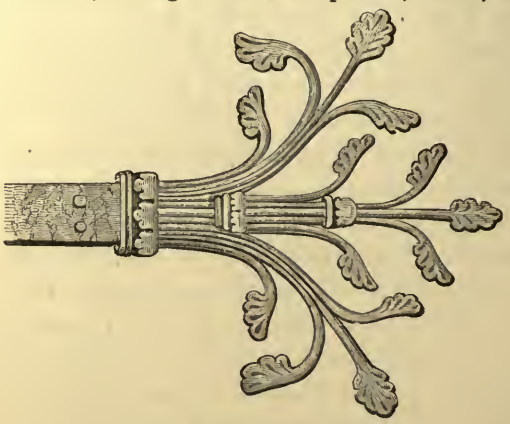


FIG. 33.—Hinge from Rouen Cathedral.

treasury and sacristy doors. In the hospital is a unique supposed paschal candlestick formed of a bunch of slender stems and leaves, charmingly fashioned into a tall open-work shaft, curling over at the summit in large rosettes and clusters of grapes. At Sens Cathedral it is used for the sacristy and treasury doors; and at Rouen for the sacristy and the north and south transept doors (Fig. 33). It was used for the great north door at Mantes and at Vezelay; and the scrolls of a most graceful grille at Braisne, near Soissons, terminate in the same leaves and grapes. Though only a low grille to one of the crypt chapels now remains in the

Abbey of St. Denis, stamped work was lavishly used there, according to Le Duc; for portions of two magnificent grilles, one almost a counterpart of our Eleanor grille, were figured by him as existing in the "*magazins*." Numerous fragments, both of grilles and

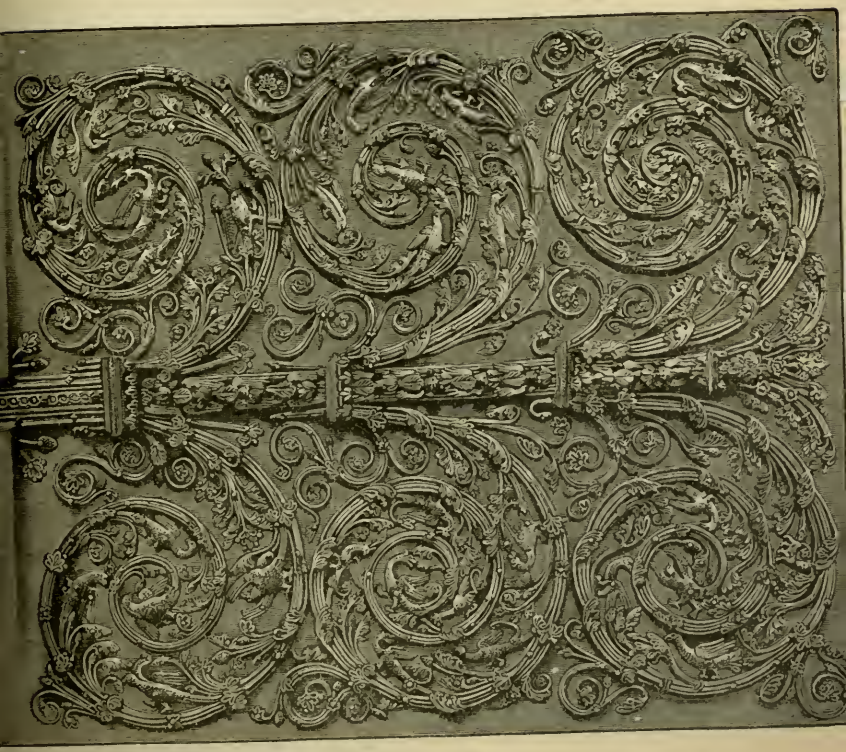


FIG. 34.—One of the hinges to the Porte Ste. Anne of Notre Dame, Paris.

hinges, exist in the Carnavalet, Cluny, and private museums, which are known or surmised to have come from the metropolitan Cathedral of Notre Dame, and in the former there is a large and perfect chest covered with hingework of the vine pattern. The work culminated, however, in the celebrated hinges still existing

on two out of the three magnificent western portals of the cathedral (Fig. 34). Each of the double doors is hung by three hinges and two strengthening pieces between, any of them being large enough to almost entirely cover an ordinary parish church door.

The work is extravagantly rich, representing, it is supposed, the terrestrial Paradise, with its foliage sheltering innumerable birds, dragons, and other fantastic beings. The stems are deeply fluted; not, as stated by Le Duc, composed of bundles of rods welded together, but with wide and deeply moulded collars or staples, and richly tufted ends in the French style. The small human heads, the quatrefoil and sexfoil centres to some of the straps, and details in the treatment of some of the leaves and rosettes, are features quite unknown in England in work of this period; but, on the other hand, much of the ornament is of the English vine-leaf and rosette type, and the dragons' heads are those of our Eleanor grille. Each hinge and strengthening piece is a separate, independently designed work, complete in itself, with little reference to its neighbour, neither interlacing nor dovetailing, nor planned to any general scale. The designs differ so considerably as to somewhat destroy the general symmetry, and, though consisting of most florid scrollwork, each piece is so circumscribed within its own rectangular share of space as to deprive the whole of the freedom so eminently characteristic of work of this period elsewhere. In spite of these defects, however, they are the grandest and most colossal work of the blacksmith of their age, yet, though belonging to the central church of the Metropolis of France, not the faintest tradition of their manufacture exists, and their date is therefore unknown. A nation which began to treasure the names of its artists in metal from the days of St. Eloi, can but ascribe this extraordinary production in iron to the devil, or to Biscornet, a Burgundian smith of the sixteenth century. The latter fable had taken such hold, however, that Mathurin Jousse, writing in 1627, regrets that Biscornet had not divulged the secret

of running iron as other fusible metals. No higher tribute could be paid than this confession by the most noted smith of the day, that he was unable to conceive that anything so rich could possibly have been forged, and that he was driven to suppose it had been cast by some utterly lost process. Nothing is really known as to where or when they were made, but several French writers ascribe them to the latter part of the twelfth century. We are inclined to regard them as not earlier than about the middle of the thirteenth century.

It is remarkable that almost all this work exists in the Ile de France, or in churches designed by architects of the Royal Domain of Philippe Auguste, and is met with nowhere else in France; even the great Cathedrals of Amiens, Chartres, Bourges, Laon, etc., being destitute of any stamped work of the kind. It lasted but a brief period, the excessive extravagance of the *magnum opus* having, perhaps, rendered all rivalry impossible. Outside France it is only met with in a single town on the continent, Liège, where it was doubtless imported. The fine hingework on the treasury door of the Cathedral of St. Paul is very similar indeed to the designs used in England; while the hinges of a press in the sacristy at St. Jacques (Fig. 35) show the cinquefoil leaf peculiar to French examples.

The distribution of richly stamped ironwork of the French type in England is rather remarkable, and the specimens are so limited in number that they might well have been the work of a single smith. Through the Eleanor grille we are able to connect them with Thomas de Leghtone, and from the similarity in the forms and stamps used we can only conclude that he had been to France, or had an opportunity of studying some typical piece of work, particularly the grille at St. Denis, which resembled so closely the one he made for Westminster Abbey. That Thomas de Leghtone is rightly identified with Leighton Buzzard is pretty certain, since the hinges on the parish church door are of the same work, and the only other church doors similarly decorated

are also in Bedfordshire—at Eaton Bray and Turvey. Of the remainder of the fourteen existing specimens of any importance —for that at Colchester seems to have disappeared somewhat recently—two are in the Eastern Counties, at Norwich and

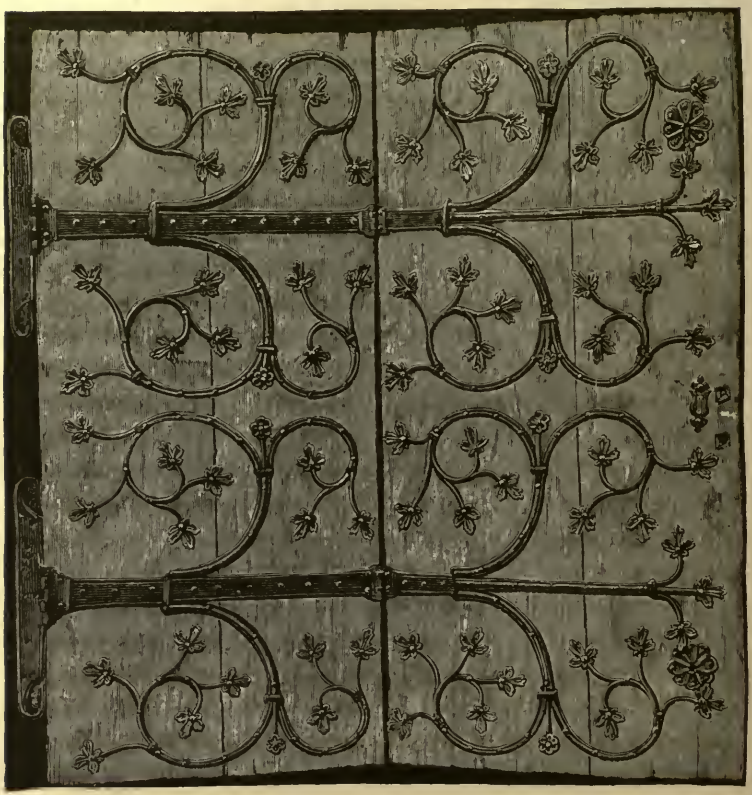


Fig. 35.—Press in the Church of St. Jacques at Liège.

Tunstall; others at Windsor, Oxford, Lichfield, and York, could have been made in one prolonged tour; the small hinges at Chester could have been sent by road; and the work at Westminster involved, as we know, a special journey, for which the

smith was paid his expenses. All the work has certain characteristics in common: thus it is all formed of easy scrolls, flowing one from the other, and which rarely complete a second whorl; the leaves springing from these grow invariably from the outer edge of the curve only; nothing but the vine is used, and the stamps consist almost solely of the asymmetrical thirteenth-century leaf, a trefoil, a bunch of grapes, and a few sizes of rosettes; the same dragons' heads are introduced in all, and the collars or fastenings are alike.

Our most magnificent example is now on the inside of the east doors of St. George's Chapel at Windsor, having been removed from the Chapel of Henry III. The design is a large vesica diaper filled with flowing scrollwork, profusely embellished with leaves and rosettes. On the Chapter House doors at York the whole vine is represented growing from the root, which is prettily treated, to the top, where it overflows on one of the doors and falls trailing down on either side. A special feature in these are the dragons in high relief at the top, which are clearly relics of Danish tradition, and very charming, when perfect, were the open-work handles, recalling the basket-hilts of rapiers. On the aumbry doors at Chester the grapes and dragons' heads are all but omitted, and the work is so delicate that the smallest leaves are no larger than the finger-nail. The west doors of Lichfield Cathedral present an example of the vine design on a grand scale, the woodwork between the four hinge-straps of each door being covered by the great scrolls and the foliage proceeding from them. They have been restored, when, unfortunately, the leaves were made to spring from both edges of the scrolls, giving the new work a different character to the old. St. Mary's, Norwich, presents an example on a lesser scale, and introduces some small fleurs-de-lis in the design. Merton College, Oxford, possesses some well-known hinges, distinguished as the only ones of the kind, in which the old crescentic form is the basis of the design. One of the two cope-chests in York Cathedral is covered with a bold

scrollwork of the vine pattern with flowing curves; beside it is the other of the same date, presenting a perfect foil, the main lines being stiff and pointed, and ending in tufted flower-spikes, which were not produced in dies, but were rounded under the hammer. As the one is taken from the vine, the other suggests the corn; the second element of the sacrament being doubtless represented to escape monotony, as we observe under similar circumstances at Sens. The three Bedfordshire doors are much alike and of inferior interest, but the treatment of the Tunstall door is quite unique, and seems to have no parallel in France. It consists of two narrow plain strap-hinges destitute of ornament, while the entire space between them is occupied by a most elaborate cruciform handle-plate, of delicate branching scrolls ending in the usual leaves and rosettes.[1] The most important specimen of all, however, of which there is a reproduction in the Museum, and the one by which we are enabled to approximately date the rest, and to attribute them with certainty to an English smith, is the Eleanor grille or herse in Westminster Abbey. The records show that this was made by Thomas of Leghtone, in 1294, at a cost of £13, a sum equalling £180 of our money. It consists of eleven panels resembling hingework, riveted to the face of a plain rectangular frame, to which the arching or herse form was given, and surmounted by a row of trident spikes, used perhaps, as suggested by Mr. J. J. Cole, as prickets. Though none of the panels are exactly alike, the easy flow of the vine pattern is apparent in nine, while the stiffer growth of the corn is conspicuous in two, notwithstanding that the vine-leaf stamp is used to finish them off. These two panels are further emphasised by the particularly small tridents which surmount them. The rich effect produced by the application of hingework to grilles is very successful, but it is impossible to tell whether the idea was borrowed from St. Denis, or *vice versâ*. Tradition has

[1] See *Transactions of the Royal Institute of British Architects*, vol. vii., New Series, pp. 153 and 155.

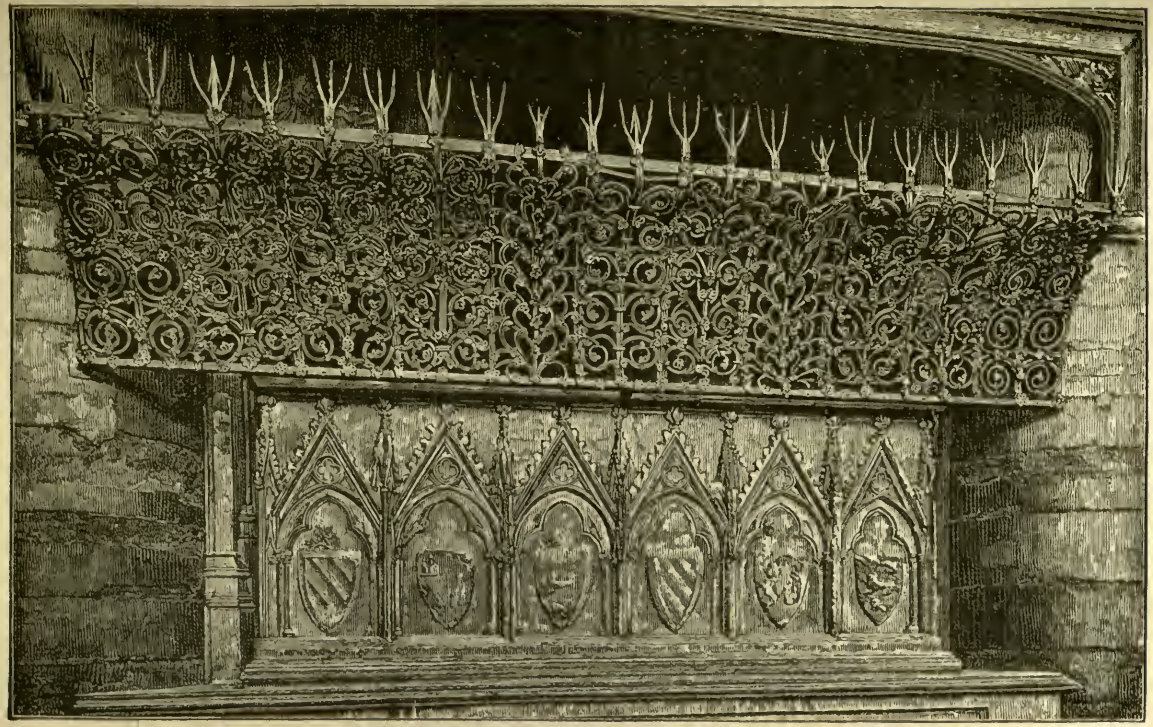


FIG. 36.—The Eleanor grille, or herse, in Westminster Abbey.

unfortunately not preserved the form of the lost grille to the adjacent tomb of Henry III., made by Henry of Lewes, nor of the contemporary railings that are recorded to have been set round the Eleanor crosses.

Except the Eleanor grille (Fig. 36), there is nothing certain as to the dates of the stamped ironwork in either France or England. We have ventured to attribute its sudden cessation in the former country to the over-magnificence of the Notre Dame hinges; for fashion in working iron, as in everything else, had its ebbs and flows from rich to plain; and that which no emulation could possibly equal, far less surpass, was let alone, since in France there seems to have been no attempts to imitate them. This could not have been the case in England, for the great esteem the work was held in is shown by so many of the wealthiest establishments vying with each other to possess it. It must have ended with the death of Leghtone, who appears to have carried the secret, or the manipulative skill, with him to the grave. Nor is it possible to doubt the great influence these designs had on English smithing. Efforts to reproduce them [1] exist on several chests, such as at Malpas and Icklingworth, which are profusely covered with similar leafwork, but hammered without the aid of stamps. Other examples exist, as at Tinswell, Arborfield, Santon, Filby, etc.; while yet others, as St. Peter's, Colchester; Wootton, Northfleet, Hunstanton, etc., though existing until recently, have now disappeared.

We have seen that the rich stamped work held no monopoly either in England or France, and we must glance at the more unpretending styles of work which accompanied it; but as in a condensed history only the stirring events are chronicled, so in our

[1] It is obviously possible, on the other hand, that these may, like the Semperingham work, antedate the use of stamps. Their gradual introduction into English work favours the theory that they were invented here; and it is also possible that even Leghtone's work may have preceded the French, and that he went to France, in which case the French work would be later than hitherto supposed. But all is unfortunately quite conjectural, owing to the absence of records in France.

record, only the more striking waves of fashion can be described. Of these, perhaps the most noticeable is represented by the rather massive hinges on the west doors of Lincoln Cathedral, which cannot be earlier than 1235. In these the crescent type is maintained, as in the older ones of Haddiscoe, though in a rather rectangular form, and with several scrolls springing off in the old style, but with their ends and those of the strengthening pieces finished off into rude flowers and leaves. Somewhat similar, but ruder, are those from St. Mary's, Rushden, in Northamptonshire. But the crescent form was obviously on the decline : its strength was no longer needed, and it was giving place to the simpler strap-hinge ending in easy scrolls or a cross. Thus we see at Oundle the strap-hinge preserving only a diminutive crescent; and at Spalding one with a very small crescent at the base, but reversed, and an even smaller one halfway, with scrolls at the end. Thus lingeringly the crescent drops out, until, in the fourteenth century, it is almost forgotten. The rich Lincolnshire work at Deeping, Lincoln, and Caistor, is much simpler elsewhere, branch after branch of the ornament being apparently shed until nothing remained but the mere strap with foliated end. A coarser type, with shorter and much broader-bladed leaves, of the peascod character, is found in the south, great numbers of examples still existing. The narrow-leaved type seems to have developed into the strap with cross end, and the broad leaf became a strap with a peculiarly broad-bladed and vigorous kind of lily-like end. It is impossible to describe all the varieties to be seen on church doors and parish chests. It must be remembered that at all periods, if no skilled smith was at hand, the simplest forms were put up with, very rich Norman doorways being often associated with plain iron straps. On the other hand, a gifted smith might often for a time revive richer styles, that were generally obsolete ; while changes of fashion would penetrate to the remoter counties in mediæval times with extreme slowness.

Precisely the same changes took place in France. The

thirteenth-century hinges at Amiens, Troyes, and other cathedrals, and at Laon, which possessed no stamped iron, might be English, except that the forms are different and, on the whole, perhaps, of somewhat better design.

The history of ironworking in Germany begins at a later date than in either England or France. It would seem that, as heirs to the Holy Roman Empire, Germans cared nothing for decorative iron while Romanesque architecture survived. Bronze was their metal, and if we find a few doors with scrolled iron hinges, like St. Ursula's, at Cologne, the designs are taken from across the Rhine. Yet even in the twelfth century we have indications of the national love for iron, which afterwards became so very pronounced. The magnificent hinges of Alsace, already described, were, it would seem, a perfectly spontaneous development, and the same form recurs on the tower door at Kaisheim, near Donauwörth. The twelfth-century hinges to the door between the castle and St. Magnus' Church at Brunswick, present another original treatment. Each consists of eight scrolls springing from a central stem and ending in a single flattened cinquefoil leaf. The iron is deeply channelled, and a peculiar character is given by the introduction of flat discs along the stem at the springing of the scrolls. There are also in Austria, at the Liebfrauenkirche in Wiener Neustadt, and in Friesach and Piesting, Romanesque doors covered with iron in the Danish fashion. These essays, however, led to nothing, and for the time the art went no further.

By the end of the thirteenth century pointed architecture was established in Germany, and the new style demanded, in its early developments at least, the use of decorative ironwork. The designs introduced were naturally those associated with the grandest expressions of Gothic ironwork in France, and were taken from the rich stamped work of St. Denis or Notre Dame. One of the most remarkable specimens is the grille closing the cathedral sacristy at Hildesheim. It is fashioned, as in French examples, of vertical bars filled in with C scrolls, ending in leaves and

rosettes. The leaves and rosettes are, from their shapes, most obviously intended to represent the stamped leaves of the Ile de France, but they are beaten out thin and flat, and the sunk parts pierced right through, giving the work an entirely novel and rather Oriental effect. It is just the sort of rendering we might get from a smith, set to work from a drawing without sections, and unacquainted with the process of stamping. These pierced ornaments, produced apparently through a mistaken interpretation of the original drawing, were repeatedly copied by later smiths, and were the basis of one of the most persistent and charming features of later German smithing. We shall see, in fact, that the German school was entirely founded on an imperfect rendering of French types, owing chiefly to ignorance of the art of pressing hot iron into dies, as practised in England and France. Its rapid development was due to the efforts made in Germany to carry Gothic architecture beyond the limits of restraint and refinement imposed in France—efforts which led almost immediately to a general deterioration, betrayed by a quite peculiar mannerism in the ironwork. Their constant recourse to natural foliage in architectural ornament, no doubt led to foliated forms being made the basis of smithing throughout the Gothic period, though, down to the fifteenth century, the smith seldom went outside conventionalised forms of the vine for his models.

The number of examples belonging to the first and second periods of Gothic architecture in Germany—roughly from 1225 to 1375—appears, unfortunately, to be limited, for though many portfolios of illustrations of German ironwork have been published, they deal almost exclusively with the sixteenth and eighteenth centuries. One of the grandest among them is found on the doors of St. Elizabeth's Church, at Marburg, near Cassel. These date from 1283, and King regarded the ironwork as contemporary. The hinges are broad tridents, in form somewhat like those of Lincoln, and certainly borrowed from the crescent; the upper ones have a fantastic central strap and three points ending in

smaller tridents, bearing altogether over fifty cinquefoil vine leaves of the French outline, seen in Fig. 35, from Liège; while the lower, of simpler form, carry about forty vine leaves of the more traditional thirteenth-century outline. A flowing border of the same is made to follow the outer edges of the doors, while a magnificently interlaced quadrupled cross fills the space between—the precursor, perhaps, of the interlaced work used so largely later on. In the hinges at Magdeburg we have another of the thirteenth-century renderings of the vine occasionally seen in France, in which the leaves are ovate, narrow, and deeply indented. The design is the strap with branching scrolls, the inner of which are prolonged on both hinges, so as to interlace over the centre of the door. A singular development is shown in the hinges of Schmalkalden, near Coburg, in which all likeness to the original vine is lost, the leaves, so far as they are visible under the great round-headed nails which transfix them, being merely cleft at the point; but to compensate for this, and to identify the plant, we have very realistic tendrils. Other variations of the vine are to be seen at Mühlhausen, Eschwege, St. Severin at Erfürt, etc.; and a remarkably elongated and deeply cleft one at Treysa, near Marburg, became later on, in the Church of St. Martin, at Bâle, exaggerated till it bears the likeness of a wheat-ear. The vine, as used in smithing, is indeed a Protean plant, and were it not that the fruit and tendrils are so often introduced, it would at times pass beyond our powers of recognition. Side by side with the foliated hinges were others of plainer scrollwork, and scrolls and fleurs-de-lis were often mingled in the designs with the foliage, which in time developed new characters.

The close of the thirteenth century marks, roughly speaking, the end of a period which we may properly define as that of genuine blacksmithing. The texture of iron, it is well known, becomes loosened by heat, and, as it softens, bars will droop and curl into scrolls under a relatively slight impetus, this property rendering it so facile a metal in the hands of the smith. When

hot it can be welded, separate pieces adhering firmly together if hammered or pressed, and the rich and intricate effects we have seen were mainly produced by this means. The welding point is the highest degree of heat the iron will bear without burning and disintegrating, and its management requires skill and dexterity. The distinction between the blacksmith's art and any other is that, whatever he intends to do, he must do quickly. He must strike while the iron is hot, for as the fierce glow fades into dull red, its plasticity is departing. The quick and decisive treatment of iron while it is transiently in a plastic condition must be regarded as the true art of the blacksmith, and of necessity leads to vigorous and masculine effects. The tools of the smithy proper consist merely of hammer and anvil, forge and bellows, tongs and chisels. In the work we have described, small objects such as hinges, however complicated in design, were nearly always welded into a single piece, while in grilles the several pieces were fixed by driving holes through the heated iron and riveting them together, or more commonly by binding the pieces round with hot wisps of iron called collars.

In appreciating this old work, we must not forget that, while the smith of to-day can buy his iron ready rolled into a thousand different sections, he had then to beat out every section with his own hand. Hence old ironwork possesses interest and attractions which few modern examples can equal, for scarcely any piece of old iron fails to please. A great deal of the modern ironwork introduced into cathedrals and churches has been designed with little reference to the properties which should determine its artistic treatment, and will, as our taste improves, probably be swept away; but even where some happily surviving antiquity has been copied, it needs no antiquary or specialist to become at once conscious which is the old and which the new. The explanation is simply that the olden-time smith cut a piece from his shingled bar which he judged by the eye would beat out into a rod of the required length, or curl into a scroll of the

desired form. More or less sufficed for him, and by his method of work he produced an irregularity and play in even the most monotonous designs, which is artistically charming to us, but which was possibly a source of reproach to himself. The designs are so practical, yet so rude, that they were obviously produced by the smith who executed the work. Even if directed by a designer, the smith's capacity must have been thoroughly gauged, and the technical details left well within his powers. It appears that, when no specially skilled smith was available, only the simplest forms were used, the capacity of the workers controlling the demand. When some unusually important occasion demanded a particularly fine work, it was not the man with local claims who obtained the commission, but the best man, and we find smiths fetched from a distance, as from Leighton or Lewes, and maintained in London and elsewhere, until the work was accomplished.

IV.

THE TRANSITION.

THE fourteenth century marks a transition period in the art of the blacksmith. The "Haupt Period," as the Germans would call it, has passed, and the smith no longer relies exclusively on hammer and heat to produce his effects. He begins to deal with iron while cold and stubborn, the results of the two treatments, unless the metal used is too thin to offer resistance, being as opposite as can be. File and saw, vice and drill, are called to his aid to shape the pieces, and they are bolted or riveted together without heat, or tenoned and morticed as in joinery. Sheet iron pierced into tracery, or cut and hammered into the shapes of leaves and flowers, begins to enter into the compositions, and the art of the blacksmith branches into those of the locksmith and armourer.

In order to understand how this change came about, we must now turn our attention to regions we have thus far neglected. The Papal motto, "Ex Oriente lux," adopted when the Crusades were mooted, was prophetic of the higher civilisation and luxury which was soon to reach Western Europe from the East. In the main, art and design had always passed from East to West, but in the older smithing, Eastern influence, by the time it reached our remote island, was scarcely perceptible. As years rolled on, and the Crusades brought the princes of the West into familiar contact with Eastern magnificence, travel bore its fruit, and the refinements of the Eastern became the necessities of the Western

civilisation. Oriental art and architecture were the sparks which kindled our magnificent Gothic architecture. The influence was powerful both for good and bad. From the East the smith learnt to use the file and saw, and the sumptuous arts of graving, inlaying with gold and silver, damascening and embossing; but from the East also came the wave of fashion which required the smith to produce in iron the wood lattice and the pierced marble window, forms proper to wood and stone, by which his art declined.

The East had been celebrated for its skill in working iron from the earliest times, chiefly for the manufacture of weapons and armour. The coats of mail were made of iron pliable as thread, and the armour was damascened and ornamented with gold, silver, and engraving. To such an extent was the richer armour produced, that the Khalif of Bagdad is stated to have exhibited ten thousand suits of gilded mail to the astonished ambassadors from Rome; but for an account of this Eastern armour the handbooks on the Arts of Persia, India, etc., must be consulted. If little use was made of iron in architecture, on the other hand, except as dowels and girders, it was from no lack of skill. India, indeed, presents us with the most extraordinary forging of antiquity, of a magnitude never attempted even in England until the introduction of steam. This, the far-famed iron pillar of Delhi, standing in the centre of the court of the Kutb Mosque, is a solid shaft of malleable iron, twenty-three feet eight inches in height, with a diameter of over sixteen inches at the base, and fully twelve inches at the capital. Fergusson assigns it to about A.D. 400, and from its vast antiquity it has become the object of many traditions and much veneration. The shaft, except for a foot or two near the base, is smooth and round, the contact of the greasy bodies of the Hindoos who make pilgrimages to it, and whose custom is to climb it, having probably preserved it from rust during the fifteen centuries it has been exposed to the air. The cast in the Indian section of the Museum shows

that the capital, which is three feet and a half high, and the inscriptions upon it, are still as perfect and sharp as when first carved.

It was, however, the Saracenic art and architecture which penetrated to Europe from Western Asia, and, following the trade routes, appeared in Northern Italy. All architectural traditions had been derived previously from the ruins of the Roman Empire, and neither in Roman architecture nor in its descendants, Romanesque and Byzantine, was there much scope for the employment of decorative ironwork. In the Christian art revival, the traditional love of costly materials was, moreover, maintained, and for rails and screens we find, instead of iron, the richest marbles and bronze and even silver employed, in St. Sophia and St. Peter's. The use of iron as a decorative architectural feature, in fact, appears to have originated in England, and to have spread from England to Western Europe and Spain. But it was never admitted into Italy—a sun whose rays deigned to illumine the outer world, but was not itself receptive.

The Venetian Republic, however, a trading organisation, with many points of resemblance to our East India Company, was, fortunately for Italian art, what the leaves are to the tree. Freely exposed to the outer light and air, it performed the functions of absorption, transpiration, and assimilation, by which the tissue of the parent art stem was nourished and renewed. But Venice, from its position, was far more open to the influence of the East than of the West, and thus, though the first use of decorative ironwork to be found in Italy is on Venetian soil, its forms are wholly independent of either English or French influence. The first attempts consist of a few grilles, copies (for the sake of strength) in iron of the pierced marble so extensively used in Saracenic architecture; and, emanating from our instructors in geometry, they are naturally geometric in design.

Examples of these exist at St. Anastasia's, in Verona, and St. Mark's, Venice, which are probably as old as the thirteenth

century. They are made of an iron framework, grooved to receive pierced sheet-iron panels, and were evidently produced with great labour. Also they appear to have been soon abandoned, and the geometric design arrived at by the simpler process of riveting straps of iron together. They were probably gilded, and we occasionally see them thus represented in paintings by old Italian masters. Still later the geometric treatment was less rigidly adhered to, and Mr. Parker, of Oxford, has a sketch from Verona, in which quaint animals and quatrefoil ornaments are cut out of the sheet metal and riveted between the geometric lattice-work. By an easy transition, armorial badges and cyphers took the place of meaningless ornament, and we have an example in the Palace of Perugia, made of broad flat straps riveted so as to form rectangular spaces, in which are rampant griffins and coroneted A's within circles. It is inscribed, "Gull. Rufinelli me fecit, 1338."

It is probable enough that the use of the circle in grilles, very likely taken from the roundel glazing of St. Mark's, suggested the far more decorative quatrefoil—a form in singular harmony with the Italian pointed architecture, by that time at its best. Grilles of circles and of quatrefoils are, indeed, to be seen in juxtaposition at San Miniato, Florence. The happy effect of those constructed of quatrefoils was immediately recognised, and for an appreciable period no other design seems to have been used.

The best known examples of this work are probably the grilles to the Della Scala tombs in Verona. The richest of the many designs is round a tomb which must have been erected soon after 1375,[1] but the outer enclosing grille may date back to the very end of the thirteenth century. The evolution of the quatrefoil grilles from the earlier plate grilles is clearly shown in these Della Scala railings, part of which are made from plate metal. We can well imagine the surprise so inferior a construction would

[1] One of the grilles has been attributed to Bovinio di Campilione, 1380.

occasion in the minds of travelled English or French men, and we can hardly wonder to find it soon abandoned, and the remainder forged from bars in the English and French fashion. The plainest of the designs is merely the quatrefoil tied together, with a sharp spike welded in where the segments join. In the richer designs the spikes and the loose ends of the collars or ties are beaten into leaves, and the ladder, the badge of the Della Scala, is introduced, either in an octagon or a circle, in the centre of each quatrefoil. There is sometimes an additional border of leaves, and a leafy cresting with arching tridents for protection. Grilles of this type were soon associated with the magnificent Cathedrals of Siena, Orvieto, and other buildings erected towards the close of the thirteenth century. They are formed in a massive-looking and richly moulded framing, really built up of plates of iron, dividing the grille into rectangular panels filled with the quatrefoil ornament. There is usually a rich frieze of foliage and armorial bearings of sheet iron, commonly surmounted by a defensive and foliated cresting. The earliest dated example is at Orvieto, inscribed, "Conte Lelli de Senis me fecit, Ann. 1337." In this there are but four quite simple quatrefoils in each panel, and the frieze is of ivy or vine leaves with a pierced shield of arms, the introduction of the latter being a feature almost peculiar to Italian ironwork at this time. The cresting is of slender fleurs-de-lis studded with spikes and lofty finials, with two tiers of very elegant cusped foliage surmounting the vertical divisions of the framework. The grille at La Santa Trinità, Florence, is an adaptation of this with much larger panels, containing thirty quatrefoils instead of four, and without the cresting. The vine leaves in the frieze are more numerous and cut up, and the quatrefoils have spikes and little leaves where the segments join. This is again almost reproduced in one of the grilles at Prato. Another adaptation from the same original is in the Palazzo Publico at Siena, in which the interspaces between the original nine quatrefoils of each panel are filled with subsidiary pointed

quatrefoils. The cresting is of straight spikes intermixed with an occasional flower-spike, like an agave or yucca bloom, and a lotus-like finial over the vertical bars of the framing. Underneath is a frieze of the richest beaten foliage, introducing shields and the wolf of Rome in the panels (Fig. 37). The filling of these interspaces may have been suggested by the grille to the Campo Santo of Santa Croce, at Florence, in which the quatrefoils

Fig. 37.—Frieze of the grille in the Palazzo Publico, Siena.

are placed within circles. There is a further development of this work, much later in date, in the cathedral at Perugia. These quatrefoil grilles remained in vogue certainly down to the beginning of the sixteenth century, and were revived in the seventeenth and eighteenth: susceptible of an endless variety of treatment, they still retained the main features in common. Still richer developments of the same design were carried out in

bronze, or with carved and inlaid marble framing and bronze panels.

Perhaps the most interesting of the quatrefoil grilles is the elaborate and perfect specimen at Santa Croce, above mentioned, dated 1371. It is divided into rectangular panels, like all the rest, by a massive-looking framework, each panel containing six quatrefoils within circles, and with the subsidiary ornament in the interspaces. The meetings of all the segments are beaten into leaves, and a simple cornice, with a dedication to the Virgin in black letter, takes the place of the richer frieze, and there is no defensive cresting. The remarkable departure in this grille, however, is the gate, which is a reproduction in iron of a richly traceried Italian Gothic window of the fourteenth century, copied perhaps from Or San Michele. Most of the iron used has been punched into the forms of caps, bases, and mouldings by tools, as well as chiselled and filed, and the twisted pillars are ingeniously composed of several pieces of moulded iron. The tracery is quite out of scale with the quatrefoil work, which is rendered coarse by comparison, and, whether from this circumstance or the great difficulties in producing it, the fashion did not spread in Italy. Such an essay at a purely architectural treatment of iron was, perhaps, the inevitable outcome of the richly moulded and built-up frames and transomes of the Orvieto grille. But it must be remembered that Italian ironwork, from its very inception, partook more of the character of joinery and carving in iron than of smithing, and it was not till the seventeenth century that it emancipated itself from its old traditions.

The Italian style stole imperceptibly into France, its fame, perhaps, inciting French ironworkers long before they were actually aware of the peculiarities of its construction. On the other hand, geometric design, the basis of Gothic architecture, was already beginning to be applied to ironwork in France, and the Italian work, perhaps, merely gave it an impulse.

The choir aisle gates from Rouen Cathedral, now in the Rouen

Museum, show one of its earliest introductions in grillework. Each door is formed of half-round iron bars crossing diagonally, with other bars intersecting the spaces at right angles, and stamped at the ends into leafy terminations. Every triangle thus formed contains a looped scroll, finishing alternately in stamped heads and rosettes, with a simple tracery in the eye of the loop. There is some apparently later work at the bottom of the doors, but the trellis design at least must be late thirteenth or early fourteenth century work, presenting, perhaps, the earliest example anywhere of flat iron tracery applied to grilles. This introduction of tracery and sheet iron eased the smith, and had most important results. Henceforth richer effects were sought and obtained with less labour, and the work was pieced together by rivets, instead of by welds and collars, which required heat. A small grille formerly in St. Denis, figured by Le Duc, affords an interesting instance of the new construction. The sharply bent scrolls of which it is composed have their ends beaten thin and cut up into quatrefoil leaves, and are riveted to the upright bars, which are themselves faced with sheet-iron strips, on which a slight ornament is punched. These changes in design and construction, slight as they appear, herald an entire revolution in the craft of the smith, who, no longer relying exclusively on the forge and hammer, has to adopt the tools of the armourer and locksmith. The irresistible set in the direction of architectural and geometric design is next exemplified in a fourteenth-century grille in the cloister of Le Puy-en-Velay. It is composed of vertical bars, hammered at the ends into caps and bases, and with sheet-iron crockets and terminals. The caps and bases are produced by the hammer without the use of the file, and the sheet ironwork is still welded, and not riveted—processes soon afterwards abandoned. The same cathedral possesses a beautiful geometric grille of a richly diapered design. During the fourteenth century grilles made of small bars threaded vertically or diagonally through each other were usual in France. These are sometimes enriched with

pierced plates and borders, as in a window grille in St. Etienne, Dijon. Geometric design is the basis of these, and of such scroll-work grilles as the one in Notre Dame, Paris, surmounted by prickets, or one figured by Le Duc from Rouen. The choir gates of the Collegiate Church at St. Quentin are partly filled with looped scrolls, but also introduce panels of open quatrefoil work and of sheet iron. Designs of quatrefoils seem to have been greatly appreciated, and were apparently imported from Italy; many instances are to be found of grilles formed of small quatrefoils in squares, or in circles, or circles within squares. Some have the cusps shaped into points more or less enriched, and one remarkable window grille belonging to M. le Secq des Tournelles has the bows of the quatrefoils united by passing through jesters' bells. The beautiful screen at Langeac, in which the quatrefoils are arranged diagonally, so that there are no considerable interspaces, is a superb example of fourteenth-century ironwork; and it is possible that an Italian look was intentionally given to the framing by twisting the bars and decorating them with rosettes, while the Italian cresting is rendered by spikes growing through tulip-shaped flowers, with shields on the main standards.

As we have seen, examples of rich window grilles, though so rare with us, abound in France. Two splendid late fourteenth-century specimens are figured by Chabot from Troyes Cathedral, consisting of bars rendered more defensive by their decoration of scrolls and hooks, and spinous leaves. Another finely decorative double-window grille, also from Troyes, is overlaid with pierced bands, battlements, and rosettes, and possesses a richly crocketed top. A fine fifteenth-century grille of trelliswork, almost hidden by the beaten foliage, tracery, and pinnacles which enrich it, has been figured from Nancy. Numerous window grilles of more severe type also exist, with the ends of their vertical bars beaten either into tufts of spiny leaves, fleurs-de-lis, bunches of lilies, or tridents, and the intersections of the vertical and horizontal bars often concealed by flowers or rosettes. One, said to be from the

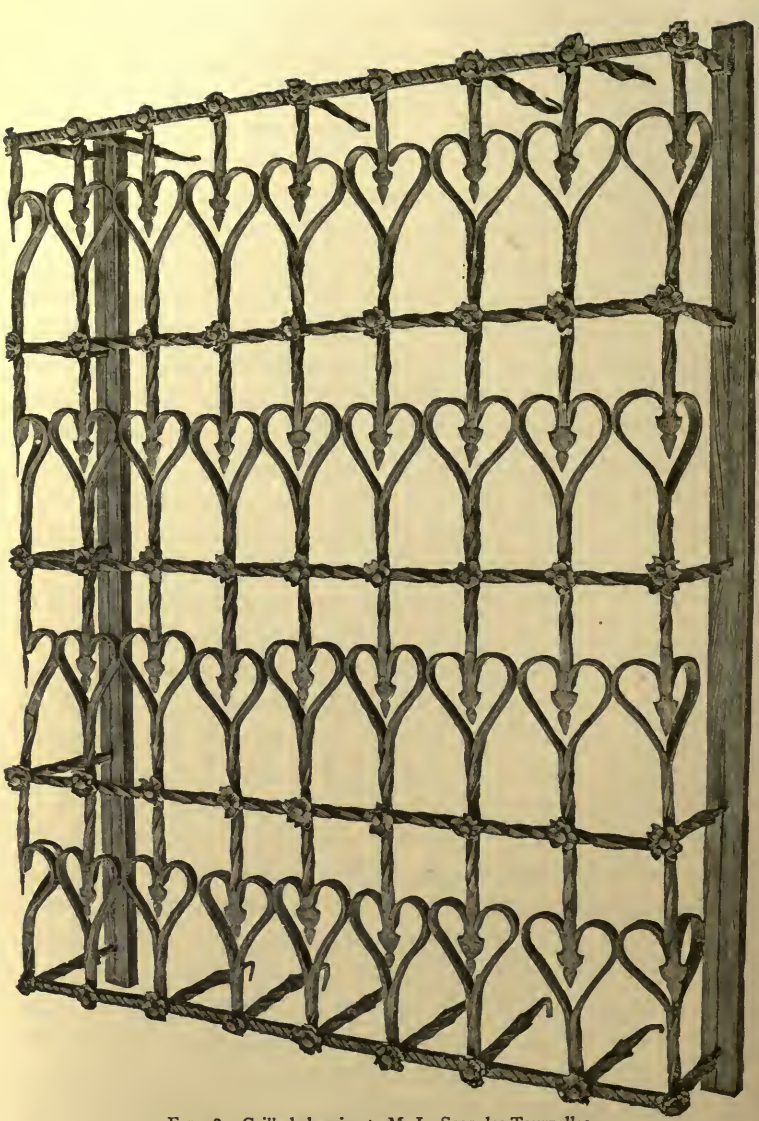


Fig. 38.—Grille belonging to M. Le Secq des Tournelles.

house of Jacques Cœur, at Bourges (Fig. 38), has the vertical bars opened out to form the outline of a heart.

The far-off influence, having passed like a wave over France, profoundly modifying its ironwork during the fourteenth and fifteenth centuries, in due course also reached England, which, from its geographical position, has borrowed its art-impulses from France, ever since France became a consolidated nation. The new mode did not, however, embrace the decoration of doors with ironwork, and this chief branch of English smithing consequently fell out of fashion. We meet very rarely with elaborately decorated hingework of the old English style in the fourteenth century, and then only in comparatively remote places. Interesting examples of such exist at Cley Church, in Norfolk; and others at Hunstanton, probably by the same hand, were figured by Digby Wyatt, but have now disappeared. The fashionable geometric treatment was chiefly applicable to grilles, but our churches have been so entirely swept out and gutted of everything not actually structural, that it is impossible to tell to how great an extent these had been introduced. Hardly any examples remain, except in cathedrals, and modern restoration has removed much from them that even Puritanism had spared. The oldest indications of geometric grilles in this country are the iron supports to the leaded windows in Canterbury Cathedral. Their forms are varied, and dictated by the designs of the windows which they follow. Their presence is no doubt due to the French architect, William of Sens (who was killed by a fall from the scaffolding in 1179), since we usually used plain stanchion bars for the purpose. In France the use of such guards was extensive, as at Chartres, Le Mans, etc., but they did not always absolutely follow the lead lines, as we see in the celebrated grille to the rose window of Notre Dame de Dijon. These, perhaps, belong rather to the domain of constructive ironwork, which was in increasing use, as proved by the accounts of Notre Dame and the Sainte Chapelle in Paris. Our earliest decorative geometric

grille protects the shrine of St. Alban, and is of the time of Edward I. It is divided into numerous rectangular panels, filled with a network of small half-round bars, only half an inch in diameter, which cross each other diagonally and at right angles in alternate panels, and are pinned together at every intersection. A border of sheet iron pierced in quatrefoils forms an appropriate cornice. It is interesting as the only example of a trellis grille in England, and seems to be earlier than any in France, and long precedes any of the German grilles that resemble it; but in which the bars are threaded instead of pinned. We are also fortunate in still possessing two of the quatrefoil grilles so frequent in France. A pair of gates remain in Chichester Cathedral of late fourteenth or early fifteenth century work, made of bars neatly halved where they intersect, forming a number of small square panels, each framing a plain quatrefoil; a novel feature in English work is that they are put together, as in joinery, by pins or rivets, without the use of iron collars or welding. Some small panels at Wells, now dropping to pieces, show remains of similar quatrefoils arranged with the cusps vertically instead of diagonally, so that the interspaces are reduced; they have no rectangular dividing bars, and the quatrefoils seem consequently to have been welded at the cusps, instead of merely bent over as at Chichester. These are the most decidedly Italian of the grilles yet left us. In Salisbury Cathedral there are some rude grilles in the choir, made of flat iron straps, about three quarters of an inch wide, forming a rectangular framing, containing rough pointed quatrefoils with the cusps perpendicular. Some identical work has been made up into gates at Christchurch, Hants, and it was remarked that they were put together as if a carpenter had made them of wood, by halving the bars where they cross, and letting the cusps into a mortice-hole in the bars.

One of the best of the "joiner's" grilles closes the Chantry of Henry V. in Westminster Abbey, and was made by Roger

Johnson, of London, in the sixth year of Henry VI., 1428, the agreement being still extant. It is unquestionably an Eastern design, exactly like some of the fourteenth-century joinery, such as that of St. Pierre, at Caen, from which it is perhaps borrowed, since all the details, including the massive timber framing, are reproduced in iron by a combination of smith's work with the use of pierced sheet iron. The design of the doors consists of two tiers of long, narrow, round-headed arches, filled with a quatrefoil diaper. Behind the arched pieces, which are applied on the face to hide the construction, are heavy vertical bars. The diaper is formed of short and nearly uniform pieces of forged iron, halved where they intersect, and merely wedged into notches prepared in the concealed upright framing. Richness was obtained by duplicating these pieces in sheet iron, cut a little broader, and riveted to the back. The filling in of the arch over the gates presents the earliest example in England of a purely architectural design worked in iron, being filled with tracery, constructed and put together like the diapered work below. It is difficult to believe that the design, as a whole, was not, at least indirectly, inspired by the grille at Santa Croce, for though there are no armorial bearings in the iron, old illustrations show that it was once powdered with gilt fleurs-de-lis and roses. The diapered portion of this grille, like most others in England, has its counterpart in France, at Le Puy-en-Velay. Another direct copy in iron of fourteenth-century joinery of Eastern design closes the side entrance to the choir at Canterbury. It is of much simpler construction, consisting merely of long notched straps of iron placed vertically, with other similar straps crossing them diagonally, and halved and riveted so as to form a rich and essentially Saracenic diaper. The same design, but in wood, occurs at Luxeuil, and has been sketched by Le Duc.

It is very obvious that the smith had no hand whatever in the production of such designs as these, and even in their execution his part was quite subordinate, for they are little more than

joinery executed in iron. His interest in an art in which his share was but mechanical naturally declined, and by-and-by fell off altogether, and, except for military purposes, smithing as a fine art became almost extinct in England for a couple of centuries. Yet it could only be dormant, for so long as men rode armed into the field, and trusted their lives to helmet and cuirass, there could be no real lack of skilled workers.

The most essentially English development of smithing is seen in the tomb-railings, formed of plain and massive vertical bars, of which our cast-iron spear-headed area railings are the descendants. While in foreign countries they were endeavouring to retain beautiful lacy designs for their grilles and tomb-rails, and to overcome the assailable weakness of these by elaborate defensive crestings, we were going straight to the point by introducing a rail constructed of vertical bars, with no horizontal bars or filling in whatever, between them to afford a foothold. Beauty was made subservient to practical utility in a way that at once brought such railings into almost universal use; so that no monument of any pretension was left unguarded by them down to the close of the Tudor dynasty. Sketches of Westminster Abbey and Canterbury Cathedral, published before the wholesale removal of these rails during the first half of the present century, present vistas of cage-like bars, which, seen in perspective, completely concealed the tombs they protected. The date of their introduction is uncertain, but none now exist that are positively older than the end of the fourteenth century, though they possibly supplanted an earlier form in which horizontal bars were numerous, and of which illustrations exist. The oldest monument in which they are used is the tomb of the Black Prince at Canterbury, but since, among the minute directions left in his will for the construction of this monument, there is no mention of any grille or rail, it appears probable that they were added when the monument of Henry IV. was completed, for the railings to both seem by the same hand. In these the vertical rectangular bars

are placed with the angle to the front; there is a heavy battlemented cornice, and six tall turret-like buttressed standards, destined, perhaps, to hold tapers. The cornice, in the case of the Black Prince, is decorated with small stamped lions' heads; and it became customary to enrich it with crests or devices. The vertical bars were soon afterwards carried upwards and sharpened into points, like the stakes of a stockade, or barbed like arrow-heads. An example of the former guards Archbishop Langham's tomb, and is the only one remaining in Westminster Abbey, though there are parts of several others in the triforium. If contemporary, it would date about A.D. 1376, but the railing may be a protection added at a somewhat later time. In the Fitzalan tomb at Arundel, 1415, the standards are greatly enriched with crocketed finials. Sometimes a richly traceried border of sheet metal in several thicknesses took the place of the battlements, or an inscription between twisted fillets replaced them, as in Dr. Ashton's tomb in St. John's College, Cambridge. This presents the earliest instance of the introduction of crests of the founder surmounting the standards, afterwards a very usual feature.

A singular departure from the normal type is that of the rail to the tomb of Sir Thomas Hungerford (d. 1411), in the chapel at Farley, which has horizontal bars hidden by richly decorated straps, and foliated ends to the vertical bars, and especially to the standards. The tomb of Bishop Beckington (d. 1464), at Wells, has a similar railing, but still more decorated, with particularly massive and richly wrought turret-like standards, with battlemented finish. Though carried out in a totally different and English way, the idea for these might have been borrowed from the foliated railings which were then beginning to be introduced into the south of France. Examples of all these railings are numerous, and would form an interesting study, but their claims as works of art do not justify further attention here. The elaborate work put into the cornices shows that this form of rail

or grille was not adopted through economy; and, indeed, considering that the appliances at the smith's disposal were very limited, it is not easy to imagine any more difficult and expensive task than the production of such massive, well-finished, unwieldy bars, and the still more massive standards. A very little study shows us that this type of grille was not selected because it was admired beyond any other, but solely on account of its offering the best means of protection. Whenever any doorway or opening in masonry that could be entirely filled required a grille, it was not formed of upright bars. Besides those of Eastern design already mentioned, we have the beautiful chancel screen in Arundel Church, with its tiers of small and elegant pointed arches, and the chapel grilles at Ely, to prove that practical considerations and not taste dictated the railing form.

The plain grilles and tomb-rails so usual in England seem to have been in little favour in France. Some, however, in the cloister at Toulouse are of massive upright bars, ending in dragons' heads and fleurs-de-lis, fine in workmanship, and imposing in effect. An early illustration makes it appear that the choir grilles to the Ste Chapelle, in Paris, were of upright bars, bound together by the iron wattlework still to be seen in some grilles in Belgium, the idea of which may well have been taken from the then fashionable trellised hedges which particularly abounded in the gardens of the Palais de Justice. Few, if any, plain-bar grilles are now seen in the churches of France, if they ever existed, for it never seems to have been customary to fence in effigies and monuments, as with us.

The change in fashion was even more immediately injurious to door furniture, scrolled ironwork almost at once giving place to moulded carved wood, with plain iron straps, so that the calls on the smith were in this direction restricted to necessaries. The door-handles and escutcheons show, however, even more than the grilles, how deep and lasting was the Oriental influence.

Innumerable church door-handles of the fifteenth and sixteenth

centuries present examples which might have been taken straight from the mosque. Of these, the most Saracenic in form is the flattened ellipse, shaped like a crescent with the horns beaten round to join the spindle. They show the utmost variety of treatment, and are often beautifully finished, their broad surfaces and edges being pounced, pierced, lined, notched, serrated, and

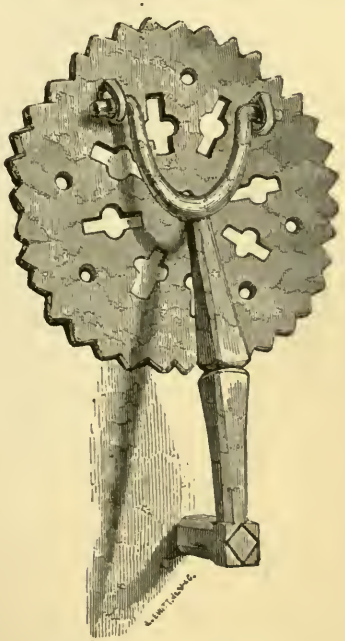


FIG. 39.—Knocker from Stockbury.

pinked; the old traditions of smithing peeping out in dragons or dogs' heads, biting at each other or at the spindle, and the newer fashion being manifest in occasional armorial devices. The back plates are still more diversified, being either simple discs of sheet iron notched and lobed round the margin, and bossed out in the centre, or more or less fancifully pierced with crosses, trefoils, key-holes, etc. (Fig. 40). The curious knocker

(Fig. 39) from Stockbury, in Kent, is an illustration of a simple form of this kind of work.

Richer examples combine sheet iron and forging, the plate being reinforced by stout circular bands, sometimes connected by cross-bands, which are punched and filed into key-borders, crenelations, or vandyked edgings. Most beautiful specimens occur on the sacristy door at Cirencester, and at Dickleburgh, Martham, Eye, etc. Sometimes the handles associated with these plates are rings, decorated or simple, or stirrup-shaped, or rarely interlacing knots. The small bar-handles (Fig. 41), attached at

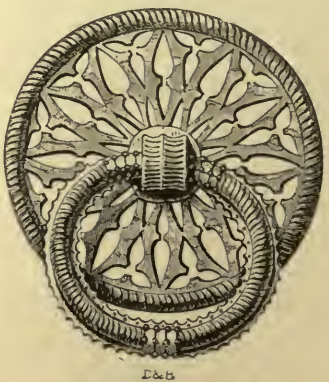


Fig. 40.—Handle, with pierced tracery, from Stogumber Church, Somerset.

each end to the doors by traceried plates or rosettes, seem mostly to belong to the fifteenth century. Sometimes they have cleverly forged knops in the centre (Fig. 42), and sometimes the plates of attachment extend the length of the handle, and are richly pierced. Examples of these are to be found, attached to chapel and chantry doors, in most of our cathedrals. The escutcheon plates, too, are of endless variety. Sometimes they are merely rectangular or polygonal plates, with fleurs-de-lis at the angle, as at Winchester and Chichester; but mostly they are founded on the shield, though this is often cut into such exuberant arabesques as to disguise

the original form. Frequently the design is essentially Oriental, and one at Rendcombe, in Gloucestershire, has Arabic numerals and figures engraved upon it, presenting their supposed earliest use in any work connected with building. Very remarkable, too, is the large plate at Hereford, with the initials and device of Bishop Audley, and a butterfly, in raised iron riveted to the plate. Similar plates are much more rarely seen in France, as at Cordes and Troyes.

Hinges of the fourteenth and fifteenth centuries, though no

FIG. 41.—Handle in Westcott Barton Church.

FIG. 42.—Fourteenth-century door-handle.

longer splendid, were still occasionally required to spread over the doors, especially those to a sacristy or treasury. The older forms are in these cases kept to, but with far more refined drawing, as if the smith were no longer the sole designer. A perfect example exists on the door at the south of the south transept, Winchester, which seems to belong to quite the close of the fifteenth century. In this the termination of every scroll is a graceful fleur-de-lis, and the door is pretty uniformly covered by the hingework. Still more elegant are those in which the simple straps terminate in a triple or even in a single fleur-de-lis. For graceful ease the Great Casterton example can

hardly be rivalled, and the hinges to the door of the triforium in Westminster Abbey are models of elegant simplicity, in striking contrast to those of approximately the same form which were afterwards used, and of which we shall speak presently. Besides the few door-hinges, there are many magnificent examples of this work on muniment and other chests, where protection was of more consideration than fashion. The interesting iron-backed treasury door at Wells, with its pretty arrangement of cross rectilinear straps, is of the same date.

In France, as with us, the hingework became severe, and was reduced in even the magnificent Sainte Chapelle to mere straps of iron ending in fleurs-de-lis. Those of Amiens Cathedral are straps dividing into three branches, each ending in three clusters of tongue and scroll ornament. At Notre Dame de Châlons-sur-Marne they branch into very unusually realistic leaves of different forest trees. Rouen has some rich hinges with fleurs-de-lis. At Coutances two of the cathedral doors and the doors of St. Pierre have deeply moulded strap-hinges, split at the ends, and bearing two stamped flowers. The same massively moulded straps form a diagonal trellis, covering the central door of the cathedral, and are fixed to the wood by the same stamped rosettes used as nail-heads. This work, which is very peculiar, also existed at the not far distant Mont St. Michel, and seems to be late thirteenth-century. Some of the hinges at Bayeux are also peculiar, recalling early grillework, though probably contemporaneous with the last. Unfortunately, the churches of France, as a whole, appear to have suffered even more than our own as regards their ironwork, many of even the grandest abbeys and cathedrals being destitute of any original work. On the other hand, a few objects of iron have been preserved, of which we have no representatives in England. The paschal candlestick in the hospital of Noyon has been already mentioned. Another of the fifteenth century, in the cathedral of the same town, has fine realistic flowers under the pricket. The thirteenth-

century iron tripod, with canine monsters on the feet, and four lions' heads, now supporting a desk, from St. Martin's Church, Brive, is of splendid character. Two others and two folding arm-chairs from Bayeux and Narbonne, all of the thirteenth century, were exhibited in the Trocadéro in 1889.

The merits of English and French smithing during this period seem evenly balanced. In both countries it was one of retrogression, but on the whole it appears to have possessed more vitality in England, and, where there is a similarity of design in both countries, England probably led the way. It could hardly be otherwise in the distracted state of France, and it is a wonder that, ruined and dismembered as she was by the English invasions, any art survived at all.

The German smiths, however, kept plodding away and developing a style peculiar to them. To follow this development will take us slightly in advance, as we meet with no convenient break precisely where we need it. The richness of the hingework was fully maintained, and, though the vine continued to be the only recognised theme, some rich effects were obtained from combinations of scrolls and small fleurs-de-lis without any foliage at all. Such were the hinges to the Palace Chapel at Marburg; and those at Oberwesel, Neukirchen, Kolin, etc.

The vine having now passed through numerous conventional forms in Germany, some of them as near to nature, perhaps, as the skill of the blacksmiths could produce, settled in the fifteenth century into a flat, lozenge-shaped leaf, so deeply cleft as to form a distinct quatrefoil. The type seems peculiarly Rhenish, and is characterised by a multitude of leaves branching from straight or slightly curved and slender stems. There is often some attempt at pierced, traceried forms on the central strap, and earlier forms as well as fleurs-de-lis are frequently mixed with the lozenge leaves. A superb and unusual example occurs at Erfürt Cathedral,[1]

[1] Many of these are figured in the *Transactions of the Royal Institute of British Architects*, vol. vii., New Series, pp. 160–162.

belonging probably to the middle of the fifteenth century, when the nave was completed. This consists of six magnificent scroll hinges, bearing numerous vine leaves and tendrils, covering a large part of the exterior surface of the doors, whilst their interior is completely covered by a splendid diaper, rich in rosettes, leaves, and armorial bearings. There are good examples at Thann, Oppenheim, Caub, Zülpich, Magdeburg, and, until 1844, there were four fine examples at Oberwesel in perfect preservation; they were destroyed by the architect who restored the church. By far the most remarkable example of this work, however, occurs at Schloss Lahneck, on the Rhine, where there are hinges almost covering the doors, across which they are trained in the singularly stiff manner of espaliers, and bearing in all some two hundred and fifty leaves.

So far it is perfectly obvious that the designs used for architectural purposes by the ironworkers of Germany were entirely based on the rich stamped work of France. The general ideas, the use of the vine, and all the conventional forms it first appears under, the introduction among the leaves of the small fleurs-de-lis, and the sparing use of tracery in combination with them, are all characters peculiar to the French school of Gothic architecture. A beautiful native school of ironwork was in active process of development from this French source alone, when, somewhere about 1450, as we shall presently see, it received an entirely new direction from Flanders and Brabant.

V.

THE AGE OF THE LOCKSMITH, FIFTEENTH AND SIXTEENTH CENTURIES.

The honours of the third period of mediæval ironworking belong to the locksmith and the armourer. Heat was now applied only in the preliminary stages, and the greater part of the work was accomplished by the file and saw, or by embossing the iron, or, when the highest realms of art were reached, by carving the statuette or other decorative object from the solid. The direct productions of the forge and hammer were seldom admitted into the design. To work successfully in iron a combination of artistic perception with manipulative skill became more than ever essential, and, to be thoroughly accomplished, it was requisite to understand construction and planning, and to be an adept in the arts of the locksmith, the armourer, and the jeweller.

The Oriental leaven had done its work, and was submerged in the rich developments of Gothic art that it had given birth to. The English smith, discouraged by the change of fashion, or engrossed in the civil wars, had ceased to lead the way, and fashioned little but the rudest work. The French smith, more pliable than the English, and with his country at last relieved from the fear of invasion, was far from being equally discouraged, and assimilated the methods and skill of the locksmith and armourer to his own. As a result, there emerged one of the most beautiful phases of ironworking that has been seen.

The use of sheet iron became general, and it was the custom

to strengthen doors with thin interlaced bands of what we should call hoop iron, fixed to the wood by rosettes or decorated nails. One of these, figured by Le Duc, has the lozenge-shaped spaces left by the intersecting bands filled with a rich pattern of sheet ornament; and another from the Abbey of St. Bertin, at St. Omer, in which the plates are horizontal and overlapping, has edges vandyked in exactly the same pattern as the plate armour then worn. The hinges to the Cathedral of Auxerre are long straps with thin vandyked edges. In some parts of France we find, at the close of the fourteenth century, hinges of sheet iron pierced and embossed into rich leaf-forms, extremely like the German work so familiar a century later. Instances of such hinges are given by Le Duc from the Abbey of Poissy, in the Ile de France, and from a house at Gallardon, near Chartres. A great many hinges were made, at this time and in the fifteenth century, of several thicknesses of sheet iron, pierced to represent tracery, and riveted together in strong frames.

This use of sheet iron was coincident with a singularly rapid development of richly traceried grillework. At first we notice small pieces, such as the guichet in the south choir aisle at Chartres, pierced in only one thickness; but increasing richness of design soon demanded the use of three or four sheets of piercing superimposed. This kind of work has, from its great beauty, been much sought by collectors, and carried away where portable. Thus a splendid flamboyant door, in private hands, was figured in Shaw's *Decorative Arts*, and two sumptuous gilt panels from the tabernacle of the church of the ancient Abbey of St. Loup, at Troyes, are figured in Du Sommerard's *Arts du Moyen Age*.

There is a magnificent portable screen in the Sauvageot Collection of the Louvre, of the utmost delicacy and refinement, which shows that at this period any design could be carried out equally well, whether in iron, wood, or stone. Among the specimens of these refined and laborious productions still *in situ*, we may notice the panels in the sacristy door in Rouen Cathedral, with

flamboyant tracery, and treatment of Tudor-like roses, of which we illustrate only the handle (Fig. 43); and the much finer example at Evreux, where the cathedral treasury is protected by a screen of wood and iron, the handles and locks of which are marvels of art, while the great press it contains has openwork iron panels, bolts, locks, hinges, etc. (Fig. 44), of the finest imaginable

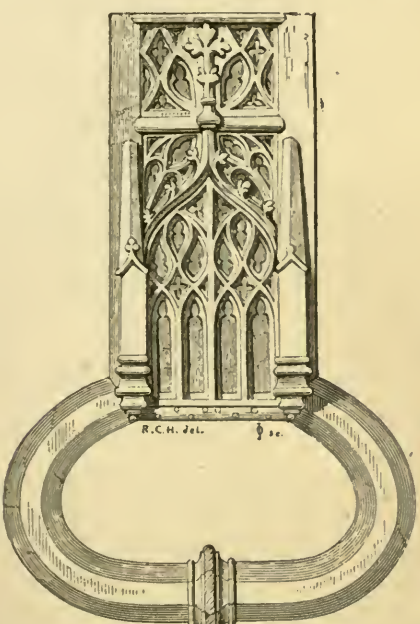


FIG. 43.—Handle of sacristy, Rouen Cathedral.

work. In all these grander works the crockets, pinnacles, and leading lines of the tracery are chiselled and filed from the solid iron in full relief, and the pierced sheet-work plays but a very subordinate part.

In smaller objects, such as locks and knockers, an even greater degree of refinement and delicacy is reached, which is hardly surpassed by the contemporary work in gold and silver. So exqui-

sitely wrought are the finest of the locks, that over £1000 has been paid for a single specimen, and splendid examples are to be found in all considerable collections of works of art. The best in design belong to the close of the fifteenth century, but they increase in richness during the sixteenth. The basis in the design of all is the flamboyant architecture of the period, with the interest

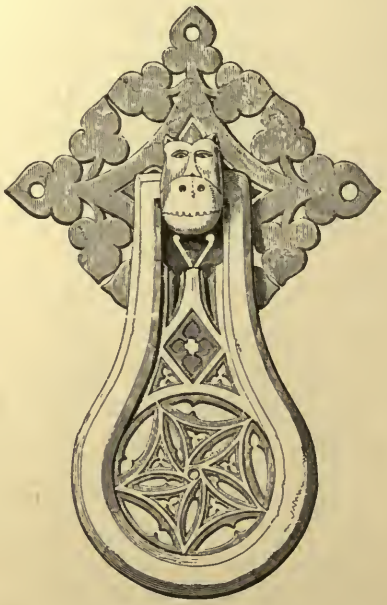


FIG. 44.—Door-handle in the sacristy of Evreux Cathedral.

centreing in the figures of saints and kings, masks, and escutcheons of arms, which they freely introduce, chiselled out of solid iron and chased as if in silver. The twelve apostles under canopies, the Garden of Eden, and other scriptural subjects are found represented. These locks were originally affixed to richly carved presses, trunks, and doors, and their mechanism is careful, concealing bolts and key-holes with great skill. The splendidly

wrought master-keys, with tracery handles and innumerable wards, were used with these locks.

Richly ornamented rim-locks appear as early as the thirteenth century, the front plate being more or less decorated with scroll-work, ending in thirteenth-century leaves and animals' heads, while the back plate, by which the lock was fastened to the door, was extended beyond the lock, and cut into leaves, animals' heads, fleurs-de-lis, and other forms. It is interesting to find the cock's head and eagle among them, and that use was made of incised lines and twisted and notched mouldings. The bolts and latches were equally ornamented, and the mechanism simple and thoughtful. The style, with slight changes of detail, prevailed through the fourteenth century, the ornament being most varied, elegant, and appropriate. The knockers and closing rings were peculiarly artistic, nearly always representing some animal form cleverly forged, often with pierced traceried back plates. The keys were no less varied and beautiful. It is unfortunately impracticable to give even a *résumé* of their distinguishing characteristics within the limits of the present work, and the differences between small objects of French and other origin cannot be expressed in a few sentences. The coffers of sheet iron, strengthened with straps carried from back to front, enriched with tracery, and with lids curved like a trunk, are invariably French. They all agree in having panels on the front and sides of more or less rich tracery, formed of thin pierced metal plates laid over each other with great neatness, with projecting pieces shaped like buttresses of two or three stages, those at the angles being lengthened into legs on which the casket stands. These are represented both at South Kensington and in the British Museum, and are of the close of the fourteenth century. This was the usual form, but others were in use, and all were painted and gilt. At this time nothing was beneath the smith, even the nails being of most varied and beautiful designs, demanding attentive study.

Hitherto scant reference has been made to the ironwork of the Low Countries. Owing to their vast prosperity previous to the Spanish yoke, everything was renewed, and there are scarcely any buildings, and little ironwork throughout the Netherlands, older than the fourteenth century. Though the stamped hinges at Liège were doubtless imported, they had some influence on Flemish work. Except these, the grilles protecting the archives in the Halle de Bruges, which, though probably of the fourteenth century, are a light rendering of our Winchester grille, are almost the only ancient specimens in the country, and they seem to have had a curious influence on the Flemish ironwork of the seventeenth century. Some rude and massive strap-hinges, fringed with small trefoil leaves on stems, on the outer doors of the Hôtel de Ville at Brussels, may also be of considerable antiquity.

It is possible that, as England's supremacy in ironworking was slipping away, the rapidly growing and enterprising towns of Flanders and Brabant saw an opportunity. Anyhow, they became the home of the iron industry in the fifteenth century. A century earlier, Bruges, Ghent, and Brussels were the recognised centres of art and commerce; and the magnificence of the wealthy burghers exceeded that of any European court or monarch. Nor were other cities, Ypres, Louvain, Mechlin, far behind in industry or population; while in the fifteenth century all were eclipsed for vastness of commerce by Antwerp, whose port received two thousand five hundred ships at one time, five hundred entering it in a single day. Ironwork was not a staple industry in any of these, except perhaps Brussels, whose workers in iron and steel during the fourteenth century are said to have been unsurpassed in Europe. We may certainly take for granted that whatever such essentially commercial towns produced would be exported to the accessible marts in Europe, and influence the productions of even distant countries.

Flemish ironwork is interesting in many ways, not the least that it presents us with a multitude of objects that are rare in France,

and seem to have been completely swept away by the Puritans and their successors in England. These embrace many objects used in Christian churches, such as stands for tapers, hanging-lamps, and book-rests, especially such as were portable. We have just seen that ironworking had reached its third and least vigorous stage in France and England—a stage marked in the French work by peculiar refinement of design. But transplanted to a new and virgin soil, it pushed back into some of the older, more robust, and forcible stages. Thus we find the brawny Flemish smiths revelling in the hardest manual labour. It is almost incomprehensible how the monster gun of Ghent, Dulle Griète, or Mad Meg, weighing 16,803 kilos, and measuring nineteen feet in length, by eleven feet in circumference, could have been produced without modern machinery. Yet there it is, formed of welded coils in the first half of the fifteenth century, with the arms of Philippe le Bon stamped upon it. The great Mons Meg of Edinburgh Castle is another of these productions, commonly reputed to have been made in Mons, in 1476; while a third Flemish leviathan is at Bâle, and yet others at Mont St. Michel. The vigour with which they threw themselves into the new industry is no less evident in the beautifully moulded constructive ironwork in the spires, etc., of Bruges, Ghent, and Antwerp; and the massive rails in the market-places of Mechlin (by Jean de Cuyper, 1531) and Xanten. Nothing is more eloquent of the force put into the work than the singular hinges that cover a pair of early fifteenth-century doors of the Church of Notre Dame at Hal. Perhaps the old hinges of St. Paul and St. Jacques at Liège excited emulation; at all events, we find these stamped hinges produced as a mere *tour de force*, since no others exist, and they seem foreign to the prevailing style, but they are of a massiveness and relief that is extraordinary and far beyond any produced when the style was at its zenith. It is interesting to find that, though the vine is still retained for the design, its rendering is quite new, the

leaves being symmetrically cleft and spined like thistle leaves, while the bunches of grapes are oval, and of about the size of a prickly pear. A face is stamped at about the centre of each leaf, and the hinge-straps end in massive fleurs-de-lis. The work on the left-hand door includes a large traceried lock, more than a foot in length, which must be contemporary with the stamped work, and is in design like our grille to the Chantry of Henry V. A cast of one of these doors is in the South Kensington Museum.

Smithing appears, however, to have been brought to its highest state of perfection in the Low Countries by the Matsys family of Louvain. The unique position occupied by the father, Josse Matsys, is shown by the fact that he held the posts of architect and clockmaker, as well as blacksmith, to the municipality. Though, strangely enough, some of his most important works for the Hôtel de Ville have been allowed to perish, at least one authentic specimen remains in the font-crane of Louvain Cathedral—a rich piece of traceried work remarkable for the particularly bold and original treatment of its leaves. A world-renowned work, the well-cover against the Cathedral at Antwerp, dated 1470, is evidently by the same hand. It is very like the work of Josse Matsys; and the celebrated painter, Quentin Matsys, to whom it is popularly attributed, could not have been more than ten or twelve years old when the well-cover was completed. Legends seem to confound him with Quentin, second son of Josse Matsys, who was not born till 1466, and followed his father's calling. In this imposing work no use has been made of stamps. The canopy is carried by four clustered columns, supporting four cusped arches converging to a centre. What might be termed the roof of the canopy is a tangle of interlacing branches and leaves, intended probably for the vine, and a conventional flower which both droops to form pendants, and soars upward into pinnacles. The whole is crowned by the figure of Salvius Brabo, in Roman costume, holding aloft a spear and

the hand of the giant Antigonus, and the springing of the arches is masked by four smaller but more pleasing figures dressed in skins. The design, though mediæval in feeling, is executed with a grace and freedom not known in ironwork of the period, and, from the ambitious introduction of figures in the round, so rarely attempted by the blacksmith, together with the crispness and vigour of the beaten iron foliage, appears to have made a profound and lasting impression on the art. These well-covers must have been once common, though only one other example now exists in the Netherlands, at the Porte de Hal, Brussels. One formerly stood outside the Hôtel de Ville at Antwerp. Perhaps the one at Dijon, like the neighbouring Jacquemart of Notre Dame, is of Flemish origin. This *Jacquemart*, a word of disputed etymology, is a large open iron belfry ending in a *flèche* with two quaintly costumed iron automata to strike the bells, and is known to have been made at Courtrai, in the fifteenth century.

Almost as important, and far more numerous, are the ponderous cranes so conspicuous in many Belgian baptisteries. They range in date from the fifteenth to the seventeenth century, and those remaining at Hal, Breda, Bois-le-Duc, Zutphen, Ypres, and Dixmunde present a fine range of examples. The Museum possesses a cast of the one at Hal, which is somewhat sparsely ornamented with tufts of leaves and large fleurs-de-lis. Iron candelabra are also to be met with in most Belgian churches, consisting usually of a tripod foot and simple angular stem, broken by a knop or moulding, supporting circles, or sometimes rows of lights, stepped one above another. The circles or bars are furnished with spikes and sockets to receive the candles, and are attached to the stem by brackets, or hang from it by straps and scrolls. One at Ypres has its stem most gracefully and simply ornamented by trefoil leaves and fleurs-de-lis. Another at Lierre, in which the candles are in rows, has a central spike on which an extra seven-branched candlestick can be socketed in case of need. A Tournai example has three tiers pierced with

quatrefoils, and is crowned with leaves. Magnificent examples, over six feet high, at Deux-Acren, and Chapelle-à-Wattines, Hainault, support two hexagonal bands pierced with the "Ave, Maria!" and surmounted with fleurs-de-lis, as well as sockets and spikes. The candle-bands in these are supported from the stem by traceried brackets with lilies, as well as connected by cusped and trefoiled straps.

The well-known herse-light at Osnabrück, over seven feet high, is probably of Belgian origin. Its massive tripod foot and moulded stem supports two spandrel-shaped brackets filled with tracery, on which rests a vertical triangle of moulded iron bars filled in with rose-pattern tracery and painted iron shields. On two sides of the triangle is a step-like arrangement of scrolls and spikes for fifteen candles, and on the foot are rings by which it can be moved. Most of these objects were probably for intermittent use, and are planned to carry very large quantities of tapers to enhance the grandeur of great religious ceremonials, when the numbers of lights were so vast as to be compared to the stars descended from the firmament. The permanent and votive coronæ, candelabra, and sanctuary lamps were in more precious metals, except in the brief period when wrought iron was intrinsically appreciated. To this belong the splendid twelve-branched corona at Louvain, attributed to Quentin Matsys; the fine chandelier surmounted by the dragon of Ghent, in the Church of St. Bavon; the beautiful open-work corona for twenty-six lights at Hal; the no less charming chandelier at Zutphen, etc. Associated with the candelabra, and of precisely the same workmanship, are the portable lecterns made on the principle of folding deck-chairs, with leather or pigskin tops. Though nearly always simple, the iron legs have generally nicely worked mouldings, and sometimes flower-work, with finials shaped into heads or fruits. The book-rails are often richly pierced. There are beautiful examples at Hal, Tournai, Courtrai, and in many of the museums. Seats, stands, alms-boxes, and even pulpits, catafalques, and

hearses for church use, are occasionally met with of similar workmanship; all these objects having been originally decorated in glowing colours, if not partly gilt. The churches of Belgium, having been less systematically looted than those of England and France, still contain a great deal of their mediæval furniture, which includes most of the finest specimens of ironwork in the country.

Mediæval iron church grilles were, however, largely displaced during the Renaissance, and chapels and choirs are now almost universally closed by screens of carved marble and wood, or bronze and brass. The fourteenth and fifteenth century grilles remaining are typically Flemish, composed of massive upright bars chiselled to indicate slightly, but effectively, the carved caps and bases of stonework, and forming long linear panels with traceried arches. The grille to the bapistery at Hal is a good example in a severe style. Another is afforded by the window grilles from the treasury of the Hôtel de Ville, at Louvain, 1463, with the decorative addition of a band of imitation wattles in iron over the top of the arch. This feature is twice repeated in the handsomer and more important grilles at Breda. We happily possess in our own country one of the richest examples of Flemish work in the gates closing Bishop West's Chapel in Ely Cathedral, 1515 to 1533. Tradition has assigned them to Quentin Matsys, and there can be no possible doubt as to their Flemish origin. A detailed description would require space; but the design forms an upper tier of linear panels of twisted bars, with forged caps and bases, and very richly traceried arches; and a more severe lower tier of narrower panels, with a base of pierced tracery, a band of very Flemish arabesque work, and a top of very beautiful traceried arches, including fleurs-de-lis and shields. Above all this panel-work are some heavy branching interlaced scrolls filling in the arch, and exactly recalling the work of the Antwerp well-cover, except that they blossom into Tudor roses instead of leaves. A touch of Flemish Renaissance feeling is given by the massive turned and moulded slam-bar. Purely protective grilles

of strong bars drifted through each other, forming lozenge or rectangular interspaces, are found in Belgium, as elsewhere; but they are sometimes rendered decorative by the introduction of traceried designs extending over several interspaces, like those of the Hôtel de Ville of Louvain. Others with roses at every intersection, and a battlemented and spiked cornice, close the baptistery of St. Walburgis, at Zutphen; and at the Hôtel de Ville, of Kempen, the plain rectangular barred window grilles have a highly decorated cresting and sides. A very rare form of grille is fashioned of strong plates of sheet iron pierced into different arabesque designs, and let into a rectangular framing. The finest examples are the shutter grilles to the tabernacle of the ancient chapel of the counts of Flanders, at Ghent, part of which is happily possessed by our Museum. It appears to belong to the middle of the sixteenth century, while an older one is figured in Van Ysendyck's *Belgian Architecture.*

The stalwart Fleming, having rapidly pushed through the earlier stages of the art, and shown his complete mastery over the most massive forgings, quickly caught up with its later development in fashion elsewhere, and produced works by aid of the file, saw, and chisel on the grandest scale. It is small wonder that, when the *rôles* of smith, clockmaker, and architect were combined in one individual, the more precise, cultivated, and elaborated tools of the mechanician are brought to bear. In this work there is always a strong leaning to architectural forms, and the effects of wood and stone are produced in iron in miniature. Though it never quite attained the refinement and delicacy of the French, some magnificent work was produced in Brabant, existing examples actually pointing to Louvain, the home of the Matsys, as its principal seat. In the Church of St. Pierre, not only the grilles, font-bracket, chandelier, and locks partake of this character, but to all the *armoires* of the chapels in the chancel aisles are fitted most exquisite little circular guichets filled with flamboyant tracery of a great variety of design. There is nothing, on the

other hand, to indicate its production in Antwerp or Flanders. Had it been produced in any of those vast commercial towns of the Middle Ages, we should doubtless now find it more widely scattered over Europe. As it is, we have only isolated pieces of ironwork of Brabançon character in England, Germany, and Spain. The most familiar objects in collections are, perhaps, the rather flat boxes of moderate size, of small and intricate geometric tracery repeated over the cover and sides, often in longitudinal bands separated by plain ridges and binding. These have peculiar locks, with uniformly rude and ill-designed buttress-shaped hasp and decoration; this identity rendering it probable that they were produced in one centre and abundantly exported.

Incomparably the finest work in iron of this class stands to the left of the altar in St. George's Chapel, Windsor. It formerly stood in front of the tomb of Edward IV., but, consisting as it does of a pair of gates and gate-piers, it can hardly have been intended for a grille, though the gates, and especially the piers, were only meant to be viewed from the front. Their intended destination is a mystery, and tradition does no more than connect them with Edward IV. and Quentin Matsys. Tradition may be right in this instance, for no one with less princely resources could have given such a commission, and in view of his connection by marriage with the Duke of Burgundy, and his vast trading transactions with the Netherlands, it is to the Netherlands that the commission would naturally gravitate. The main features are in the Perpendicular style, but the details are flamboyant, as if only the general lines had been given by an Englishman, or taken from English architecture. There is no English ironwork in the least approaching it in style, and, if made in England, it must have been wrought by foreign workmen. But it is unlikely that so extraordinary a work, intended for a royal palace, and which must have taken years to execute, could have been made on the spot, or in any part of England, without leaving a tradition behind. Moreover, it seems never to have exactly fitted any

position, or that any position in the chapel could be found for it. But whether due to the whim of a self-indulgent and lavish despot, or to some carefully considered but incompleted plan, it is the most magnificent and unrivalled specimen of its kind in existence. The design is in the richest style of fifteenth-century architecture worked out in full relief and in the minutest details, and consists of two gates about seven feet high, and two much higher hexagonal piers. The gates are formed each of three bays, separated by buttresses with richly crocketed niches and finials. The bays are formed of a traceried window in two stories, surmounted by a three-sided canopy, equally in two stories, with feathered arches and crocketed pinnacles, and finishing in a parapet of open tracery. The upper story of the canopy recedes, and is connected by flying buttresses with the lower, all the spaces in both being filled profusely with most delicate tracery, with open-work crested tops and every kind of purely architectural enrichment known to the period. The piers are an exact repetition in their lower story of the bays of the gate, arranged in plan as four sides of a hexagon, so that there are double buttresses at each angle; the additional upper story is formed of double-light traceried windows, overhung by very rich canopies of one story, almost repeating the lower tier, but with the angle buttresses continued up, and bearing five richly wrought open cressets or lanterns, forming a strikingly effective and rather original finish. This great amount of repetition is a defect common in Perpendicular work. Many thousand pieces of carefully filed iron have been required in the construction of this monumental work; and the caps, bases, mouldings, crockets, and cusps are chased out of the solid, and tenoned, morticed, and riveted together as in joinery. Depth and richness are given by using one thickness upon another, over a background of saw-pierced sheet iron, and the intricacy of detail produced by this process becomes most remarkable in an object of such dimensions. The whole was originally gilt, and remained in this state when it was described

by Gough, the antiquary, as a work of gilded copper. On the south door of the ambulatory is a "vizzying," or guichet, a square escutcheon, and a handle-plate in form of a rose window surrounded by the Garter, all worked in the same way in tracery of marvellous minuteness. The chapel also boasts two other fine flamboyant locks of perhaps Brabançon workmanship (Fig. 45). Locks, handles, and "vizzyings," of elaborate flamboyant tracery, are not unknown in other places in England. A most beautiful specimen of the latter is preserved at Compton Wynyates, brought from the older house dating from the last years of the

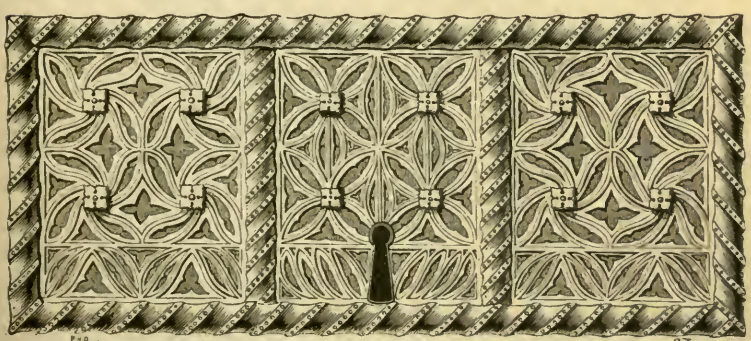


FIG. 45.—Lock in St. George's Chapel, Windsor.

reign of Henry VII.; while another (Fig. 46) most interesting specimen, introducing the wattle border, is in the Museum. Flemish ironwork, like the Flemish chests, was probably in fashion during the reign of Edward IV., and was certainly imitated in England during the succeeding reigns. It is not easy to distinguish, except by its greater elaboration and different architectural detail; but the locks, handles, and door-knockers are sturdier and plainer than the French, which they rarely rival in taste and refinement.

Belgian work of this date is to be found abundantly in the towns between the Meuse and the Rhine, once forming the

FIG. 46.—An extremely rich Flemish "vizzying," or guichet, with iron wattlework. In the South Kensington Museum.

Duchy of Cleves, and as far south as Cologne. The magnificent candelabrum and bier-stand at Xanten, the candlestick at Neuss,

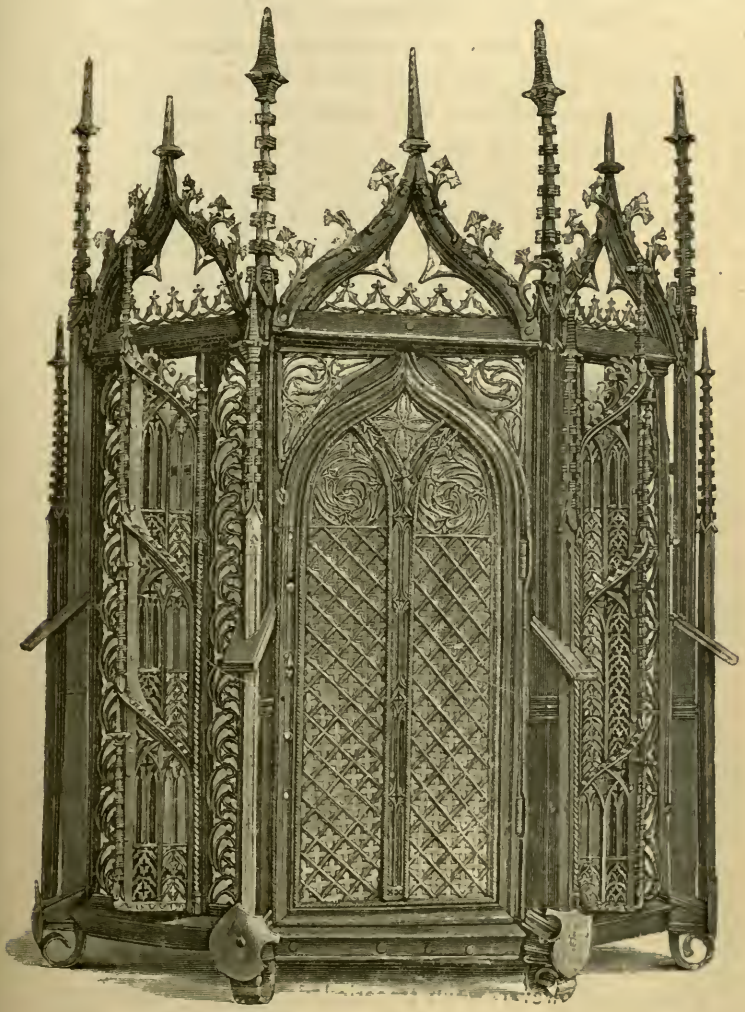


FIG. 47.—Tabernacle grille from Ottoburg, Tyrol. In the South Kensington Museum. German fifteenth-century work.

the dwarf grille at Kempen, the grille at Calcar, the fine bracket at Zülpich, the hinges from Viersen, are known examples, and there are hosts of others. These are distinct from German work, though the Germans were quite ready to assimilate the style as far as they could. Thus the traceried work they produced was quite as elaborate as the Brabançon, if not more so. A singularly rich and beautiful tabernacle grille is possessed by the Museum, which, notwithstanding its unusual elaboration, shows clearly that the German productions were as inferior to the Flemish as these were in turn to the French. In the specimen illustrated (Fig. 47) —said to have come from the château of Ottoburg, in the Tyrol—it will be seen that, while the tracery is delicate, the buttresses and pinnacles are intolerably coarse. German imitations of this purely architectural kind of ironwork are not very interesting.

Traceried grilles are to be found in the Church of St. Ulric, in Augsburg, one of which, supposed to date from about 1470, consists of a vesica-shaped diaper, filled with tracery, in which the fleur-de-lis is an oft-repeated ornament. Tracery ornament was used for screens at Heidingsfeld, near Würzburg, 1510, and more frequently for tabernacle doors. At Lüneburg are beautiful strap-hinges crossing a door, and richly worked handles, forming a museum of delicate and, as described by Mr. King, of finely coloured tracery design. Intricate open tracery handles of Saracenic outline are peculiarly German, as are the tracery back-plates, and their intertwining, leafless, and branching handles. No grander specimen has been produced than the lock-plate, eighteen inches high, taken from the Church of Maria-Saal, in Carinthia, now preserved in the Klagenfurt Museum. From its unusual size and elaborate character, it is regarded as having been a diploma work (Fig. 48).

It is only, however, when traceried designs began to develop into something else that they become of interest. At Cologne, celebrated as a cradle of art, and with so much in common with,

and united by such close ties to, the trading cities of Flanders, the Brabançon ironwork roused a strong spirit of emulation. Thus it is at Cologne that we meet with one of those massive forged iron cranes for raising the font-cover, which are otherwise wholly peculiar to Belgium. Its simple triangular form filled with feeble vesica tracery, and its unnecessary and defective mechanism, pro-

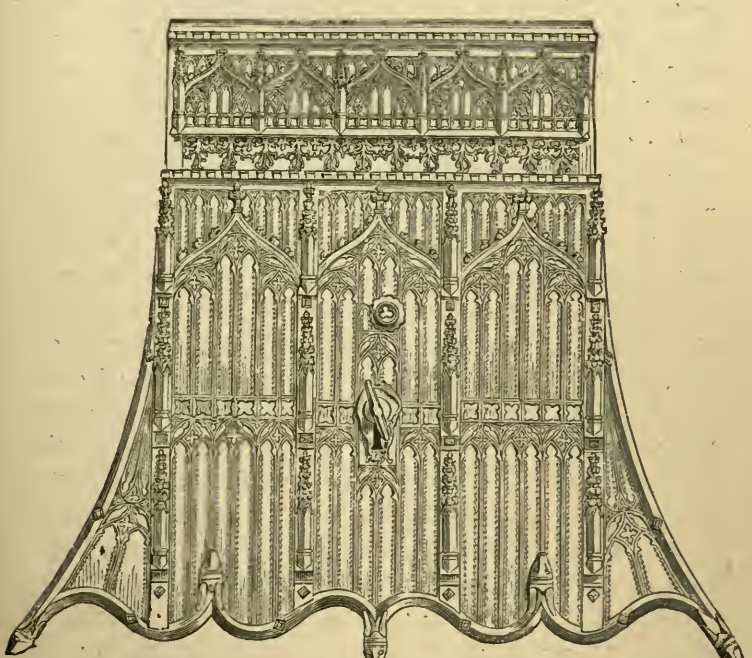


FIG. 48.—Lock, eighteen inches high. In the Klagenfurt Museum. Fifteenth century.

claim it the effort of a 'prentice hand. Then we have, diverging more and more from the Flemish style, the curious *rastellum*, a light traceried railing with fleur-de-lis cresting, and five prickets for candles and five shields emblasoned with tailors' shears. This is supported on a rafter most exquisitely painted with figure-subjects after the Cologne school, while the ironwork is

rose and blue and gold. In the same traceried character is the bell-holder of St. Cunibert's, the lantern and bracket at the Rathhaus, the bracket at Plückhof, the grille at Gross St. Martin's, and the trellis grille in the Dom surmounted by a cresting like that of the *rastellum*, but more imposing. These suffice to show how well the Flemish style of ironwork was received and incorporated at Cologne, from whence, as from an advanced post, it penetrated to the heart of Germany. As a specimen of work from Flanders, or due to Flemish inspiration, we have cited the celebrated herse-light of Osnabrück, a large triangle filled with rose-window tracery, holding fifteen prickets on its upper margins, supported on a tripod foot, and embellished with tracery, shields, and fleurs-de-lis. The magnificent *Chapelle ardente* of Nonnburg, near Salzburg, restored from existing fragments, and engraved by Gailhabaud, is another grand specimen of ironwork of architectural design. It consisted of roof or catafalque with six gables, supported on twisted columns, filled with tracery and cusps, holding innumerable prickets along its ridges and eaves, and adorned with numerous finial-like candelabra at its angles. Beneath is a dwarf railing filled with tracery, also supporting candelabra. Among other remarkable specimens are the pulpit and candelabra of Oberdiebach, near Fürstenburg. Nor should we omit, among the many important German works, the magnificent corona made by Gert Bulsinck, of Vreden, in 1489, and presented to the church by the Corporation of Locksmiths. It consists of two most richly pierced sheet-iron bands, to which are attached canopied niches with figures of saints, and in front of each a candle. In the centre, beneath a wrought canopy, is a figure of the Virgin in gilded wood, and above are two kneeling figures.

The Cologne smiths did not confine themselves to reproductions of the traceried work, but were still more bent on acquiring the particular style, characterised by its mixture of tracery and beaten leafwork, of which the Antwerp well-cover

is so famous an example. The Cologne ironwork of the sixteenth century is distinguished from that which preceded it in Germany and elsewhere by the constant use of the thistle, a plant only used rarely with us, as in the choir gate-hinges at Wells. Perhaps the richly cut and wrapped vine or acanthus leaves of the Louvain crane and the Antwerp well suggested thistles, or perhaps the fine form of the plant and its religious associations led to its spontaneous selection. At all events, not only the glossy foliage, but the flowers and buds of the holy milk thistle lend themselves to an extremely rich, and at the same time conventional, treatment, while the legend that the white veins on its leaves were caused by the falling on it of a drop of the Virgin Mary's milk, would be likely to render it at that date extremely popular in Germany. The flowers, buds, and leaves of the plant begin to appear among the traceried iron from the beginning of the sixteenth century, and spread thenceforward over Germany as rapidly as the plant itself is propagated over pastures new by its airy thistle-down. It immediately ousted the vine, and as effectually as its original has ousted the indigenous plants of countries cursed by its introduction; and for a century no ironwork of any pretension was forged in Germany into the composition of which the thistle did not enter. In the funeral candlesticks from St. Columba's Church, Cologne, and the beautiful wall-brackets of the Rathhaus *Freitags rentkammer*, probably made in 1549, we see its boldly modelled leaves as well as a band with towers and buttresses at the angles enclosing the prickets. A still finer example is figured by Raschdorf, from a private collection in Cologne.

When treated flat, as in pierced sheet-work, of which great use was made, the ornament is arabesqued and rendered very rich. Most exquisite specimens of this work are the two coronæ in the Chapel of the Münster, at Magdeburg. These consist of a wide band of richly pierced design, with battlemented top, suspended from a crown by several curved and decorated rods, to which

brackets holding prickets for candles are attached. The chandelier in the church at Kempen is another magnificent example, in

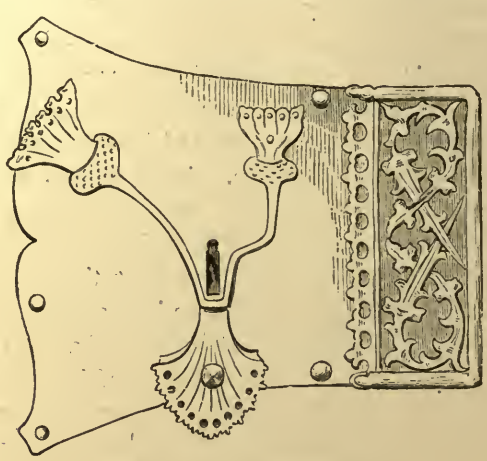


FIG. 49.—Lock from Neuberg, Styria.

which the whole ornament is derived from the thistle, except the figure of the Virgin, the leaves having in this instance taken

FIG. 50.—Lock of chest. In the Augsburg Museum.

a definite cruciform shape, which henceforth characterises them until the final disuse of the plant in ironwork. Another example presents us with the image of the Virgin, with six richly scrolled iron arms for prickets, all fashioned from this plant. The thistle formed the basis of all the pierced and slightly embossed sheet-iron, sea-weed-looking ornament, applied to locks, hinges, and handles, in which the iron was brightly tinned and laid over red cloth or paper. The splayed locks peculiar to Germany were often treated thus, as in the Rathhaus of Cologne, of Bingen, and

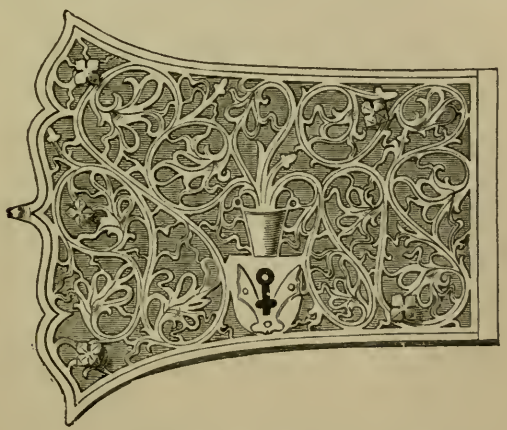


FIG. 51.—Lock in Mr. Amerling's Collection, Vienna.

elsewhere on the Rhine. Thousands of examples are to be met with, varying from the utmost simplicity to extreme richness. Four typical examples are illustrated (Figs. 49–51). Perhaps the most complete illustrations of the various purposes the ornament was made to serve is to be seen at St. Maria im Capitol, in Cologne, where the reading-desk, door-hinges, locks, and handles are all ornamented with this pattern. The richest examples of this kind seem due to A. F. Butsch, whose work is to be seen in the locks of the Soyter Collection, and the chapel at Blutenbourg, near Munich. There are also some particularly

rich hinges in the Nuremberg Museum, embossed to an unusual height, and assuming, as frequently happens, an almost geometric arrangement. The filling-in of a bracket at Xanten is a magnificent example, in which the scrolled and interlacing thistle is seen in every stage, from the bud to the fully developed flower and fruit.

Sometimes the plant is introduced as a single flower termi-

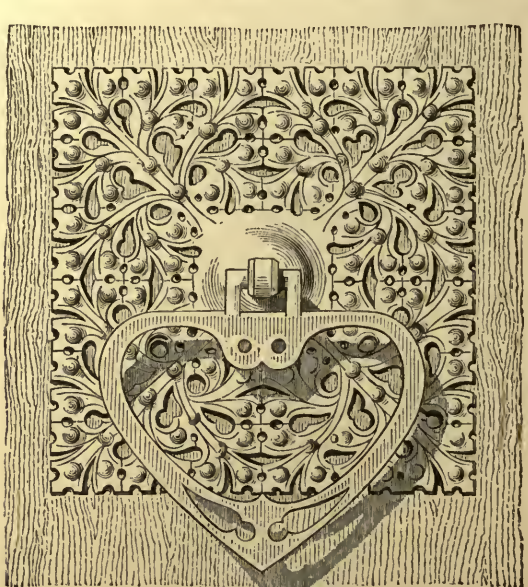


FIG. 52.—Handle from church door of St. Marein, in Styria.

nating a strap-hinge, as at Hagenau, or the vertical bars of a grille, as in the Cathedral of Freiburg im Bresgau, dated 1538; but more often every part of the design is an adaptation from it. In German hands, the thistle, like its predecessor the vine, became protean, and simulated the oak, the fan, the Eastern spathe, the fleur-de-lis, the cross, or mere tracery. Even when almost all sense of its original form is lost, the derivation is

sometimes betrayed by some cross-hatching, the last trace of the calyx.

Connected in some measure with the thistle was the fashion of lining entire doors with pierced and embossed plates and straps of iron, already mentioned as occasionally practised in France, and as having been carried to a point of unusual magnificence in Erfürt Cathedral. It was very prevalent in Austria, Bohemia, and

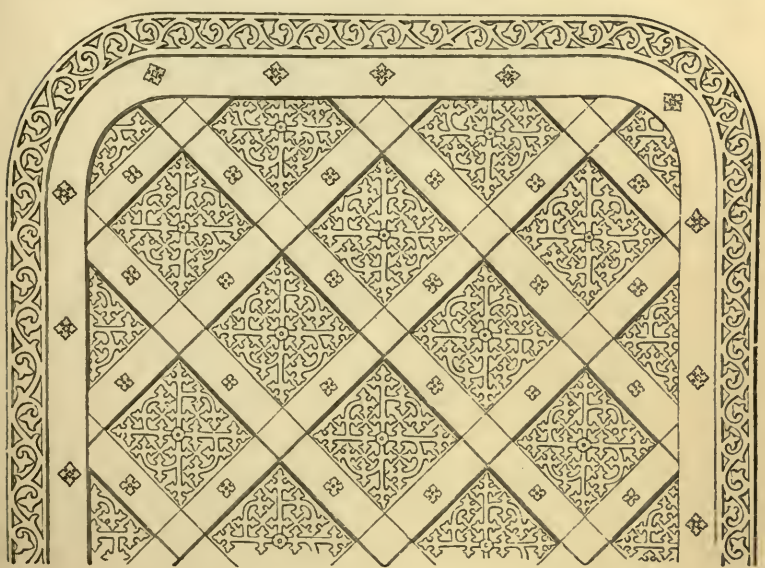


FIG. 53.—Part of door-lining from the Rathhaus, Cracow. Fifteenth century.

Poland. Though many examples are met with in Vienna, they are but little known in this country, where scarcely any attempt to render the defensive linings of doors a means of decoration has been made since the thirteenth century.

None of the Austrian examples appear to be older than the fifteenth century, and the custom was retained long after the adoption of Renaissance architecture. They are all characterised by great richness of detail, and, when illuminated in black and

white, red and blue, and profusely gilded, their effect must have been very splendid. There are several in the Rathhaus and University of Cracow, based on the thistle, like Fig. 53, by no means the richest of them. They were evidently produced in the latter half of the fifteenth century. A still more beautiful example, perhaps the finest in existence, belongs to the Priory of

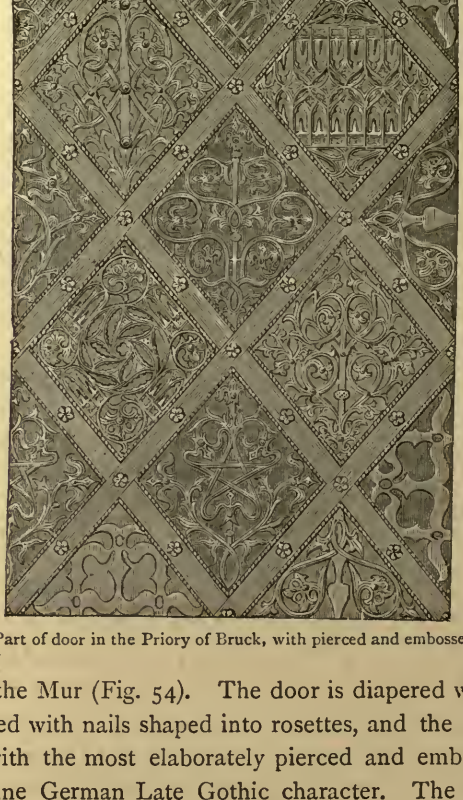


FIG. 54.—Part of door in the Priory of Bruck, with pierced and embossed ironwork.

Bruck, on the Mur (Fig. 54). The door is diapered with banded iron, studded with nails shaped into rosettes, and the interspaces are filled with the most elaborately pierced and embossed ornaments of fine German Late Gothic character. The thistle and fleur-de-lis are twined into arabesques, or mingled with tracery of extraordinary diversity and beauty, few of the designs being re-

FIG. 55.—Iron-bound and painted door in the Castle of Karlstein, near Prague.

peated. The ground of the lozenges was painted alternately red and blue, so that the general effect was like gold lace on a scarlet-and-blue chequer. The more usual plan, however, not only in secular but in ecclesiastical buildings, was to fill the interspaces with armorial bearings oft repeated. These were sometimes merely painted on the woodwork between the iron straps, as in the example from the Castle of Karlstein, near Prague (Fig. 55), in which the black eagle of Austria on gold alternates with the silver lion of Bohemia on red. The iron straps are fixed by well-modelled nails, and decorated with gold-and-black rosettes. The beautiful doors from the suppressed monastery at Krems has, on the other hand, the armorial bearings splendidly embossed in iron. The upper half of the door (Fig. 56) bears griffins alternating with a coat-of-arms, and the lower half is diapered with imperial eagles and lions. The nails are finely worked. Doors of the same workmanship exist in Carinthia and the town of Steier, all believed to date from towards the close of the fifteenth century.

These diapered designs appear to have been suggested by the trellised grilles of the tabernacle doors of Belgium and Germany, which the richer taste of further east decorated with rosettes and other ornaments at the intersections of the bars, as seen in the two fine examples in the Museum. The main bars were always massive, though often almost wholly concealed by pierced foliage and arabesques; and the interstices, which in the richer examples were rectangular, are filled with carved iron tracery, with filigree, or with pierced and embossed subjects. The specimen in Fig. 57 shows one of the doors of the *ciborium* in the Hospital Church at Krems. The designs filling the interspaces are cut out of sheet metal, embossed and chased, and are taken, in part at least, from the New Testament. Three similar doors in the church at Znaim still preserve their gold and coloured decoration. Other beautiful examples exist in Vienna, Mödling, Pressburg, and in Styria and elsewhere, on which a great amount of work has been expended, and which well merit careful study.

This trellis is as distinctive of German smithing as the thistle, and was evidently first borrowed by Belgium from the sparse examples of England and France. In the oldest specimens in Germany, such as those of Cologne and Aix-la-Chapelle, all the diagonal

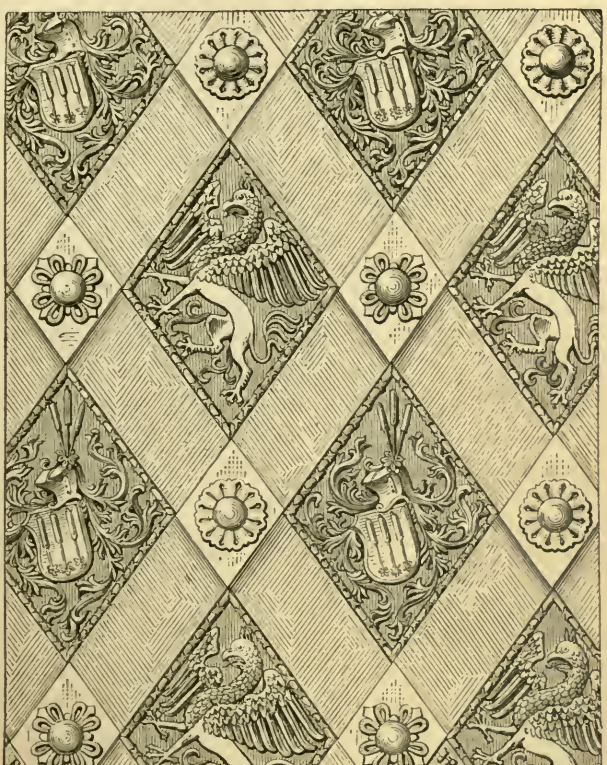


FIG. 56.—Iron-bound door in the Monastery of Krems. Late fifteenth century.

bars passing in one direction are threaded through those passing in the opposite way; but in the somewhat later and more ponderous example of Magdeburg, 1495, they pass through each other alternately, as in the familiar work of a century later, from which they differ, however, in being made with square instead

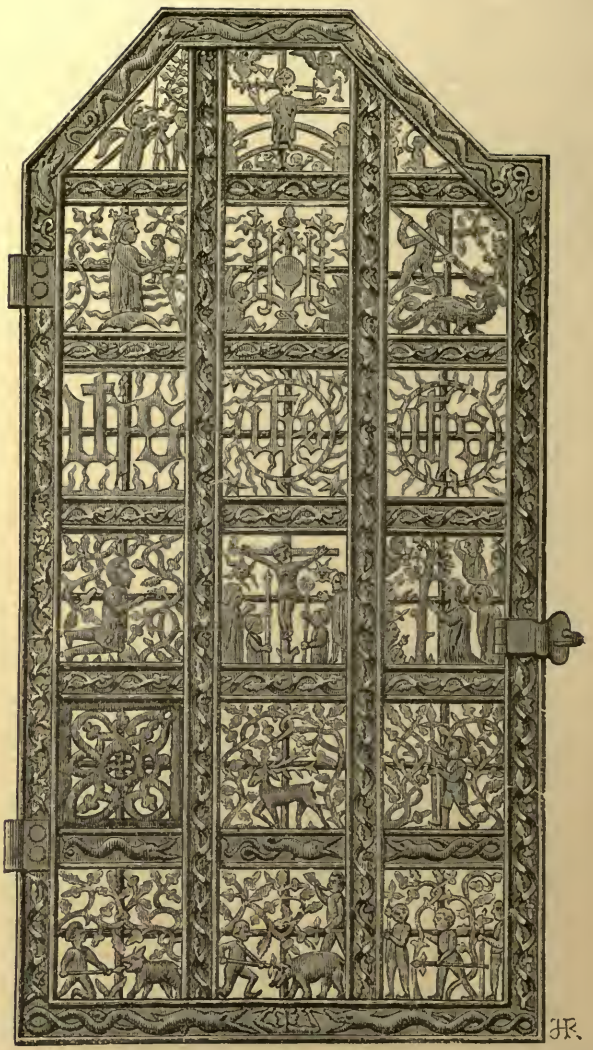


FIG. 57.—Tabernacle door in the sacristy of the Hospital Church in Krems. Late fifteenth century.

of round iron. It seems as if the German smiths were already courting difficulties in order to display their skill. These grilles are complicated by rings and other ornaments interlaced in the bars, and are associated with richly traceried cornices, twisted and moulded vertical bars, armorial bearings, etc.

Bound up with the development of the trellis grille was that of the Passion-flower. A richer form than the thistle was needed for the termination of the standard bars and the intricate crestings associated with them. This seems to have been supplied by elaborating the ordinary twelfth-century iris or fleur-de-lis, which consisted of two inner elevated, and two outer recurved petals, and two stamens. Like all other forms that passed into the hands of German smiths, this became rapidly complicated, until the result bears a somewhat strong resemblance to the Passion-flower. The mystic sentiment associated with the *Flos passionis* from its earliest discovery would appeal strongly to so imaginative a people, and the form of flower soon became a favourite. Its interest was due to a fancied resemblance of its flower to the implements of the Passion. Thus its corona was the crown of thorns, its stamens the nails or wounds, and its petals and sepals symbolised ten of the apostles. The effect of fervid imagination is seen in the illustrations of the flower in contemporary botanical works. The fully developed type in ironwork belongs, however, to the Renaissance, and consists of a spindle-shaped coil of wire for the pistil, with elongated hammer-shaped stamens, and slender recurved petals. We shall meet with it again in our second volume.

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