IV.

THE ANCIENT BRIDGES IN SCOTLAND, AND THEIR RELATION TO THE ROMAN AND MEDIÆVAL BRIDGES IN EUROPE. By HARRY R. G. INGLIS, F.S.A. Scot.

One of the most striking and important features in the story of the Ancient Bridges of Scotland is that there are certain distinct periods in more recent history when almost no stone bridges appear to have been built; and this breach in continuity seems to be the reflection of a long period at an earlier age, when, for 800 years, between the close of the Roman Occupation and the Scottish War of Independence, the building of stone bridges would appear to have been a lost art.

Bridge-building is in fact a fairly modern development, for of the 1400 important road bridges in Scotland at the present time, something like 1000 have been built since 1745, while only about 200 were constructed between 1630 and 1745; and to go back to about 1630, there were then only about 220 fair-sized bridges in the whole of Scotland. In other words, bridge-building in the last century was at the rate of 10 to 15 per annum; previous to 1745 only 2 or 3 per annum; and before that, from the records gathered, one bridge per annum (and seldom even that) seems to have been the average rate of construction. In these circumstances, it is fair to assume that, allowing for broken bridges, there would not be many stone bridges prior to 1400.

Of the 220 bridges existing in Scotland in 1630, only about 67 are left in one form or another, none in their original state; all the others have been washed away or entirely rebuilt.

It is for this reason that it appears almost useless to expect to find any complete Roman bridges over rivers in Britain. If nearly every structure of the thirteenth and fourteenth century has gone

in 500 years, how can we expect others to remain for 1500 years, when those in Rome itself, with all the care bestowed on them, have ceased to exist ?

The records show that the average life of a stone bridge does not seem to be much more than from 70 to 100 years. Storms, floods, frost, and sun, playing upon the fabric alternately, will ruin the strongest building in the course of time, and the tramp of horses' hoofs sends tremors through the whole structure. Arches must be rebuilt, retaining walls strengthened, parapets straightened, to keep it in repair. Indeed, any old bridge on examination tells its own story of weakness, and only those structures that have been carefully renewed and repaired are able to stand the battle of the centuries.

I. Roman Bridges in Europe.

Now this question of the existence of Roman bridges, on account of their popularity, is one that is worth attention, and to be on sure ground it is absolutely necessary to see genuine Roman structures, and compare them with those that are called such.

In Italy there are a number of so-called Roman bridges, and in Rome itself there are four, popularly supposed to be of this character. But an examination of these structures does not wholly bear this out. Of the four at Rome, one is dated 1451, another 1575, a third has been entirely rebuilt. The fourth has clear indications of at least six different periods of reconstruction, and its second oldest portion seems to bear the arms of a pope of 1440. On the other hand, the ruined bridge over the Tiber, at Narni, fifty miles from Rome (fig. 1),—a most magnificent and unique structure,—appears to be unquestionably Roman; but it must have been in ruins for at least 800 years, and if this splendid and solid bridge has been unable to hold together, one's confidence in the possibility of slighter structures remaining intact is considerably shaken. Those reported

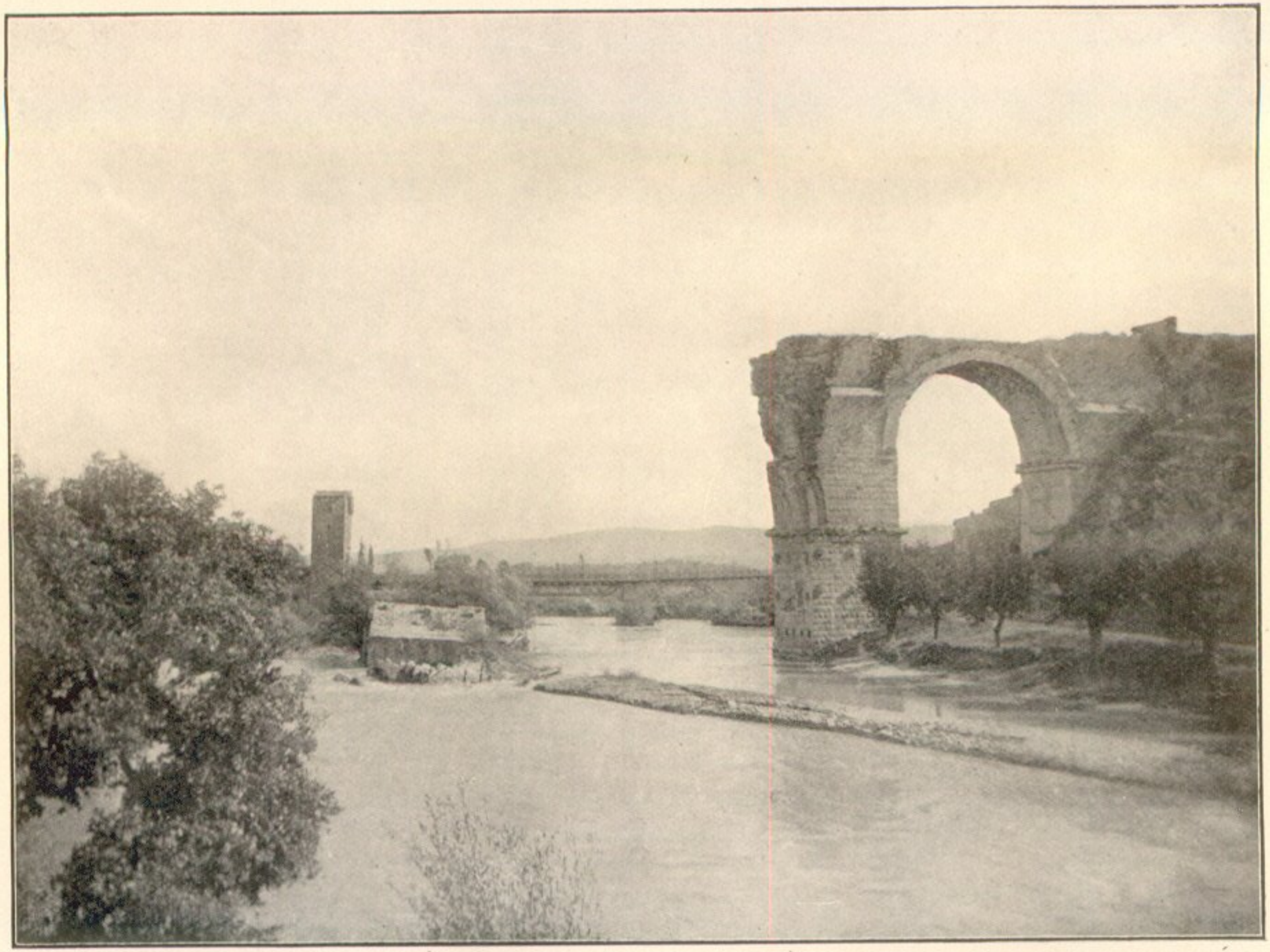

Fig. 1. The Roman Bridge at Narni (Italy), with the Tower of the Mediæval Bridge in the background; in the centre, lying on its side, is a Pier (which fell after 1780) of the Roman Bridge.

to be at Rimini, Veii, Salassien, and St Martin, I have not seen yet, and therefore cannot express an opinion upon them.

In France the only Roman bridge that seems to remain is Pont Flavien, with its Roman inscription on the triumphal arches; but the bridge itself is so much less weather-worn than these arches that one can only accept the theory of restoration.

In Spain the bridges at Cordova,[1] Alcantara, Merida, and Ronda are attributed to the Romans, but the first has recently been incased in cement and is unrecognisable, the next two have been restored, and the last is merely a name, and does not need to be taken seriously.

In Germany the bridge at Treves is said to be on Roman foundations, but as this does not make the present bridge "Roman," one can only use the fact to point out that this structure also has been unable to stand the test of time. In Austria, Trajan's Bridge over the Danube has frequently been quoted, and its likeness is stated to be shown on the bas-reliefs on Trajan's column; but an examination of that remarkable monument does not appear to show any stone bridge, and some wooden railings, which may be those of a wooden bridge, are the only things of this kind that seem visible.

But there is another class of structure which is of great help to us in dealing with bridge-building. The Romans were great builders of aqueducts, and a number of fine structures led across the Campagna to Rome. Some are in ruins; others are kept in repair. In France, one of the finest Roman relics in the world, the Pont du Gard, near Nimes (fig. 2), is still extant, though partly ruined. In Spain the aqueduct at Segovia, extensively repaired in 1483, still remains. But these are not bridges in the true sense. No heavy traffic rolled across the arches to shake the bonding loose, or horses' hoofs stamped on the roadway to force out the parapets. These structures all show deeply

[1] One writer says this was built by one of the Caliphs of Cordova, but the bridge looks mediæval.

Fig. 2. The Roman Aqueduct, Pont du Gard, near Nimes (France), exhibiting construction closely resembling that of the Bridge at Narni, Fig. 1.

weather-worn stone, and all tell that but for careful repair they would have fallen to pieces.

Again, we have the theatres and amphitheatres—Rome, Verona, Nimes, and Arles, and many others—all in ruins; also triumphal arches, all deeply weather-worn and much patched, at Rome and other places.

Yet although the story of these relics is to some extent a depressing tale of ruin and repair, there is one instructive fact which all these structures have in common;—the size of the masonry. The Roman foot was 11 inches, and the courses of masonry on nearly all these bridges, aqueducts, amphitheatres, and triumphal arches, vary between 20 and 23 inches, roughly, 2 Roman feet. The Pont du Gard, in France, has masonry of the same type and character as that at Narni, while the Pont Flavien resembles in type and masonry the Ponte Cestio of Rome. The amphitheatres, triumphal arches, and bridges that remain have nearly all masonry of the same size.

What does this teach us? The natural conclusion we come to, is that these structures have remained, because the size of masonry is so great, that the weathering of the stone and mortar has borne an inappreciable relation to the general mass, whereas the weathering of the joints of the thin, small-stoned masonry of the middle ages has caused pieces to drop out, and so brought lighter structures to absolute ruin and disappearance; massiveness alone seems to be able to stand the test of time.

II. Roman Bridges in Britain.

With this impression left by the study of Roman relics, one is only prepared to look for the remains or foundations of bridges of the Roman period in Britain.

One of these bridges, of which there is absolutely clear evidence,

is that across the North Tyne on the Roman wall at Chollerford, excavated for in 1860, of which only the foundations remain; and even these have certain remarkable features which point to its not being necessarily a bridge so much as a barrier.

The present road bridge, replacing an older one swept away in 1771, has five arches with 225 feet waterway, while the Roman bridge had only four arches with 136 feet of waterway—nearly one half. From this it seems clear that this was an intentional water-race, forcing the river into a deep stream so that no one could easily pass this gap in the Roman wall, and forming part of the line of defence.

The reason for throwing doubt on its being designed for a bridge is, that the original Roman road—the Stanegate—lies some miles away, while the shape of the piers (recalling those of St Angelo in Rome, built 1451), is such, that it is scarcely credible that they can ever have been designed for a bridge. I also draw attention to the enormous width of the masonry, to the pier surrounded by fresh masonry, and to the fact that it is on the front line of the wall. It is inconceivable to me that a bridge would be erected where the crossing of troops would necessitate their being in full view of an attacking party, and close up to the limit of attack. We must rather look upon this as a water-race, and conclude that, when originally constructed, chains were stretched across the river, tightened or fastened round the curious circular stones which are found among the masonry, and that one of the disasters, to which the ruins of the adjoining camp testify, happened at this point, owing to the passage being effected through the water being low. When rebuilt, the masonry was therefore advanced another 30 feet into the river, and made twice as thick, to resist the enormous pressure of a flood; and it is the remains of this water-race that we see, and not a genuine bridge.

Relics of a Roman bridge were also found buried at Corbridge, and

are stated to have been seen in the river Tweed below Newstead; but this is the limit of our knowledge, unless anything may be found at St Boswells, where the old Roman road from Lilliard's Edge makes a straight line for a narrowing of the Bowden Burn, where two rocks confine the burn and make an easy crossing.

The small bridge near the Roman camp at Ardoch is devoid of any features that would identify it as belonging to any particular period, but it has all the appearance of a structure of the 1630–60 period, to facilitate access to the church. It is only the proximity of the Roman camp that causes attention to be given to it.

III. Mediæval Bridges.

With this view of the Roman remains, in endeavouring to decide which is the most ancient bridge in Scotland, one feels on most uncertain ground. The very early references in literature are to some extent not very definite, and the dates only indicate the period to which they are attributed by various writers. In 1199 and 1294 there are references to Berwick Bridge; in 1234 to Ettrick Bridge; 1283 to Dumfries Bridge; 1297 to Stirling Bridge (cut by Wallace); 1320 to Balgownie Bridge (Aberdeen); 1329 to Bridge of Earn (fig. 3); 1340 to Glasgow Bridge; 1390 to Tay Bridge (Perth); 1419 to Dunblane Bridge; 1420 to Guardbridge; 1452 to Dunkeld Bridge; and 1482 to Lauder Bridge.

We have all these references, but where are the bridges? Berwick Bridge in 1199 was wooden, and both it and its successor were swept away; Stirling Bridge, from the seal of the burgh, was also of wood; Glasgow Bridge was decayed in 1340, rebuilt in 1345, fell in 1675 and 1761, and was demolished in 1856; Dunblane Bridge, Pocock tells us, was pulled down and a new one built; the Dumfries Bridge was almost all washed away in 1620. Only two arches are left of the Bridge of Earn; of the Ettrick, Dunkeld, Perth, and Lauder Bridges—the

two latter definitely known to be of wood—there is not a vestige left. The Bridge of Balgownie partly fell in 1587, while Peebles Bridge required 4000 turf sods for its parapet in 1632. We are thus left with purely negative information; but it all tends to show that structures prior to 1500 were mostly of wood, and have gone to ruin.

An examination of the bridges outside Scotland reveals much the same state of affairs. In Italy one bridge is attributed to Theodoric the Goth in 604 at Spoleto; but after that nothing is known of bridge-building till those at Florence in 1218, 1235, 1252, and 1362 (all of which were washed away), at Lecco in 1335, at Verona in 1355, at Borgo in 1322, and at Rome, already referred to, in 1467 and 1575.

In France the first bridge over the Rhone at Avignon, of which only a trace is left, was completed in 1187.[1] Pont St Esprit, twenty-two arches, also over the Rhone, begun in 1265, took 45 years to build. These were the first efforts of a nation which has always taken the foremost place in pioneer work in engineering, and from whom we have taken most of our engineering terms.

The first stone bridge in Paris was only erected in 1412.

In Spain the Moors appear to have done little more than keep the Roman bridges in repair. Granada alone shows a relic of a bridge at the Alhambra, but it also dated from the thirteenth century. At Toledo the two bridges there, erected in 1212 and 1258, had to be rebuilt in 1390 and 1380 respectively; and these are said to be the present structures.

In England, London Bridge, which took 33 years to build, and was finished in 1209, is apparently one of the first stone bridges in that country, and the close of its history forms a well-known nursery song.

In Germany, the first bridge appears to have been that over the

[1] The present remains only date from 1670.

Danube at Ratisbon in 1135, followed by one at Munich in 1158, and one at Frankfort in 1340.

It is thus evident that Europe began to awake to the necessity of bridge-building about the same period, and we must therefore judge that the commencement of the Scottish bridge-building period would be about 1400.

IV. Scottish Bridges.

The periods of bridge construction in Scotland may be roughly divided at the year 1600, prior to which date most of the bridges were the result of individual effort; but after that, the majority were built by national subscriptions taken up by churches, shire committees, and Town Councils. After 1600 the Kirk Session and Town Council records enable us to date many of the bridges accurately; but prior to that, some of the largest bridges would appear to have been built privately, for there are no public records of the building of great structures such as Cramond Bridge (fig. 4), Stirling Bridge, Ayr Bridge, Bothwell Bridge, East Linton Bridge, and many others which must have cost large sums. Glasgow Bridge, the Dee and Don Bridges at Aberdeen, Guardbridge, and Dunblane Bridge are attributed to the efforts of bishops of the adjoining cathedrals; therefore one is tempted to look to generous local landowners as being the builders of the other structures. Few seem to have been constructed by Government, for although the Exchequer Rolls and Records of the Privy Council have constant references to grants in aid of falling bridges, disputes, authorisations of tolls, in which certain bridges are mentioned, few seem to have been built from the public purse, and in each case individuals or towns obtained concessions for the upkeep.

In place, therefore, of allocating a bridge to a certain date, it is more convenient to divide bridge construction into periods; and, while recognising the almost total suspension of bridge-building from 1540

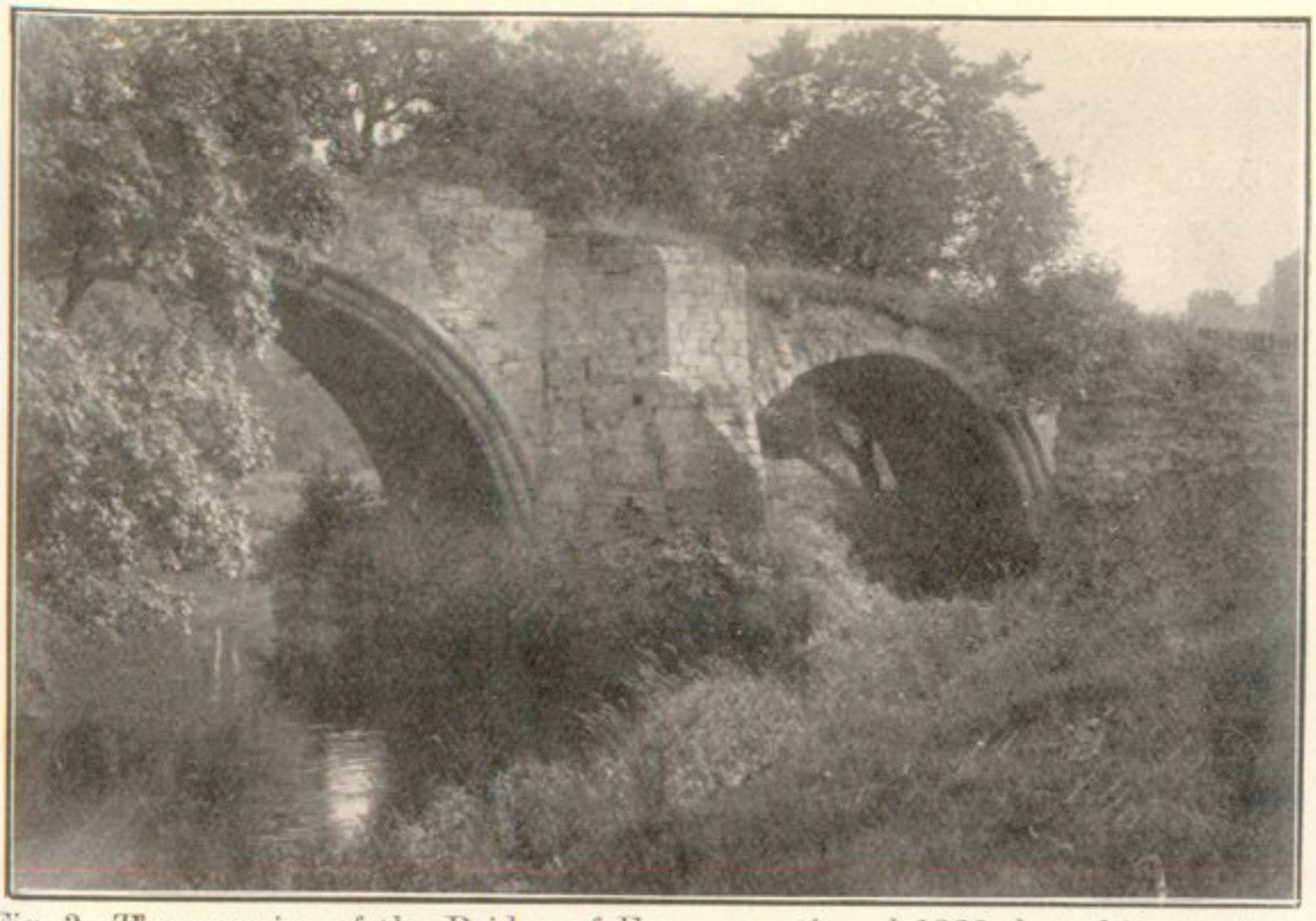

Fig. 3. The remains of the Bridge of Earn, mentioned 1329, but this structure is probably much later. Roadway, 13 feet 6 inches.

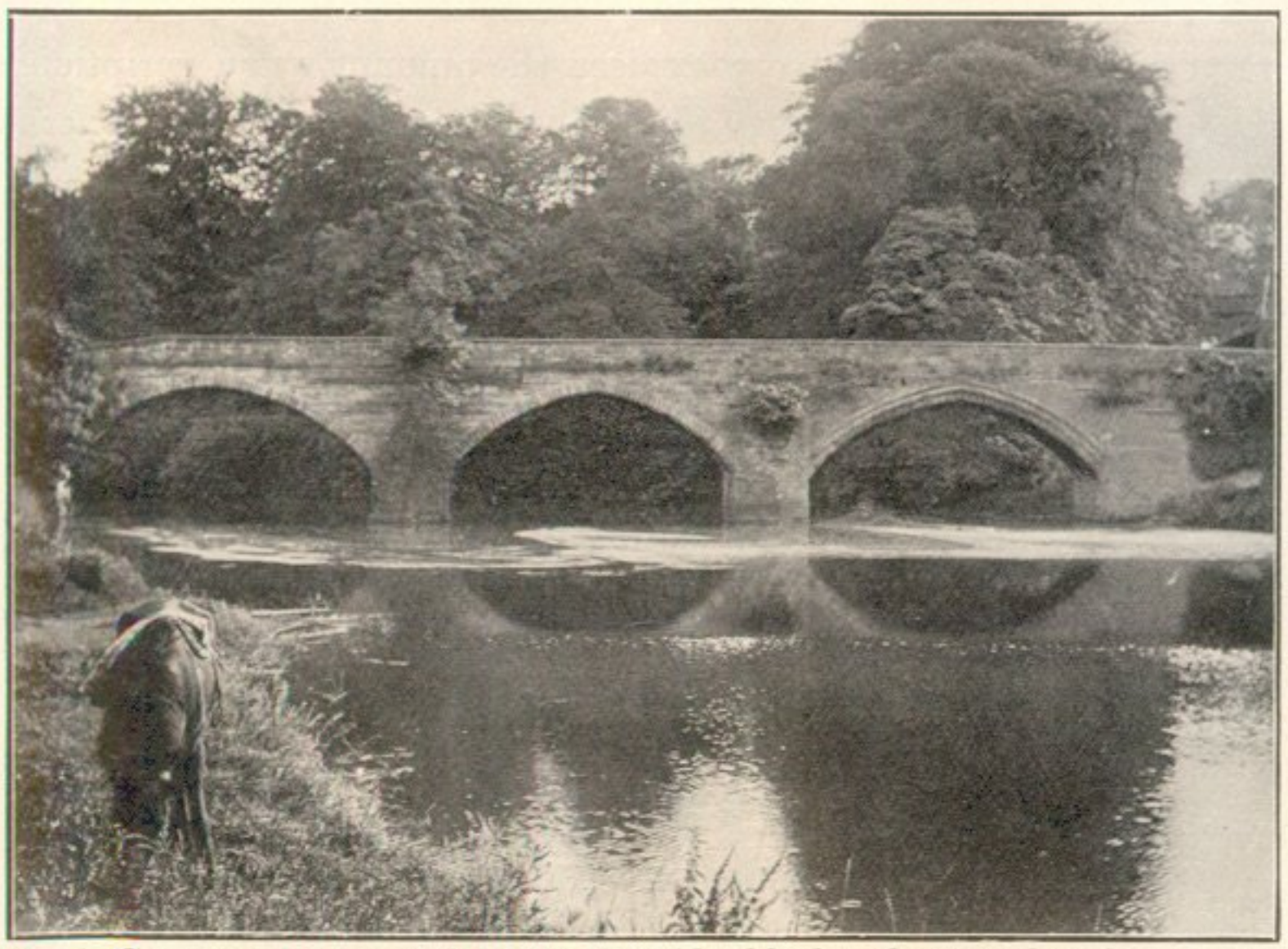

Fig. 4. Cramond Bridge, exhibiting the old ribbed and pointed arch, and the rebuilt arches of later date. (Fell 1587 ; rebuilt 1619.) Roadway 13 feet 6 inches.

to 1570, from 1688 to 1696, and from 1706 to 1720, one may suitably divide the periods thus :—

The Roman period.	
The Pre-Reformation period	1400–1560.
The Post-Reformation period	1560–1600.
The " Collection " bridges	1600–1680.
The Local bridges	1680–1710.
The Shire and Military [1] bridges	1710–1754.
The Turnpike bridges—early	1754–1770.
,, ,, later	1770–1800.
,, ,, heavy or mail road	1800–

These periods are helpful in one way, as they make distinct the means by which the money was raised. In the Pre-Reformation period the bishops were among the chief benefactors ; in the Post-Reformation period the large landowners ; in the " Collection " period the churches largely raised the money. In the Local and Shire period the shires and towns raised the amount by subscription ; in the later periods the military bridges were constructed by Government, and the turnpike bridges by the Turnpike Trusts.

But with bridges near the large towns there was no such distinction. Glasgow looked after its own bridges. Perth looked after Perth Bridge and Bridge of Earn. Aberdeen had to keep up both the Bridge of Don and the Bridge of Dee. St Andrews had Guard Bridge ; Jedburgh had its own and Ancrum Bridge to look after. Stirling, Linlithgow, Dumfries, Ayr, Irvine, Brechin, and Inverness had each their own bridge to keep in repair, and these royal burghs helped others when their bridges were badly damaged, but a wary eye was kept to see that the money subscribed was not put into the town's purse. Glasgow, in particular, early showed its far-seeing and keen commercial aptitude, as well as generosity in supporting good works,

[1] These were on certain lines of road, and were continued and extended in out-of-the-way parts, by the Commission of Highland Roads and Bridges till long after 1800.

by the promptness with which handsome and substantial financial support was offered to every proposal to build a bridge within even the fifty-mile radius; the attached terms that all Glasgow citizens should be exempt from toll, and that the money was to be paid only when the parapets were begun, being two delightfully clever and

Fig. 5. The " Roman " Bridge, Lanark; a good example of a dilapidated Bridge of the 1560–1680 period. Roadway, 9 feet.

useful conditions, the humour of which will appeal to all who appreciate the business-like character of the Western Capital.

These financial arrangements for raising money are of more importance than is generally recognised, as the sums required for construction and upkeep of bridges in many cases were considerable, for a substantial and well-constructed bridge is to a large extent simply a matter of expense; and its permanence a matter contingent upon choosing proper foundations, having ample waterway, good design, materials, and workmen. In each of these periods, first,

second, and third class bridges were constructed, and, naturally, those best built, and kept in repair by a responsible body, are left to us; while the ruins of inferior structures, and those which, after being built by public-spirited effort, were left to take care of themselves, furnish most of those picturesque ruins which are popularly designated as Roman Bridges of hoary antiquity, like the one at Lanark (fig. 5).

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Turning to the structures themselves, in endeavouring to fix the date of a bridge, nothing has been so important as the general introduction of wheeled carriage traffic about 1680–1700. Prior to that period the traffic of the country was mostly carried on horseback, and narrow bridges served all the needs of the community. The new traffic required broader bridges, and after this date there is scarcely a bridge with less than 10 feet roadway.

But this in itself is no criterion of age, it is only one very im portant factor which must never be lost sight of; for the length of the bridge, the height of the arch, and the traffic of the district, all play their own part in fixing the period, when no architectural feature makes the matter perfectly clear.

The second important date-mark is the shape and thickness of the pier (fig. 6). In early periods one of the most unsatisfactory features—from an engineering point of view—was the enormously heavy piers which were laid down in the rivers. They obstructed the fairway of the water, dammed up the river, and were the cause of the sweeping away of many an early structure. As centuries passed on they were made thinner, and the shape of the pier modified to suit the different conditions; but it was not till the nineteenth century was well begun that they were cut down to slim proportions.

The third very important date-mark is the relation of a bridge to those in its neighbourhood. We cannot get away from the fact that local considerations and influence are almost paramount in a matter of this kind, and each bridge is to some extent a copy of, or improve-

ment upon another in the district, which has served as a pattern. Five bridges out of six—if not more—are built by those who have familiarised themselves with bridge construction, and in looking at any one bridge, we must be looking at the pattern for half a dozen others.

Bridge-building is now a special branch of study, relegated to civil engineering, but the true relation of bridge construction to

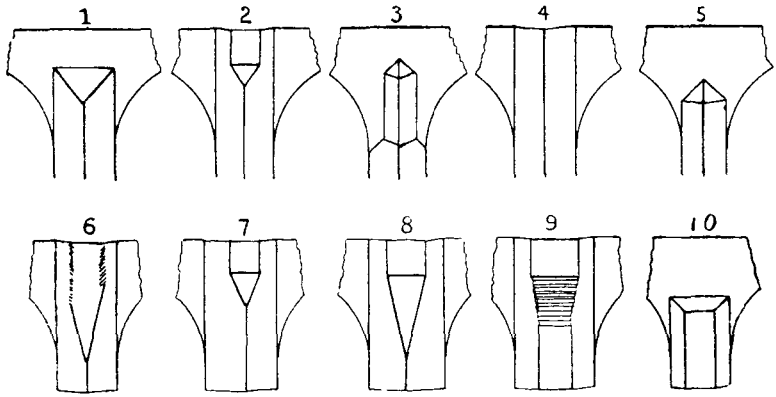

Fig. 6. Types of the Piers on Scottish Bridges.

1. The usual pattern up to the year 1770. 2, 3, 4. Various old styles, occasionally met with. 5. The usual pattern after 1770. 6, 7, 8, 9, 10. Five varieties of Pier on Guard Bridge, St. Andrews, evidently of different periods.

architecture is, that in architecture an arch has to carry a permanent load, and can be weighted with masonry to give it stability; whereas an arched bridge has to bear a moving load, and has to stand the thrust at every point in the semicircle, an effect easily demonstrated by pressing one's hand over a hoop, thus flattening the circle and thrusting out the sides. The construction of stone bridges until about 1700 was in the hands of a few, and wooden bridges were usually preferred, as being easily and more cheaply built; they stood little risk of collapse, and were readily repaired by renewing the beams.

With these facts before us, the allocation of a bridge to its period of construction is to a large extent a question of collecting details of all the bridges in a district, comparing, sifting, and classifying their features, and consulting the historical records of the country for references and remarks which have a bearing on the matter.

It is the ignoring of this that has occasioned much of the loose information that is at present extant, and as each year passes, the less satisfied are we that the bridges are so ancient as is made out, for the history of the bridges in Scotland appears to be the history of bridges all over Europe. The same types are repeated, the same designs, the same features; showing how far the masons travelled, and followed out the plans adopted successfully elsewhere. Indeed, if we could trace the footsteps of the bridge-builders, we should be in a position to know much that is at present conjectural, and be able to follow a most interesting study.

The first period of bridge-building in Scotland is *the Pre-Reformation epoch*, from 1400–1540—the dynastic period of the James's I., II., III., IV., who laboured much for the consolidation and welfare of their country, and are specially noted in history as having built and repaired bridges. It is to this period that we can generally assign all the great stone bridges of the country, and others of unknown antiquity on the main lines of traffic, about 40 or 50 in all. It is also to this epoch that we appear to be indebted for most of the ribbed bridges, the best examples of which are seen at Cramond, Haddington, East Linton, Dalkeith, Jedburgh, Bothwell, Tullibody, the old Avon Bridge (Hamilton), and Bridge of Dee at Aberdeen; but as the same style of construction was also adopted for the old North Water Bridge about 1580, at Inverness in 1685, and at Gannochy Bridge in 1732, this style is therefore no key to a period, if these latter dates are not wrongly given in local literature.

The pointed or Gothic arch of this period is exhibited in the Bridge

Fig. 7. The Brig of Balgownie (Aberdeen), reputed *cir.* 1320, but partly rebuilt 1597. Roadway, 11 feet.

Fig. 8. Guard Bridge, St Andrews (1420–1530), showing the higher cut-water of the first Pier, and the low cut-waters of the older Piers. Roadway, 11 feet 6 inches.

of Balgownie (fig. 7) at Aberdeen, at Cramond Bridge, at Abbey Bridge (Haddington), at Tullibody Bridge, and in one arch of Dairsie Bridge.

Among the other structures of this epoch, mention should be made of those at St Andrews (fig. 8), Musselburgh, Stirling, Doune, Peebles, Irvine, Ayr, and Doon, all of which are important.

The records of this period, however, are very fragmentary, and there is a complete absence of information of any bridge being built between 1464 and 1527, a period of 60 years; and one can only hope that it will be ascertained that some of the undated bridges belong to this wide interval.

One class of bridge of this period, of which special mention is desirable, is the "Fortified"[1] bridge, because of the ingenuity shown in constructing a bridge that would in itself form a defensible barrier to the approach of troops (fig. 9).

The finest example in Scotland is the bridge at Tullibody, which seems to be the most perfect and unique of its class in Europe. In it a series of twists are produced, designed to effect the throwing of a body of horsemen into confusion. The bridge at Stirling has the same idea carried out at the north end, by means of a double turn; while that at Peebles has the arches arranged at different angles, evidently with the same object in view. Whether the bridge at Balgownie has its abutment placed in a curve for this object is a moot point, but it also has the same curious bent abutment, which, though of bad and unscientific design, must have been made for a definite purpose.

Most of the old Scottish and English bridges were, however, guarded by a gate in the middle or at one end, but on the Continent, and especi-

[1] This title is adopted from an old description, but it does not accurately convey that the shape of the bridge is more of a military barrier for defensive purposes than an actual fortification. A more correct title would be "Defensive bridge."

ally in Spain, gates at both ends were provided, following the Roman style indicated on Pont Flavien.

By far the finest example of a fully fortified bridge is the Ponte Nomentano in Italy (fig. 10), whose plan shows a handsome castle in the centre, and a gateway at both ends, thus forming a regular fortress. As it bears the arms of two popes, we must assume that the bridge was

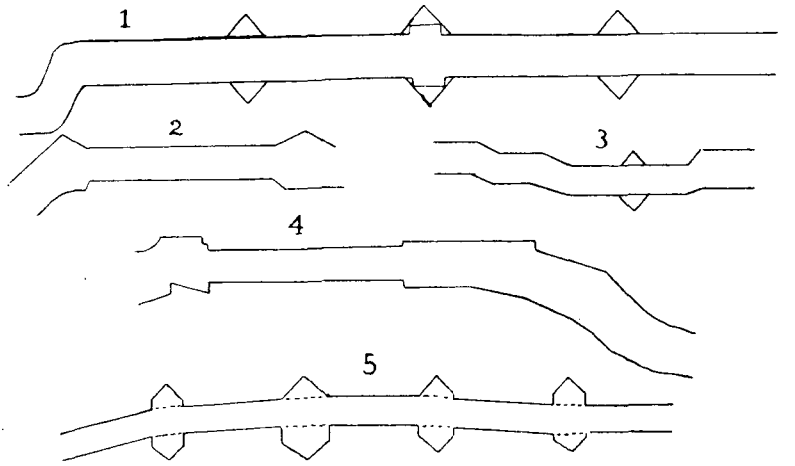

Fig. 9. Plans of Bridges with angled approaches on Roadway.
1. Stirling Bridge. 2. Brig o' Doon. 3. Tullibody Bridge. 4. Balgownie Bridge. 5. Peebles Bridge.

erected about 1450, and strengthened in 1650; but whether it was fortified as the result of the fall of Constantinople and the irruption of the Turks, or as a clever and new design by Alberti, Pope Nicholas's famous architect, it is impossible to say, as no one seems to know anything about it. None of the books to which I have had access make any mention of the three coats of arms on different parts of this bridge. But the curious shape of the battlements will be noticed, resembling in type the Damascus Gate at Jerusalem, built in 1537.

In the same Pre-Reformation period, chapels were attached to many

of the bridges in England and France, but it is rather striking that the practice does not seem to have had much vogue in Scotland [1] or Ireland, although the cross in the centre of the old wooden bridge at Stirling is similarly placed to the one on the old bridge at Avignon.

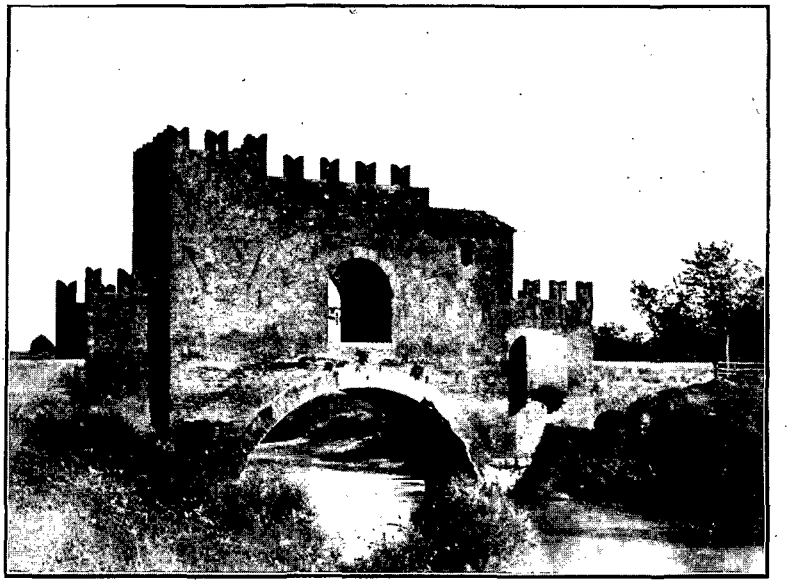

Fig. 10. Ponte Nomentano, near Rome; formerly fortified, and with gates at both ends.

It was at the close of this period, marked by the distraction caused by Mary of Guise, that a blight seemed to fall over Scotland, and the records are almost silent as to anything being done in bridge-building. In 1545 the Somerset expedition wrecked the country to the gates of Edinburgh, and retired by Jedburgh, devastating and tearing down every building. In 1549 Peebles was burned; while in 1559 the Scots broke down Tullibody Bridge to prevent the French

[1] A chapel was attached to Bridge of Dee at Aberdeen, and to Stirling Bridge.

troops from approaching Stirling. It was only when the great movement of Reformation that swept across the Teutonic races of Europe had gained the upper hand in Scotland by 1560, that a great wave of educational, religious, and progressive fervour set in; and, beginning in 1575,[1] the records are full of earnest efforts to repair the

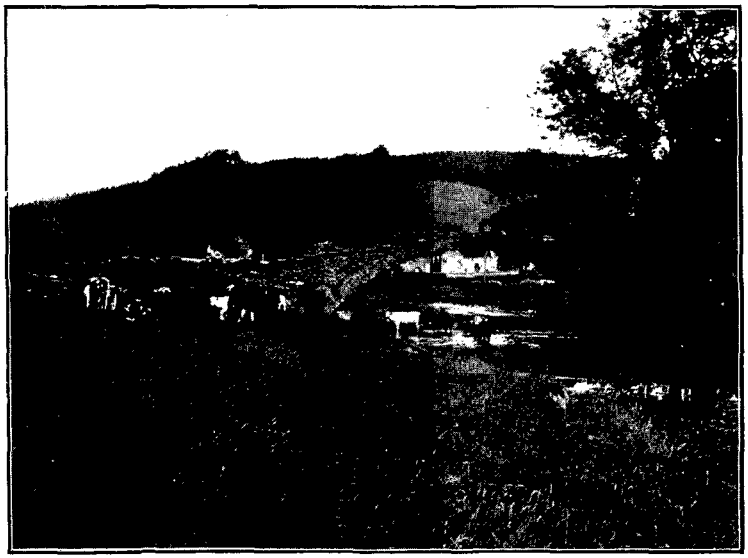

Fig. 11. Collection Bridge Period. Old Bridge at Stow, beside the Church; 1654. Roadway, 7 feet 6 inches.

bridges falling into disrepair, to build new structures, and so to promote the welfare of the country. To this Post-Reformation and "Collection Bridge" period belongs the long North Water Bridge, built by Erskine of Dun; used afterwards to herd in the Covenanting prisoners for their night's lodging on their way to Dunottar. To this period belong a little bridge at Skelmorlie, one at Dunfermline,

[1] It is only right to mention that between 1580 and 1600 I have no record of bridges being built.

the bridge at Linlithgow, the bridge of Urr, that at Berwick, as well as a long series of little bridges, 7 feet to 9 feet wide, erected beside churches, to enable the inhabitants to cross to their place of worship in safety, mostly erected from the proceeds of collections taken up in the churches.

Were it not that a number of bridges having no connection with churches were built, it would very appropriately be called the Collection or Church Bridge period, for practically every bridge in close proximity to a church was erected at this time (fig. 11).

But this happy and almost continuous period of bridge-building, from 1605 to 1650, came to an end, and an unexplained slackness for nearly 60 years swept over the land. Bridges were going to be built, but all that was actually done was spasmodic and at irregular intervals. But when the first carriages began to appear about 1680, instantly the whole outlook changed. Bridges were no longer for local use but for general traffic, and the building of important structures became urgent.

The best bridge of this period is that at Lanark (Kirkfieldbank), completed in 1699, and at that time the widest bridge in Scotland; but the troubles of the Union of 1705 seemed to drive away all money for progressive work, and the subsequent unrest, culminating in the 1715 outburst, made work impossible, and it was nearly five years before the country settled down to that era of progress which thereafter never slackened.

1720 commences the period of modern bridge engineering. In France the *Etablissement des Ponts et Chaussées* took matters in hand, and the art of bridge engineering began to be studied scientifically. But the Scottish bridge-builders adhered to their rule of thumb, and though the sparing use of material, with plenty of mortar, made a less substantial structure, bridges were run up by the shire authorities in quick succession (fig. 12). The military authorities also contributed their network of roads from Carlisle to Portpatrick, Stirling to Dumbarton, and Stirling to the Highlands; so that for 40 years a

Fig. 12. Shire Bridge Period. Earlston Old Bridge; 1755.
Roadway, 10 feet.

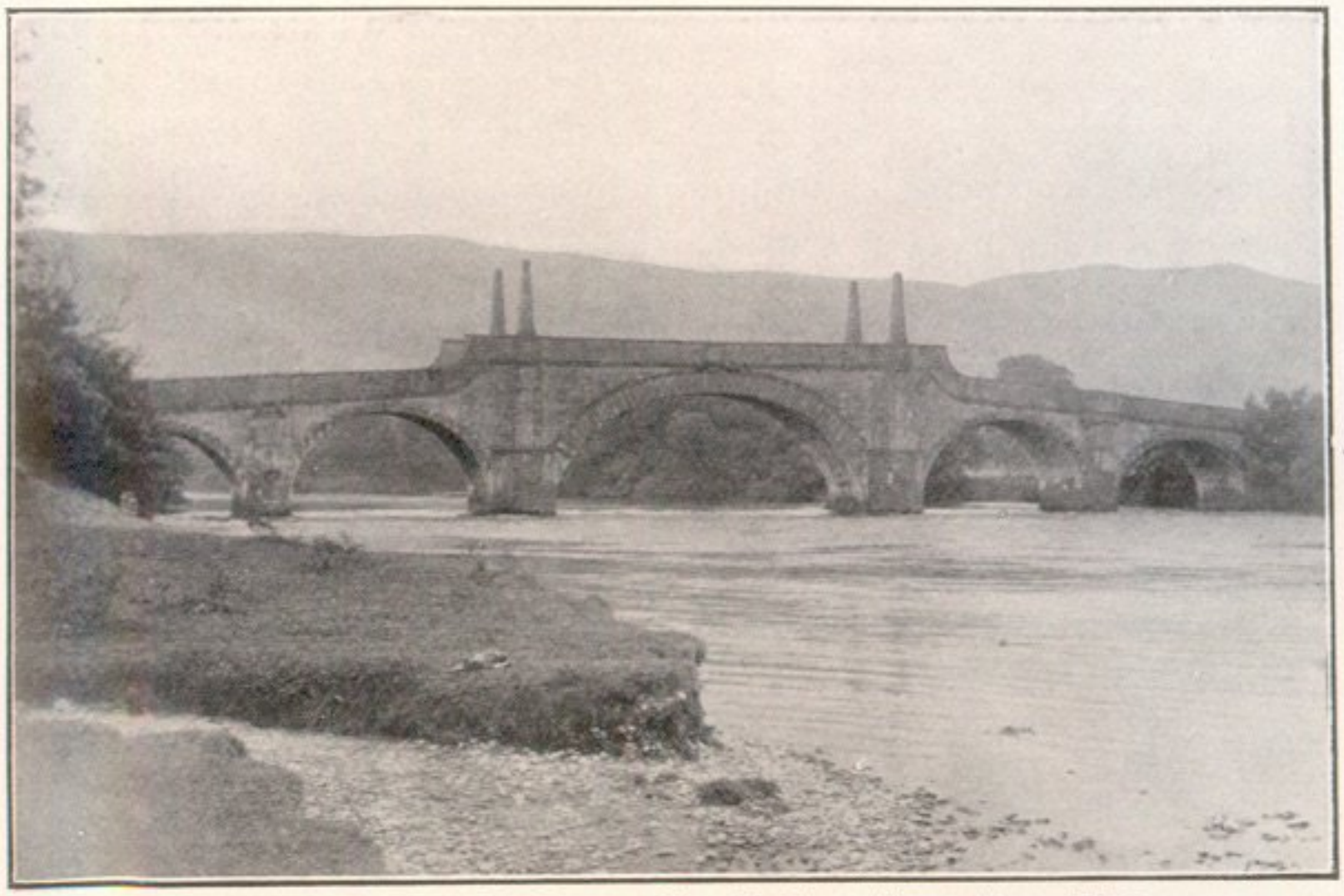

Fig. 13. Military Bridges. Tay Bridge, Aberfeldy; 1733.
Roadway, 14 feet 6 inches.

continuous series of serviceable bridges sprung up in every part of the country, for facilitating transport, hardly any of them of less than 10 feet roadway (fig. 13).

Up to this time the traffic of the country had been conducted on roads following the old horse paths, climbing hills utterly unsuited to the heavier loads of carts and carriages, and with unmetalled surface and deep ruts caused by the new traffic. It became speedily evident that the whole line of roads must abandon the hills and keep to more level ground. The money for this was found by forming Turnpike Trusts. The Turnpike Acts began to take effect about 1754, and practically brought to an end the Shire administration. The bridges were now attached to roads barred with turnpike gates. As money was more plentiful, the bridges were more solidly built and wider. Coldstream Bridge, built 1766, 23 feet wide, is the best example of a fine bridge of this period, but the average bridge was spare and rather slender, much the type of the North Bridge at Edinburgh, taken down as unsafe many years ago. This period is suitably called the *Early Turnpike,* as the year 1770 apparently marks the disappearance of the old Scottish pier so prominent in the older bridges, caused no doubt by the new theories of bridge-building which began to spread (fig. 14).

The *Later Turnpike* period, beginning 1770, as distinct from the Early Turnpike, was the commencement of a period of solid bridge construction; the piers were cut down in thickness, the arches flattened, the stones were carefully cut and dressed, ornamental mouldings were introduced to cover the joints and strengthen the parapets, and the average width brought out to 14 feet. This period is known conclusively by one special type of bridge, namely, a hollow spandril or circle, relieving the weight of the haunch of the arch. Wherever these are seen, the bridge may be assigned without hesitation to this period, as also may the bridge rising to an apex in the centre be classed as "before 1799," hardly any bridges of this design being erected after the turn of the century (fig. 15).

Fig. 14. Early Turnpike Period. Clydesbridge, near Abington; 1769. Roadway, 11 feet 9 inches; replacing an older Bridge.

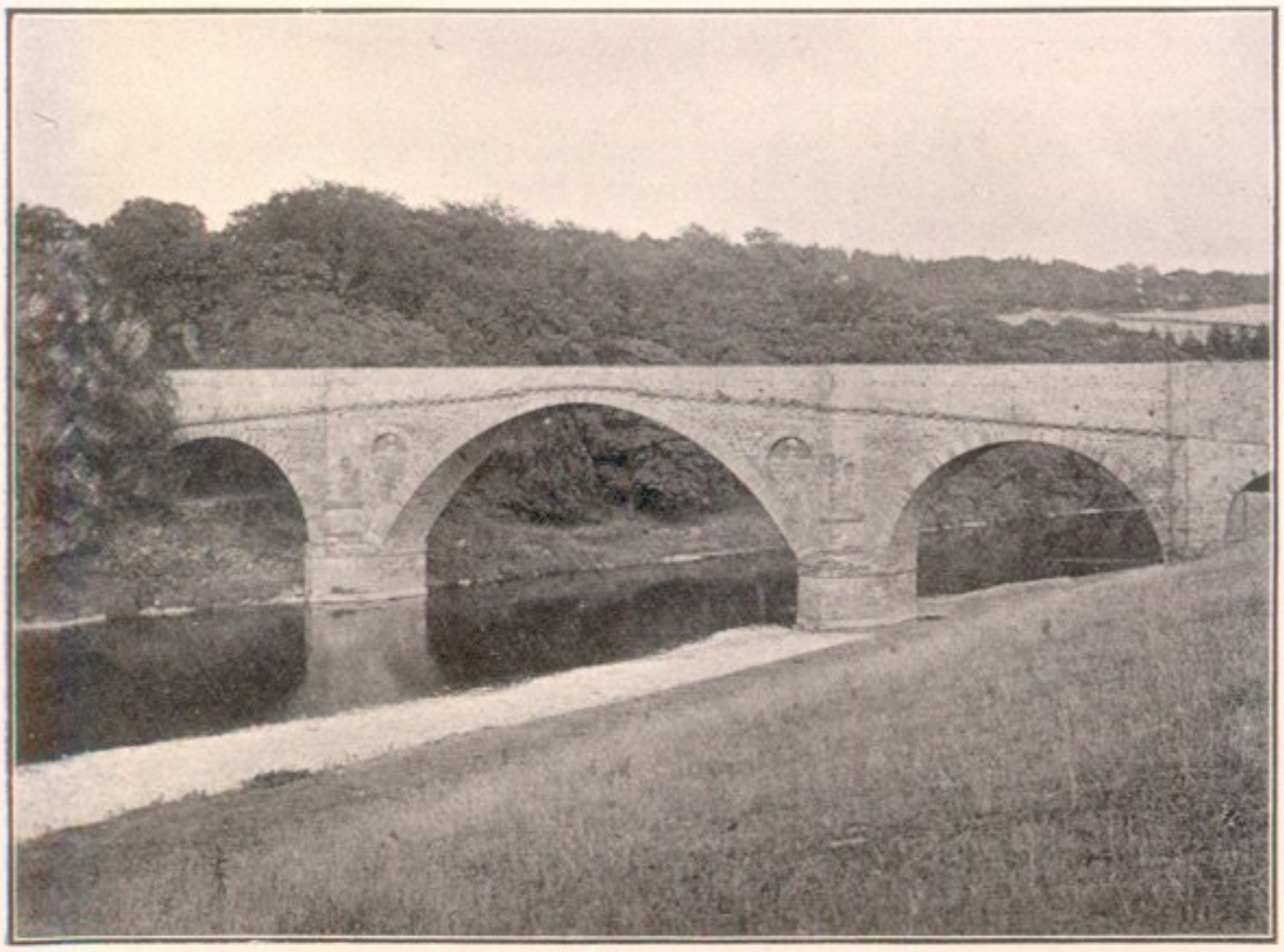

Fig. 15. Later Turnpike Period. Fly or Drygrange Bridge (Tweed); 1776–1780; showing the circular spandril, and lines rising to an apex, a style abandoned after 1800. Roadway, 16 feet.

Upon the Mail Road period, which began with the heavy and fast mail coaches about 1800, I do not propose to enter. The bridges then built were the finest and most solid constructions ever known—seldom less than 20 feet and often 30 feet wide; we pass over great valleys thinking little of them, and their life must be many more years than the more flimsy constructions of the eighteenth century. Telford's bridges are known over the world, and we cross the Dean Bridge noting the beautifully squared, close-fitting stones, and observe the light arch supporting the path and the heavy arch the traffic. These are bridges of a period of which we may be proud.

May I hark back to one phase of history which is ever before me. We have referred to the Pre-Reformation and Post-Reformation periods from 1400, the Local Collection bridges, the Shire and Military, and Early and Late Turnpike, and the Mail Road periods; but what of that 800 years between the fall of Rome and the accession of Bruce? Nearly every bridge we know comes within the historical period of the last 600 years. Were none built before that? What is the history of the bridges of France, of Spain, of Italy, of Germany? Is it not the same in every respect, 800 years of black night? The magnificent culture of Rome that spread its skeleton civilisation over Europe, that taught bridge-building to the world, and has left monuments in every colony of the vast empire—the arched aqueducts at Segovia in Spain, at Pont du Gard in France, at Rome over the Campagna—all these remain in the minds of the uncultured as being "Devil's work." How are we to explain it in any way except that the hordes of Goths, Vandals, Northmen, Danes, and Saxons who swept across Europe were almost rude, unlettered savages in comparison, with neither culture nor feeling, but to kill and possess. The departure of Roman civilisation blotted out progress in Britain, and whatever causes led to the decline and fall of the Roman empire, we must recognise the magnificence of its achievement, and deplore the ethno-

logical cause that set back the hands of the clock for 800 years. There were none that cared to build, but many to destroy.

The Danes hooked their vessels to the old wooden bridge at London, in order that the force of the current on their vessels might tear away the supports of the bridge and pull it down. If such a reckless disregard for a structure benefiting the community was the spirit of the Dark Ages, no wonder Europe was at a standstill for centuries. Indeed, if we look at history, the end of the Crusades seems to have marked the beginning of progress in bridge-building in Europe.