

Many towns, nevertheless, were still fortified in haste and only when a siege threatened. Tavannes (1850, 132) claimed that the process need not take more than three weeks.

Little or nothing remains of such works on the ground today, but it is possible that they exercised an important influence on the principles of the permanent fortification which gradually supplanted them all over Italy.

Fortress warfare had for the first time assumed the character of an equal duel. The mobile cannon and the explosive mine had certainly destroyed the medieval sense of impregnability, but it was equally true that the besieger would be badly knocked about if he just wheeled his cannon into the open field in front of the ramparts.

Hardly a decade of the early sixteenth century passed without some addition being made to the basic vocabulary of fortress warfare. As early as 1498 Philip of Cleves writes in unimpeachable terms of the need of defilading the siege attacks, 'which must be conducted with caution and sagacity. You have to watch out for the towers, bulwarks and batteries of the town, and you must direct your trenches in such a way that none of the guns can get at you inside.' Sap attacks on an extensive scale were employed by the Imperialists against Padua in 1513, and by the French against the Castle of Milan in 1515 and Pavia in 1524. Batteries varied in size from three to thirty pieces, and were planted in some sieges at a range of four hundred paces from the walls, and in others, as at Casale in 1554, in the fortress ditch itself.

The nobility of Europe accommodated themselves slowly to the muddy yet perilous work of fortress warfare, where personal prowess often went

for nothing. Branthôme writes (1858-78, book I, part 1) that in the earlier decades of the century it was almost unknown for a young courtier to go off to serve in a siege, and we have seen already how unwilling were the German nobles to get off their horses and serve on foot at Padua in 1509. Bayard too, the epitome of French chivalry, did not like the idea of fighting alongside 'cobblers, farriers, bakers, mechanics and the like, who do not hold their honour in the same high regard as gentlemen' (Mailles, n.d., 119). But in the end it was Bayard and the French knights who saw that they must fight on foot, and the Germans who refused.

Three years later Bayard himself was the first to propose that the armoured nobility should dismount and stiffen the infantry in the assault on Brescia. As the century wore on there are signs that people were ready to look on the defence or attack of a fortress as an affair just as glorious as (and far more important than) a cavalry encounter in the open field. Kings of France made a point of awarding the Order of Saint-Michel to officers who had distinguished themselves in the command of a besieged fortress; Bayard was so honoured for his defence of Mézières in 1521, de Lude for his dogged resistance at Fuenterrabia in 1522, and Montluc for his help to the Sienese in 1554-5. From the middle of the century onwards, we find that commanders like Guise and Coligny no longer stood aloof from the routine and danger of siege warfare, but eagerly sought out and listened to any veteran who had experience of this trade. Parma, for one, never undertook a siege without constantly referring to a centenarian private soldier who had trailed a pike for Spain since as long ago as the Middle Ages.

Two Later Italian Wars and the Origins of Permanent Artillery Fortification 1530-1600

War in a fortified theatre

The Italian wars of the 1530s, 1540s and 1550s were fought under conditions radically different from those of earlier decades. Politically and strategically the scene was simplified by the fact that the House of Habsburg never released its grip on the Duchy of Milan and the Kingdom of Naples, lands which in earlier wars used to change hands several times in a single year. As for the Pope and the Florentines and Venetians, they stood aloof for most of the time from the quarrels of the French and Imperialists, and, having affirmed their neutrality by studding their states with fortresses, they managed to push the theatre of war away from themselves and north-eastwards to the Lombard plain and the Alpine foothills of Piedmont.

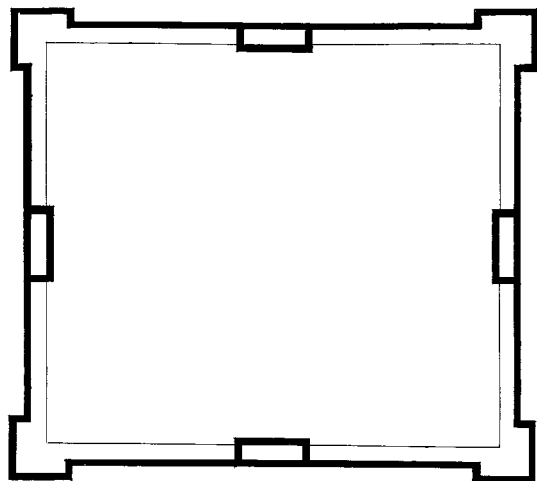
Frontiers were congealing and solidifying fast. Bourbon's expedition to Rome in 1527 may be counted the last of the old-style unrestrained rampages which had been devastating Italy since 1494. Antonio da Sangallo the Younger and Michele di Sanmicheli were already at work on strengthening the fortresses of the Pope's northern dominions, and when, thirty years later, the Duke of Guise came south to attack Naples, the French no longer traversed central Italy by right of their cannon, but by invitation of the Pope, who needed help against the Imperialists. While the negotiations were still in progress, Guise wrote to his brother to ask whether His Holiness was aware of the quantity of artillery needed to make up a modern siege train:

You know that when you want to take a fortress of any strength, you have to think of taking along twenty-four heavy cannon to form two batteries, and six or seven powerful culverins to fire at the (upper) defences. You must also have at hand eight or ten thousand shot and 200,000 pounds of powder (Guise, 1850, 251).

The techniques of siege warfare had been worked out and proven during the turmoils of the first three decades of the century. The problems which remained were those of execution rather than invention. Here lay the difficulty: major new theatres of war had opened on the Emperor's frontiers with Turkey and on the northern borders of France, and neither the Imperialists nor the French could spare resources for Italy, where campaigning was consequently feeble and short-winded.

While the Imperialists were fortunate enough to be established in the Duchy of Milan, the entry of the French to Italy still hung upon the goodwill of the Duke of Savoy. This uncertain foundation collapsed altogether when hostilities threatened in 1536, and Duke Charles III refused his uncle Francis I the requested passage across Piedmont.

The French overran the offending territory in a lightning campaign, but the resistance of the fortress of Vercelli destroyed any prospect of their continuing the advance into Lombardy. Now that the French had lost the initiative, Emperor Charles V



7 The citadel of Turin

gathered together fifty thousand men and dodged around the southern flank of the Maritime Alps into Provence. Here the Imperialists were checked by a retrenched camp at Avignon, and, as was usual in such cases, the invading army was decimated by disease and forced to retreat.

Over the following years the French consolidated their Piedmontese foothold across the Alps. They strengthened Moncalieri, Savigliano and Centallo with the help of Italian engineers, and transformed Turin into the citadel of French power in Italy. The new fort at Turin consisted of a great square which was flanked by four large right-angle bastions. Half-way along the six-hundred-yard length of each of the curtains rose a cavalier or artillery platform, which commanded the curtain and swept the open space lying between the new outer enceinte and the old medieval castle which was preserved within. In the sixth book of his *Quesiti e Inventioni* of 1556 the artillery writer Tartaglia takes the Prior of Barletta to task for claiming that 'as far as the art of fortification is concerned, the human intellect has reached the highest attainable summit'. The Prior produced as evidence a plan of the new fort at Turin, a work 'which all men of understanding regard as impregnable'. Tartaglia riposted that he could find 'no trace of particularly great understanding in that construction', but he was vague as to what he would have preferred to put in its place (Tartaglia, 1556, part 6).

The Imperialists were never able to evict the French from their Piedmontese enclave. A dangerous offensive which began in 1543 was blunted by the French victory at Ceresole on 14 April of the next year. Hostilities broke out again in 1551, but the Marshal de Cossé-Brissac was able to preserve most of the disputed territory by means of bold marches and a well-calculated use of interior lines.

In 1555 the Imperial general Alva came to Italy with an army of some thirty thousand men, together with a 'large number of pioneers who were to follow the practice of the Turks by digging great quantities of earth and filling up ditches with wood and fascines' (Branthôme, 1858–78, book I, part 1). All the Spanish might proved of no avail against the earth-and-log fortress of Santhià, which successfully withstood a three-week siege in August.

By such means the French held on in Piedmont until the Imperialists were compelled to come to terms by a series of reverses in northern Europe. The Peace of Câteau-Cambrésis of 1559 was favourable to the French (apart from compelling them to abandon Turin), and secured them the foothold in Italy for which King Francis had first gone to war in 1536. They owned a secure communication back to France by way of Pinerolo, and they had defensible outposts at Chivasso, Chieri and Villanova d'Asti, which usefully hemmed in Turin.

What truly lay beyond redemption was the former

French influence in central Italy. In a last outburst of the republican spirit of medieval Italy the city of Siena had cast out its Spanish garrison in 1552, and appealed to France for help. The Imperialists closed in from all sides, and although successive French reinforcements under Piero Strozzi and Blaise de Montluc managed to prolong the resistance of the Sienese, the city itself capitulated from hunger on 21 April 1555. With the fall of the last stronghold, Montalcino, in 1559, the republic was swallowed up altogether in the Grand Duchy of Tuscany.

The development of permanent artillery fortification

The need for permanent fortification

The history of *active* fortress warfare in sixteenth-century Italy may be adequately recounted without a single reference to permanent artillery fortification. A cat would just as soon swim a tub of citrus juice as a sixteenth-century engineer would have set about the siege of some of the new strongholds that were springing up all over Italy. Moreover, some of the most enlightened patrons of the new fortification were careful to keep out of the quarrels of their powerful neighbours. Thus Verona was repeatedly besieged early in the century, yet after it was rebuilt in the 1530s it never saw a determined enemy until 1797; thus Rome in 1527 was as thoroughly sacked as a city can be, and did not undergo a further siege until 1849.

If the permanent fortification of the Italian Renaissance was of purely deterrent and negative value in its own time, the brilliance and originality of its designs nevertheless determined the shape of strongholds until the middle of the nineteenth century.

The strong provisional works of the early sixteenth century were gradually replaced by fortresses in masonry. These were costly, but always available for use. Whereas provisional fortresses like Santhià were cheap to build and offered almost inexhaustible passive resistance, they proved to be difficult to keep up in time of peace. In the course of time the earthen banks subsided and the palisades decayed – which was dangerous in the case of a

frontier fortress, and fatal if the stronghold was intended to hold down restless people like the citizens of Pisa, Florence, Siena or Antwerp.

The permanent fortress also had the advantage of appealing to a certain aspect of human nature. Fortress-building gave a cowardly sovereign something literally and metaphorically concrete to do, in time of deepest peace, which could directly influence the course of a future war. Whereas the finest field regiments were at the mercy of accidents or poor leadership, a well-built fortress could intervene in wars which were waged years or generations hence, long after the writs of other legacies had run their course.

The bastion system: its nature, origins and development

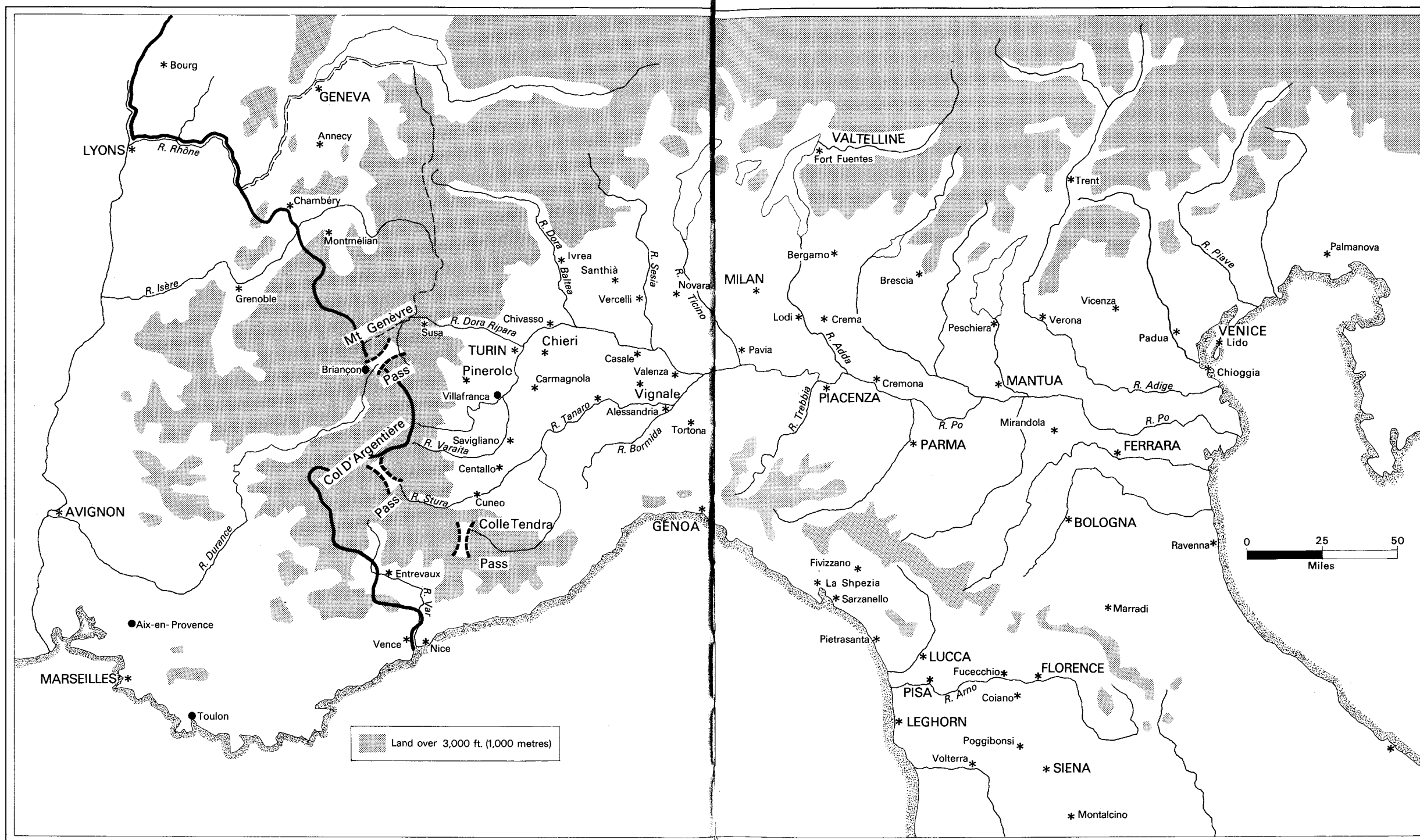
The new fortresses were traced according to a revolutionary principle. The younger generation of Italian military architects rejected the circular towers of medieval times in favour of a four-sided angular construction called the 'bastion', which consisted of two sideways-facing 'flanks', and two outward-facing 'faces'. Three far-reaching consequences were inherent in the new shape:

1 The provision of a distinct and wide flank enabled the defender to bring a heavy cross-fire to bear along the ditch.

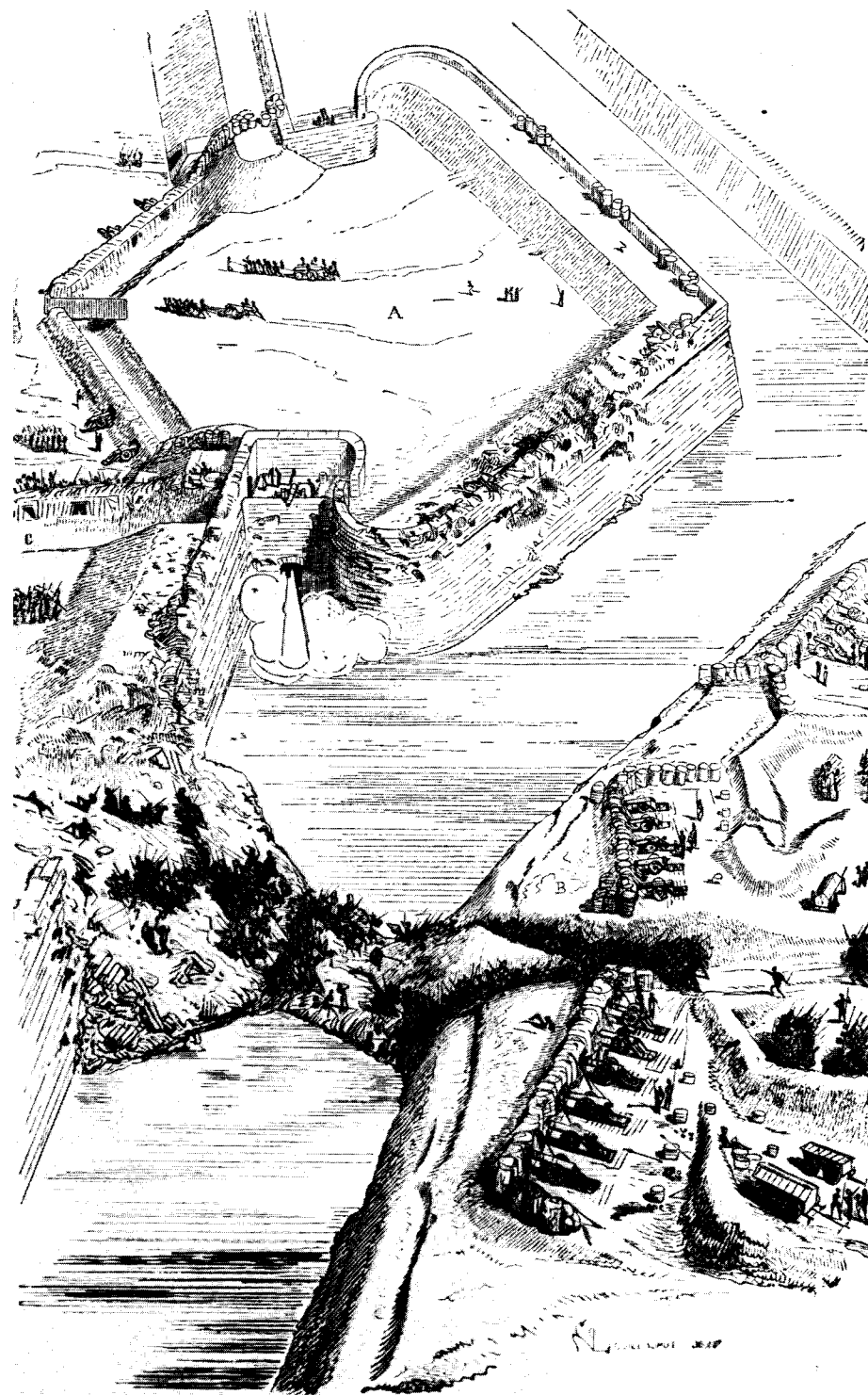
2 The meeting of the two faces of the bastion in an angular salient effectively eliminated the patch of dead ground which had existed in front of the circular medieval tower, and opened clear fields of fire for the flanks of the neighbouring bastions. No longer did an individual tower have to provide for its own close-range defence.

3 The long, straight parapets of an angular bastion enabled the defender to mount a greater quantity of cannon than was possible in the case of a circular tower of similar dimensions and cost.

Among the supposed forerunners of the bastion system are numbered certain wedge-shaped towers in the designs of Francesco di Giorgio Martini in the 1470s (La Croix, 1963, 265), a triangular spur on the northern tower of Mont Saint-Michel, and the extraordinary outer enceinte of the Castle of Lucera (1269–83) (Langenskiöld, 1938, 265–7). Claims



North Italian fortresses in the sixteenth and early seventeenth centuries



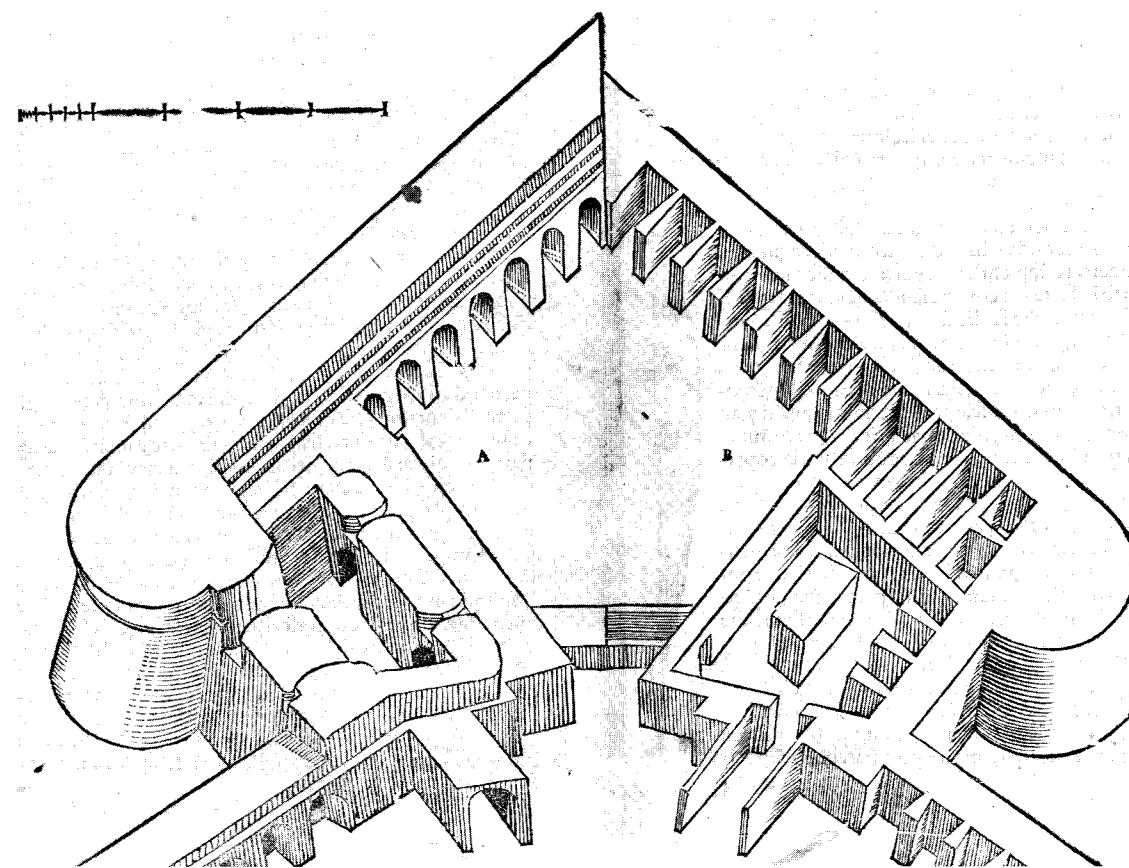
8 A bastioned fortress under siege, showing a retired flank in action (Violet-le-Duc)

have been lodged on behalf of the Hussites, the Turks, the Spanish (Un Antiguo Oficial, 1846, 52–3), and, rather tentatively, the Peruvian Indians.

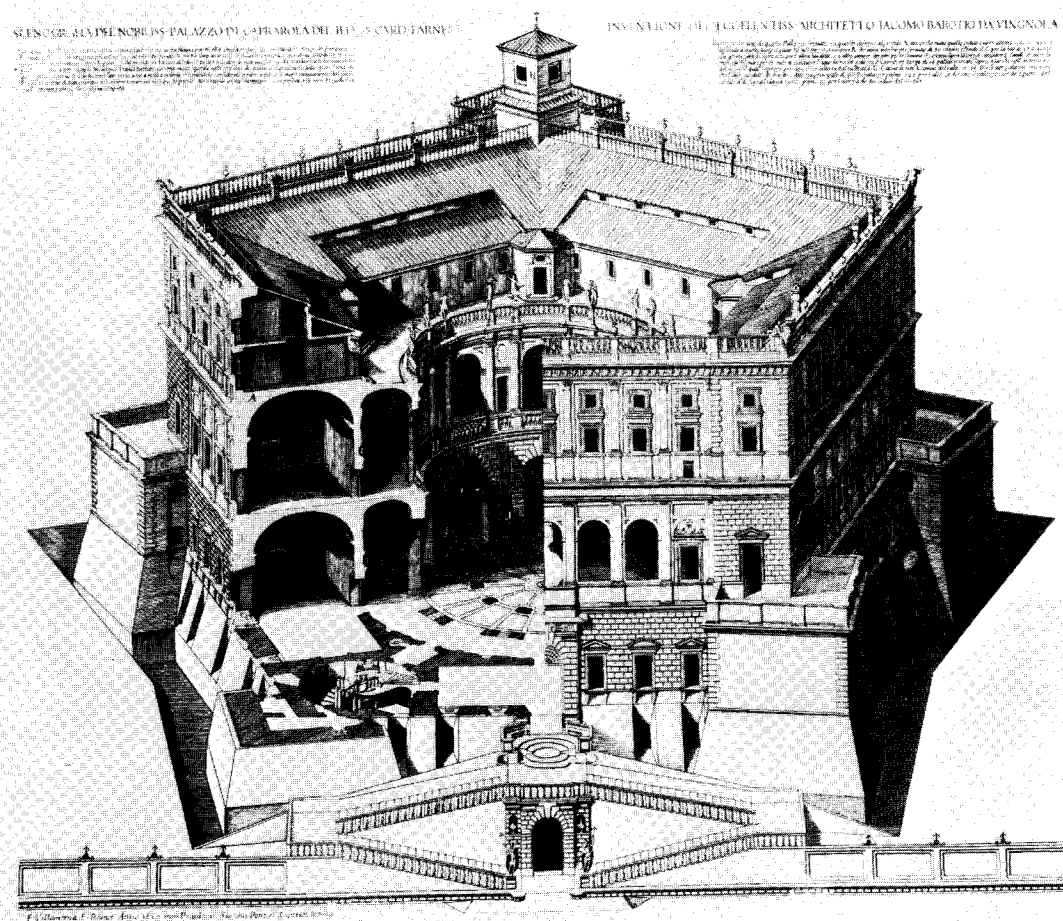
We are on much surer ground when we turn to the work of the Florentine family of Sangallo, which reshaped the sloping walls which had been built in Tuscany since the middle of the fifteenth century into something which is undeniably 'bastioned' in concept. Giuliano di Francesco Giamberti da Sangallo (1445–1516) was almost certainly the architect who in 1487 drew up the designs for the castle and the town enceinte of Poggio Imperiale, which present ten unmistakable bastions. In 1494 his brother, Antonio da Sangallo the Elder (1455 or 1463–1534) began to reconstruct the fort of Civita Castellana for Pope Alexander VI as a small

pentagonal fortress incorporating four bastions, a single round tower and an octagonal inner *maestio* or keep.

After taking these first decisive steps, the Sangallos began to employ the angular bastion with increasing freedom and invention. The four bastions of Giuliano's square fort at Nettuno (1501–3) show a significant development, namely the recessing of the greater part of the flank into a 'retired flank', a feature which was to become one of the hallmarks of Italian fortification. The outer part of the flank, where it met the face, followed the line of the earlier straight flanks, so forming an ear-like lobe or 'orillon'. The orillon screened the retired part of the flank from view, and enabled it to proceed undisturbed with its vital work of defending the ditch.



9 View of the masonry of a bastion, showing massive interior buttresses (counterforts), and a double retired flank (on left) (G. Zanchi, 1560)



10 Caprarola

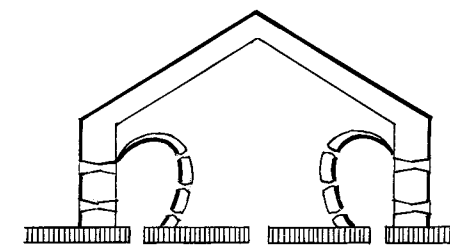
Giuliano was a devotee of orillons with rounded corners, whereas Antonio favoured the squared-off variety.

At Caprarola in 1515, Antonio da Sangallo the Younger began to build the fortified basement of the future palace of Cardinal Alessandro Farnese in the form of a regular pentagon, a classic shape of artillery fortification which became very popular in later times for the design of citadels. The actual palace (1559–73) was piled immediately on top of the fortification by Giacomo Barozzi ('il Vignola'). The tradition of the fortress-villa survived well into the seventeenth century in central Italy; the motives were partly symbolic, and partly practical – as a deterrent against restless vassals or Moslem pirates. The most spectacular construction of the kind was Buontalenti's Fort Belvedere (1590) at Florence, which formed a defensible perimeter around a villa which had stood for many years on Monte Magno. This kind of arrangement also held a strong appeal for the nobles of eastern Europe, who were isolated on their plains amid potential enemies, and in the seventeenth century we encounter Polish 'Caprarolas' at Krzyztopor and Podhorce, and an Italo-Moravian counterpart in the palace of the princes Kaunitz at Austerlitz. There are similar buildings at Verdala and Mellicha on the island of Malta.

While the Caprarola fortification was still a-building, the bastioned motif was being applied to the urban enceintes of Civitavecchia, Ferrara, Urbino, Pesaro and Senigallia. The first large-scale and systematic application of the bastion motif to the fortification of a town was, however, the work of the Venetian architect Michele di Sanmicheli (1484–1559).

Sanmicheli had made the acquaintance of the Sangallo family while he was in the Pope's employ, but in the desolate months after the sack of Rome in 1527 he travelled north to the comforts of his native Venetia. There he attracted the suspicion of the authorities by taking an excessive interest in the fortifications at Padua. But this little misunderstanding was soon cleared up, and on 14 April he was given the title of *Ingegnere al Servizio dello Stato per le Lagune e Fortificazioni*, an unusually responsible post for a son of Verona.

In 1530 Sanmicheli had already taken over the



11 The San Bernardino Bastion at Verona

task of reconstructing the works of his home town Verona, which was one of the key fortresses of the Venetian mainland. Verona had been seized and held by the Imperialists earlier in the century, and Sanmicheli and his masters were determined never to let foreigners get possession of such an important position again. The mountains formed a natural barrier to the north of the town, but Sanmicheli had to strengthen the western and southern sectors of the enceinte by remaking long stretches of the curtains, and building in succession the bastions of Trinita, San Bernardino, San Zeno and Spagna.

These Verona bastions were angular, in the Sangallo tradition, but they themselves incorporated some influential novelties. The bastions and curtains alike were low-lying, and their revetments of brick masonry were backed up by counterforts (interior buttresses), a narrow internal arched corridor, and a thick rampart of solid earth. Stout ashlar courses bound the bastions together at the angles. All of this made for a design of great stability and endurance. Sanmicheli elaborated on the Sangallos' simple retired flank by building his retired flanks on two levels: an upper, concave flank on the level of the terreplein of the bastion, and, further to the front, a lower straight flank near the floor of the ditch.

For the Porta Nuova at Verona, Sanmicheli devised a gateway in the form of an ancient triumphal arch. The design of gateways had languished in recent decades, but in the Porta Nuova Sanmicheli built a work which matched his bastions in strength and novelty, and proved to be at once artistically and militarily satisfying. With its severe yet effective architectural decoration, lateral guard-rooms, and arrangements for gates – a large central arch for vehicles, and smaller side arches for

pedestrians – the Porta Nuova was going to influence the form of gateways for more than three centuries to come.

To follow the later career of Sanmicheli is to discover in him the qualities which place him as first in the direct line of the great engineers of the sixteenth and seventeenth centuries. He was as liberal-minded and considerate as Vauban, while he bore with Coehoorn all the tribulations of having to work for a republic. In his appearance, at least, he was an original: he owned a hooked nose, a keen eye, and a long curly beard which strangely matched his bald and decidedly pointed head.

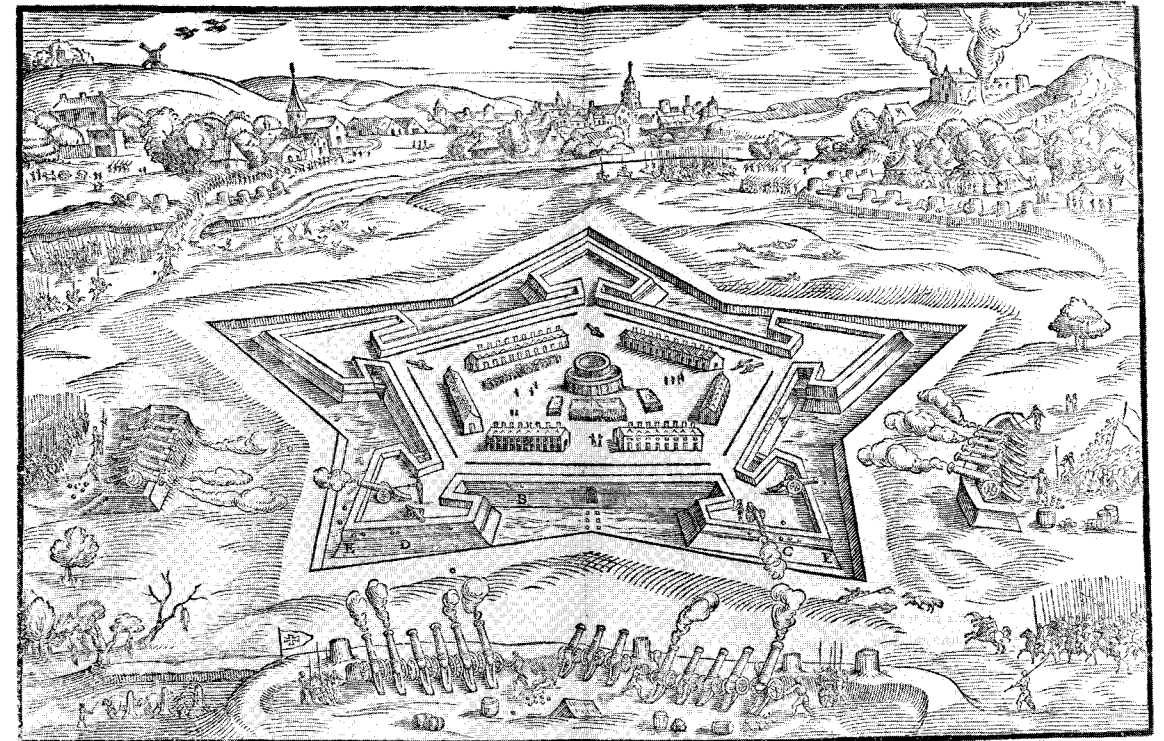
Far more than a hired technician, Sanmicheli served the Venetian Republic with complete devotion, concerning himself not just with fortifications, but with public health, civil architecture and engineering, as well as the wider issues of

state defence. He travelled as far afield as Crete to build new defences against the Turks, and he secured the mainland possessions of the Republic by strengthening Chiusa, Legnago, Peschiera, Brescia and Bergamo. He was especially proud of the new works at Padua which, he claimed, made that place the strongest fortress in Italy, 'and when I say Italy, I mean all Christendom' (Langenskiöld, 1938, 30).

Sanmicheli designed his fortifications according to the nature of the site, and made no attempt to impose the model of his Verona works as a rigid 'system' that was to be applied in all cases. Thus the main defence of Chioggia, at the southern entrance to the Venetian lagoon, resided in a wide ditch, not in masonry ramparts as at Verona or Padua. A similar freedom is shown in the design of the massive seven-sided casemated fort of Sant' Andrea, on the Lido sandspit guarding the northern channel into



12 Porta San Pietro (Lucca). A characteristic fortress gate, with a central arch and two smaller entrances for pedestrians. The stout masonry is crowned by a pavilion



13 Classic pentagonal citadel, of the type made famous by Paciotto

the lagoon. The Senate, taking into account Sanmicheli's achievements in the distant colonies, decided that he deserved the honour of being commissioned to fortify this prominent site, which lay within view of the city of Venice. He began to work in about 1543, by driving a double row of piles into the marshy ground, and assembling a huge labour force which set down the first layer of stones in one go. After allowing the foundations some time to settle, he built up a stout masonry fort on top, and finished off the outside with hard-wearing Istrian stone. Some malignant spirits suggested that this wonderful work would collapse under the concussion of the firing of its own artillery, whereupon the Signoria piled a large number of its heaviest guns into the fort, and discharged them simultaneously without the slightest damage to the fabric.

What Sanmicheli did for the fortified town, the Duke of Savoy's engineer Francesco Paciotto da Urbino (1504–76) did for the design of the military

citadel. In 1564 he founded the new citadel of Turin, a work which was universally admired for its regularity and the magnificence of its conception. Gabrio Busca proclaims that Paciotto was

the first engineer to make the curtains and bastions of reasonable size, and arrive at a rational allotment and distribution of the parts of fortification. For this reason we may say that he was the first man to put his profession on firm foundations. I am quite certain that nobody built so many royal fortifications as he did, whether in Flanders, Savoy, Piedmont or elsewhere in Italy. The architects who preceded him used to grope their way forward by guesswork, and they followed no regular manner in the design of their shoulder angles, flanks or curtains (Promis, 1863a, 429–30).

By the end of the sixteenth century all the advances of the earlier decades had been incorporated into a coherent system of fortification

called the 'New Italian School' (Tartaglia, 1556; Cataneo, 1554; Maggi and Castriotto, 1564; da Carpi, 1570, 1584; de' Marchi, 1599; Scamozzi, 1615; Sardi, 1639). The hammer-headed bastions had by now become massive and powerful affairs, and they were grouped closely enough together to permit the whole of the intervening ground to be swept by artillery. At Sarzanello in 1497 the Genoese had devised a free-standing triangular outwork, an important new fortification which later became known as the 'ravelin'. The ravelin was placed in front of the curtain, on the same site as the old medieval barbican. Its most immediate function was to cover the gateway in the curtain wall behind. Towards the end of the sixteenth century, however, engineers came to appreciate that a sufficiently large ravelin could protect the curtain as a whole and lay down a cross-fire over the ground in front of the neighbouring bastions. For those reasons ravelins began to appear on ordinary fronts which were devoid of gates.

In the first decades of the new artillery fortification, the musketeers and the cannon had been crowded into the single line of defence which was formed by the bastions and curtains. In 1556 Tartaglia made the excellent suggestion of stationing some of the infantry in a walkway (*via coperta* or *via segreta*) which was to be cut into the top of the outer rim of the ditch. Pietro Cataneo added to the efficiency of this 'covered way' by broadening the salient and re-entrant angles of the work into 'places of arms', where large numbers of infantry could congregate for the purposes of defence or counter-attack. The ground in front of the ditch was heaped up into a bare fire-swept slope called the 'glacis', which acted as a massive parapet to the covered way, and helped to screen the masonry of the ravelins, bastions and curtains from artillery fire.

Taken together, the main rampart, the ravelin and the covered way made up a triple line of works, which formed an effective defence in depth and went far to fulfil the requirements for a true artillery fortification.

It was not altogether surprising that the bastion system should have originated in Italy. On the one hand, the Italians were the people who were the first to encounter the power of the new artillery. On the

other, they were well suited by character and circumstances to devise the best counter-measures. A naval historian has discovered an illuminating parallel for the work of the influential warship-designer Cuniberti at the beginning of the twentieth century:

Ever since the Renaissance, the Italian engineering mind has always had a special capacity for viewing a project with a fresh and practical artistry. The Italian talent for stripping down to bare essentials the elements of compromise, which is the heart of all creative design, has never been surpassed (Hough, 1964, 4).

There is every reason to regard bastion fortification as a characteristic product of fifteenth- and sixteenth-century Italy, alongside more 'artistic' manifestations like painting and sculpture. Great civil building projects such as the Duomo at Milan or St Peter's at Rome gave men unrivalled experience in assembling labour and materials on the same scale that was needed for fortress construction, and provided meeting places where engineers could exchange ideas, and find patrons and colleagues who would help them to put their military designs into effect. The clearest example of this process in operation is offered by the construction of the Borgo enceinte at Rome.

Moreover the men of the Renaissance held that fortification obeyed the same laws of organic symmetry as governed all branches of architecture. According to Scamozzi, 'for a powerful and well-designed fortress, you must dispose and arrange the elements in the same way that Nature, the true teacher of all things, has ordered the parts of the human body' (Scamozzi, 1615, 191). Cataneo and Sardi expressed similar sentiments. The organic ideal was expressed in geometrical terms, reflecting contemporary advances in surveying and cartography, and perhaps also a survival of medieval obsessions with mystical symbols and numbers. The pentagon in particular was invested with a magical significance.

Programmes of fortress-building

By the middle of the sixteenth century all the major states of Italy and most of the minor ones had



14 Ravelin at Sarzanello. Probably the earliest example still standing

undertaken schemes of defence which were based on the new fortification.

The doyen of the Venetian architects, Sanmicheli, died in 1559, and his place was eventually taken by Giulio Savorgnano, one of the twenty-three sons of the vigorous old general Girolamo Savorgnano. Giulio worked at Zara, Zante, Candia and on the Cyprus fortifications, and in 1593 he co-operated with Vincenzo Scamozzi to build the important mainland fortress of Palmanova, which stood in the Friuli plain in the path of Austrian and Turkish invasions. The 1600s witnessed a lavish new Venetian expenditure on fortifications, this time prompted by the growing power of the Spanish in Lombardy. The military commentator Federico Ghislieri dal Bosco began to wonder whether all the

effort was worth while, for 'this republic will be incapable of waging offensive war as long as she keeps 15,000 and more "dead" troops locked up in her fortresses' (Promis, 1863b, 620).

If Florentine sieges tended to be feeble and long drawn-out, there was no mistaking the sense of purpose behind the fiercely-indented bastioned works which the Medici dukes were now building to overawe their cities. Significantly, one of the first works undertaken by the Medici after their restoration in 1530 was the Citadel da Basso, which was sited between the Prato and San Gallo gates of the city of Florence. The foundation stone was laid on 15 June 1534, and the building was prosecuted with great speed by Antonio da Sangallo the Younger (1485–1546). The result was a deliberately

aggressive-looking polygonal fort, with narrow curtains, and acute bastions which were revetted in ashlar blocks studded with disc and diamond decorations. Only later came the fortification of the city enceinte and the hill of San Miniato, according to the designs of the former wool-merchant Giambattista Bellucci (1506–54). In the same way the subjugation of Siena was celebrated by the construction in about 1560 of the large brick-revetted citadel of Santa Barbara, planned by Baldassare Lanci on the orders of Duke Cosimo I.

The Popes were in no way outdone by the Medici dukes. Once Orvieto had been strengthened as a vital refuge immediately after the sack of Rome, the papacy could afford to look wider afield. In 1536 Antonio da Sangallo the Younger built a citadel crowning a dominating height at Ancona, the main papal port on the Adriatic coast. Nine years later work was begun on Piacenza on the plans of the same architect, so helping to defend the landward approaches to the north-west flank of the Romagna.

Rome itself was dangerously vulnerable, as was shown by episodes like the great sack of 1527, or the appearance of a Turkish fleet off the Tiber in 1534. A series of engineers completed the outer bastioned defences of the Castel Sant' Angelo, and in 1537 Paul III and his *Dieta* of architects set about the task of fortifying the Borgo (Vatican City) with nearly two miles of enceinte, ten large bastions and five main gates. The bursts of activity in the 1530s, and again in 1548, 1563 and 1613 were interspersed with long periods of lassitude brought on by lack of money, lack of interest, and stultifying arguments.

Out of all the Borgo works, none attracted wider attention than Antonio da Sangallo's elaborate and splendidly-proportioned bastion by the Porta Ardeatina, at the southern extremity of the enceinte. It was not too polite for a stranger to inquire after the cost.

Meanwhile in the far north-west corner of Italy, Duke Emanuel Philibert of Savoy (1528–80) was making a skilful job of piecing Savoy and Piedmont together again after the bout of Franco-Spanish wars which came to an end in 1559. He was a student of engineering and artillery, and he had a command of Latin and five modern languages. He therefore conceived very firm ideas on what had to be done for

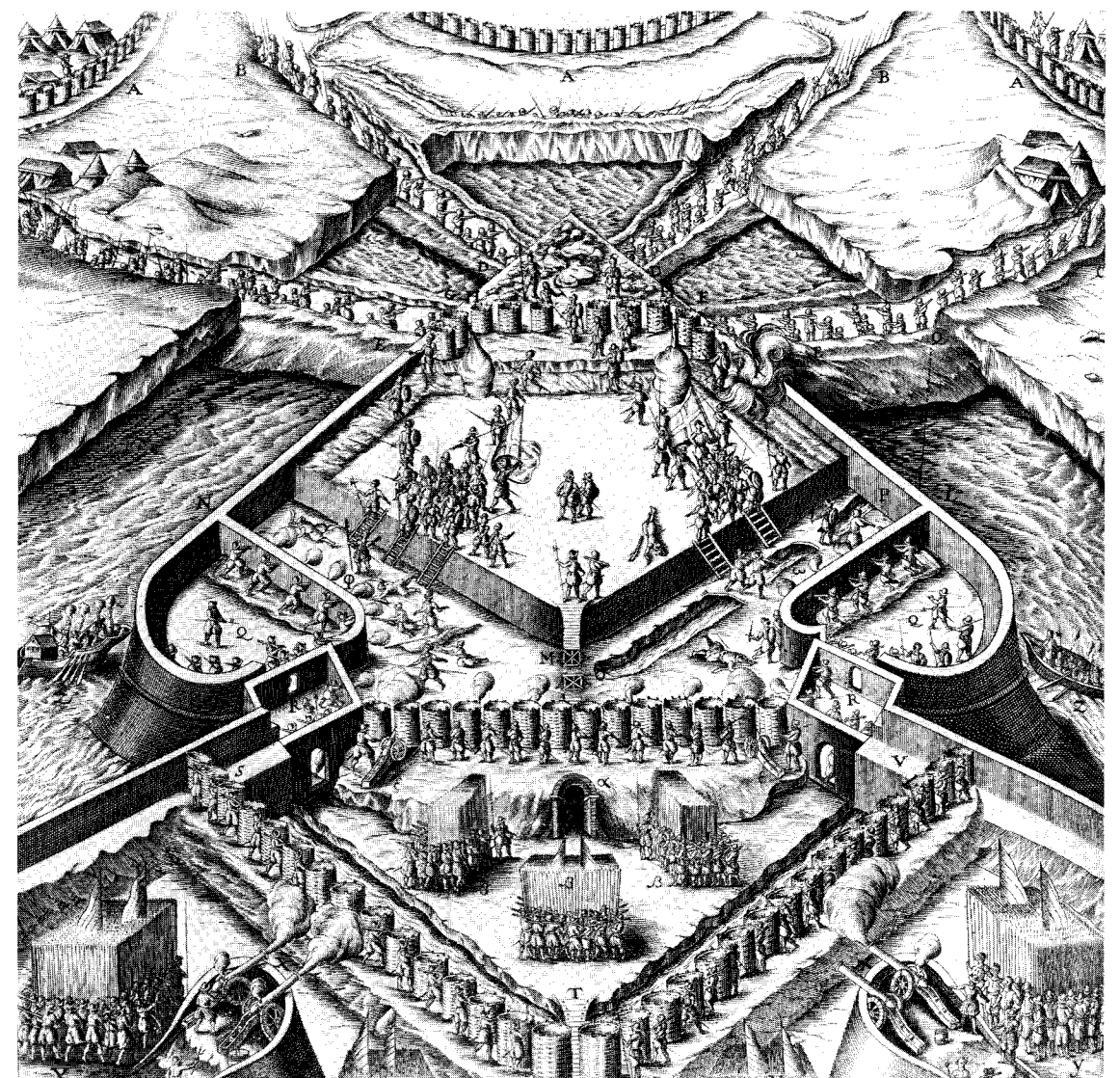
the defence of his domains, and he exercised a tight personal control over the ring of gifted engineers he summoned to help him at his work: Paciotto, Vitelli, Orologi, Busca and others.

Turin was at last recovered from the French on 12 December 1562. Emanuel Philibert accordingly moved the capital thither from Chambéry, and, since the place was still encircled by French posts, he presided over the building of a powerful citadel, according to the designs of Paciotto, and ringed it with a stupendous system of brick-lined countermines. The Duke of Alva, the famous Spanish commander, was so impressed with what had been done at Turin that he whisked Paciotto off to the Netherlands and asked him to repeat the performance at Antwerp.

On the Alpine flank of his states, Emanuel Philibert set Gabrio Busca to work to strengthen the Savoyard frontier by building the castle of Montmélian, 'a fortress of a most unusual site and construction, being largely cut out of very hard rock' (Promis, 1874, 620). The duke himself designed the companion fortress at Bourg-en-Bresse, which occupied another cramped and difficult site. He completed the triangle of mountain fortresses by constructing the great stronghold of the Annunziata, which helped to overawe the heretical city of Geneva and leant some colour to the Duke's declaration that all his effort was devoted to containing Protestantism. This pious striving did not deter him from planting a fortress on the site of the monastery of Mondovi, and buying up unoffending popish church bells from the Huguenots and having them recast into cannon by Protestant German foundrymen.

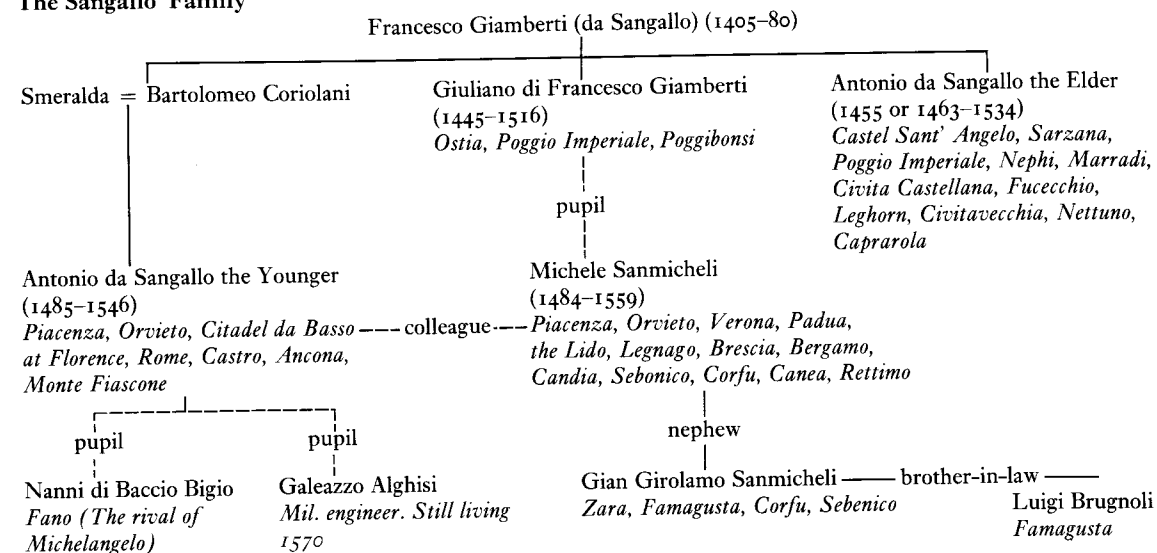
All the time Emanuel Philibert was working hard to recover the rest of the alienated territories on the north Italian plain. The Spanish restored Asti and Santhià in 1575, and the Duke was still trying to persuade the French to disgorge the Marquisate of Saluzzo when he died in 1580.

To the south of Piedmont-Savoy, the coastal republic of Genoa cast around in 1536 for the best possible advice in modernising the defences of the capital city. Antonio da Sangallo the Younger proved to be too busy to attend to the work in person, but from Milan the Senate managed to

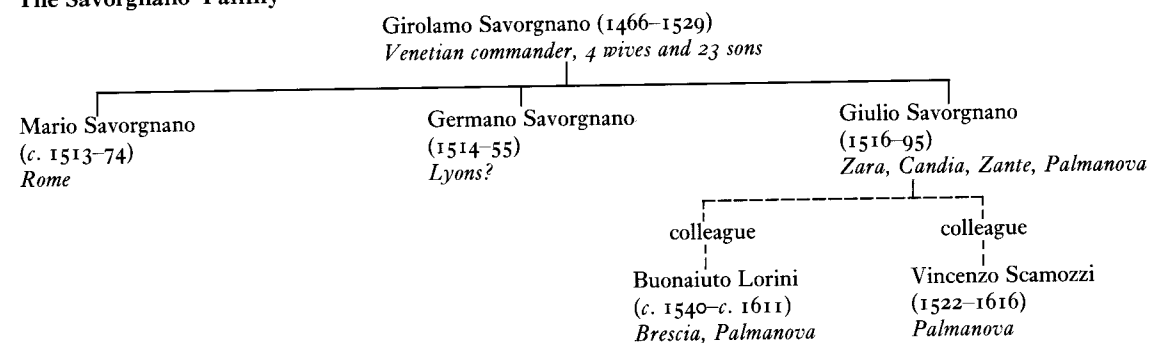


15 Defence of a bastion. The salient has been lost, but the garrison is resisting behind elaborate retrenchments inside the bastion

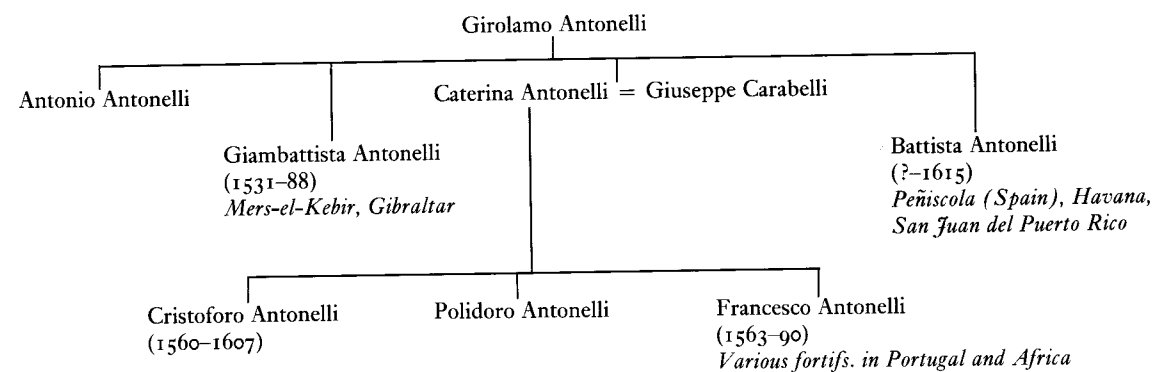
The Sangallo 'Family'



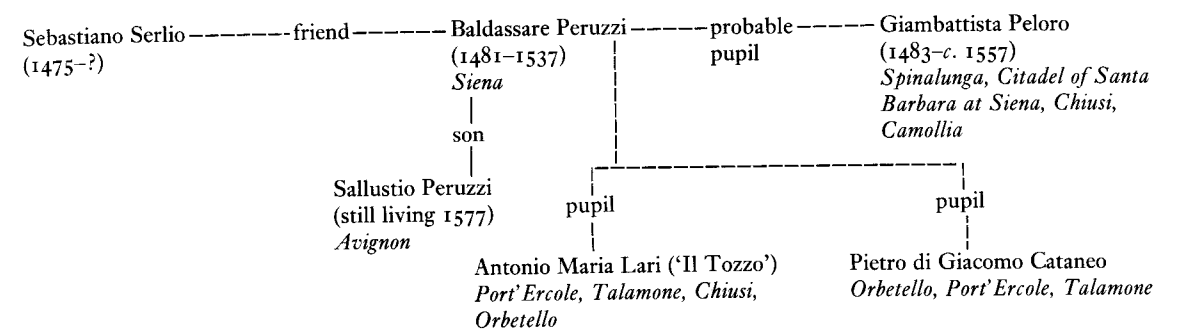
The Savorgnano 'Family'



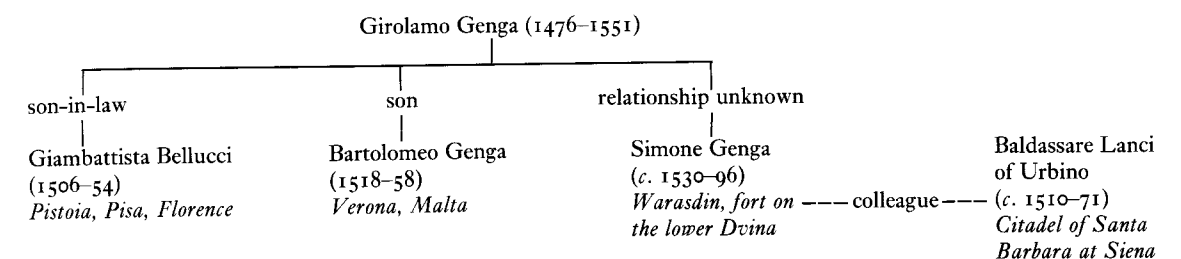
The Antonelli 'Family'



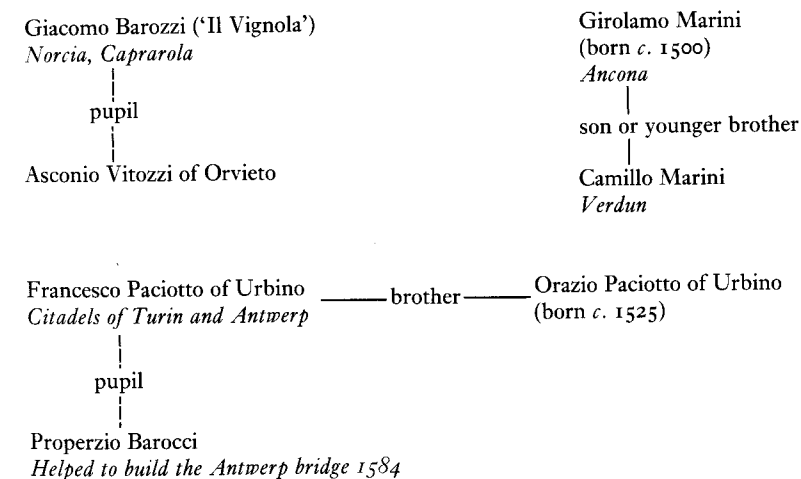
The Peruzzi 'Family'



The Genga 'Family'



Other 'Families'



obtain the services of Giovanni Maria Oligati, who had the advantage of having been born in Genoa. Oligati planned a bastioned enceinte for the immediate urban area, and the news of an unexpected passage of French troops into Italy gave a new impetus to the work. The citizens made some large voluntary contributions, and the landward defences were completed in essentials in 1538, which was a very short time indeed.

In the seventeenth century the increasing power of artillery, together with the ambitions of Piedmont-Savoy, induced the Genoese to carry the line of defence well inland to the summits of the hills which overlooked the city. Work on the *Nuove Mura* began in 1627, and the vast twelve-mile circuit was mostly finished by 1633.

Only Genoa's relative commercial prosperity enabled the republic to entertain mighty undertakings such as these. A common feature of all the new plans of bastioned defence was their immense cost. Thus the Pope himself found it difficult to cast an enceinte around the Vatican (see p. 36), while even the model Venetian fortress of Palmanova, as built, represented a twenty-five per cent reduction on the scope of the original plan. For a struggling little state like Siena the burden proved to be catastrophic. In the interests of cohesion, the embattled republic made the decision to defend as many as possible of its component towns in the face of the Imperial attack of 1553. The antiquated financial system was quite unequal to the strain. By prodigies of effort a dozen or so strongpoints were put in an adequate state of defence, but as a consequence the republic was left without troops or supplies to face the second and fatal onslaught of 1554–5.

The Renaissance engineer

The Italian military engineer enters our period as the characteristic Renaissance jack-of-all-trades. The tradition of versatility goes back at least as far as Filippo Brunelleschi (1377–1477), one of the leading lights of the early Renaissance, who designed two citadels at Pisa, as well as building the famous dome of Florence cathedral.

The progress from one branch of learning to another was natural and easy. Francesco di Giorgio

Martini began his professional life as a sculptor, and then took up bronze-founding after metal statuary came into fashion. This experience equipped him to cast artillery, and thus gave him an insight into the wider field of military affairs. Likewise Michelangelo Buonarroti, who is now remembered chiefly for his titanic struggles with blocks of marble and the ceiling of the Sistine Chapel, was also renowned in his own time as a military engineer. He did not regard his essays in fortification as being in any way inferior to the rest of his *oeuvre*, and in 1545, in the course of an argument with Antonio da Sangallo the Younger, he gave vent to the astonishing statement that

I don't know very much about painting and sculpture, but I have gained a great experience of fortifications, and I have already proved that I know more about them than do you and the whole tribe of the Sangallos (Clauses, 1900–2, II, 351).

The Italian architects of the sixteenth century managed their affairs very well without the support of anything that resembled a modern engineering corps. Their genius for association enabled them to group themselves together in Mafia-like bands which were contained by ties of blood, companionship and patronage. Several such 'families' may be identified, though it is easier to trace their ramifications diagrammatically than in prose. At a lower level we encounter family groups of skilled fortress masons, from Lucca and other places, who hired themselves out through the medium of sub-contractors. They were paid by the measure, and not by the day, and in the long run their services proved to be cheaper than those of unskilled low-paid labourers.

Every now and then the building of particularly ambitious fortifications or churches would cause members of several engineer families to associate for a common purpose. Martini, Giuliano da Maiana, Giuliano da Sangallo, Fra Giocondo, Benedetto da Maiana and Antonio Marchesi da Settignano are all known to have worked in Naples some time between 1484 and 1495. Similarly in the next generation the construction of the Borgo fortifications at Rome brought together Michelangelo, Antonio da Sangallo the Younger, Giovanni Mangone, Galeazzo

Alghisi, Jacopo da Ferrara, Bellucci, Castriotto, Laparelli and Marchi.

The concept of loyalty to a particular state or regime seems to have weighed fairly lightly upon most engineers. Pietro Cataneo wrote *I Quattro Primi Libri d'Architettura* (Venice, 1554) as an apparently whole-hearted servant of the Sienese Republic. He later added four more books, and incorporated them with the earlier ones and coolly presented the whole to his new master Francesco de' Medici, as conqueror of Siena and Grand Duke of Tuscany. Leonardo da Vinci nowadays appears as one of the towering figures of the Renaissance, and yet his contemporaries seem to have regarded him as little more than a foot-loose dilettante. His notebooks were full of doodlings of old-fashioned catapults and bombards, and he peddled his limited capacity as a practical engineer to the Venetian Republic, the Pope and the king of France. He died in 1519 at the palace of Amboise, where he had earned his keep as a deviser of mechanical entertainments for festivities.

We have already seen that when the Florentine Republic stood in mortal danger in 1529, Michelangelo felt some of the urgings of patriotism which befitted a great man, and not just a great artist. However he could not compare in purity of republican principle with Baldassare Peruzzi, who was sent by Pope Clement to help in the siege, but refused to have anything to do with the unholy work.

In the middle decades of the sixteenth century the Italian architect began to lose something of his splendid versatility:

It was a time when the field of human knowledge had grown to the point at which a single individual was no longer able to master it in all its aspects and when the accumulated knowledge had to be divided into a number of as yet loosely defined segments, each of which became the focus of attention for groups of newly emerging specialists . . . Sanmicheli and Antonio da Sangallo the Younger were at once the last dual-purpose architects who worked in both civil and military architecture, and the first representatives of the new trend of specialisation (La Croix, 1963, 273–4).

Another significant development was the way the Italian engineers dispersed over all the nations of Europe and some of their most distant colonies. Military skills at that time were still very much a matter of national speciality. Just as the Swiss were famed for their pikemen, or the Spanish for their musketeers, so the Italians were prized by all the warring parties as the masters of the novel science of artillery fortification. We saw a smaller phenomenon after World War II, when the Americans and Russians set their hands on the German missile experts.

Where Italian engineers were not available, or where they were not trusted, native architects did their best to imitate the southern style. Thus all over Europe there sprang up little military Italies, whether works of authentic Italian construction, like the citadel of Antwerp and the fortress of Navarrens in the Pyrenees, or home-grown renderings such as Meister Johann's enceinte at Düsseldorf. Most striking of all, perhaps, is the example of the still well-preserved granite fortification of Berwick-upon-Tweed, which was begun among the links of the Northumbrian coast by Sir Richard Lee.

Even the Spanish, as fellow-Catholics, did not like to overburden the Italians with their confidences. Luis Collado, writing in 1592, argued that Spanish artillery officers ought to make themselves acquainted with engineering matters, for the engineers 'for the most part are foreigners who, on the least excuse, will go over to the enemy camp on the next day' (Vigon, 1947, I, 129).

An Italian historian is at pains to explain that the notorious restlessness of the engineers did not proceed from capricious instability:

We must put ourselves in the position of these men. They were short of money, and yet they were aware of their own talents and regarded themselves as superior beings who moved among folk who were less civilised than the Italians. They were upset by the example of the few men among them who rose to the highest ranks, and they were liable to go off and serve any distant prince who attracted them by tempting promises. And yet they did not end up any better off – their creditors were many, their purses light, and the expense of

long journeys made it difficult for them to return to their homeland. They had to put up with the scorn which the soldiers reserved for those among their comrades who tried to combine the theory of war with the weapons of war The Spanish offered perhaps one exception, for their indolence and their trading connections with Italy helped

them to get on rather well with the Italians. At the same time the Spaniards could never forget that they were masters. They were not at all inclined to obey or respect inferior people who did not have Castilian blood flowing in their veins (Promis, 1874, 541).

Three The Frontiers of France 1513–59

France on the defensive 1513–50

The northern border

Sometimes the late medieval mind defies penetration. In 1494, seized by a fit of strategic madness, Charles VIII delivered vast tracts of the French borderlands to powers which, by any sane reckoning, ought to have been counted the natural enemies of his kingdom. Cerdagne and Roussillon went to the Spaniards, giving them a foothold on the northern side of the Pyrenees. Worse still, Louis ceded Franche-Comté and Artois to Maximilian of Austria. The purpose of all this largesse was to buy a free hand to pursue the Italian wars, those ventures which brought calamity to Italy, and came close to visiting the same on France. These losses represented the rough equivalent of a century of campaigning, and they forced a united population of fifteen million people into decades of disadvantageous defensive.

The borders of France in the early sixteenth century ran at almost every point well within the modern demarcation, and seldom rested on adequate geographical barriers. Along nearly every sector the advantage of the higher ground lay with the enemy, and the thin line of French fortresses touched for only brief stretches on major rivers such as the Saône or Meuse. Indeed the Somme and the Marne were the only water obstacles completely in the command of the French.

Considered as a whole, the northern and eastern frontiers took the shape of a long double curve. The

first arm fell back from the Channel coast at Boulogne to the Somme at Abbeville, then slowly bulged forward again to an apex at Sainte-Menehould and Bar-le-Duc, facing the Moselle gap. From there the line fell gradually back by way of Langres to the Côte d'Or at Dijon and Beaune, and terminated at the border of the territory of Bresse, which was the north-eastern outpost of Piedmont-Sardinia.

Now to turn back along the same line, and follow the chain of fortresses in more detail. The south-eastern sector was fairly secure, for the Imperial territory of Franche-Comté was contained by the ninety-mile chain of strongholds which extended north from the Saône at Chalon-sur-Saône and Seurre (which was re-fortified by Francis I) by way of Beaune and Dijon to the plateau of Langres, the great watershed of northern France. The line of fortresses was certainly thin, but in compensation hostile Franche-Comté was wedged against Switzerland and was difficult to support from the Empire. Only once in this period did it form the path for an offensive, when Maximilian paid the Swiss to go out and attack Dijon in 1513.

The real danger lay elsewhere along the frontier, where the upper reaches of the Moselle, Meuse and Scheldt snaked into France, bearing provisions and siege guns from the great cities of Germany and the Netherlands.

Northwards from the plateau of Langres, where we last left off, Champagne and Paris were threatened by a group of neutral or actively hostile lands