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Architectural Principles IN THE Age of Humanism

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discard problematical elements, traditional features, and Gothic reminiscences. In addition, the classical detail reveals a bias for romantic and fantastic forms which can best be illustrated by a glance at one of the capitals (Pl. 15c). Antiquity is the authority which guided the architect, but his approach is emotional rather than orthodox.

The next façades, S. Maria Novella and the first scheme for S. Sebastiano, represent a change to an expurgated classicism as a result of a more purist attitude toward antiquity, which is also apparent in the detail (Pl. 15d). But S. Francesco and S. Maria Novella are connected in so far as they show the compromise of wall and column, a compromise which was abandoned in S. Sebastiano. Here the compliance with the authority of classical motifs was replaced by their interpretation in terms of a consistent wall architecture. And in the second scheme of S. Sebastiano and still more in S. Andrea the purist approach to classical architecture gave way to the deliberate and free combination of its elements.

In the relatively short period of twenty years Alberti passed through the whole range of classical revivals possible during the Renaissance. He developed from an emotional to an archaeological outlook. Next he subordinated classical authority to the logic of the wall structure. And finally he repudiated archaeology and objectivity and used classical architecture as a storehouse which supplied him with the material for a free and subjective planning of wall architecture. Alberti was perhaps the only architect who progressed through all these stages, one following another in a logical evolution.

These façades must be regarded as an intellectual and artistic achievement of supreme importance. In contrast to almost all other Quattrocento architects, who preferred to avoid the problem altogether, Alberti offered a wealth of solutions—in fact, four different ones—for his successors to choose from. If one takes the trouble to survey the post-Alberti church façades, it immediately becomes evident to what considerable extent they are dependent on his work. For fully a hundred years nobody grappled equally seriously with this task. Not until Palladio designed his church façades did an architect approach the problem in a similar spirit of penetrating analysis. We shall therefore have to return to this theme in the next part of the book.

PART THREE

PRINCIPLES OF PALLADIO'S ARCHITECTURE

1. *The Architect as 'uomo universale': Palladio, Trissino and Barbaro*

IN 1547 APPEARED Giangiorgio Trissino's *L'Italia liberata dai Goti*. It was the first of the great heroic epics of the 16th century, dogmatically based on ancient precepts. The author himself proudly repeats more than once that he had chosen Aristotle as his 'maestro' and Homer 'per duce, e per idea.' This epic had a topical interest. It tells of the expulsion of the Goths from Italy by Belisarius, Justinian's commander, a feat of arms which safeguarded the survival of classical traditions in Italy, and made Italy part of the eastern empire from which Greek civilization had sprung. But by the time the epic was written the infidels were masters of that ancient empire; the book was therefore fittingly dedicated to the emperor Charles V, the new Justinian, who would now come from the West and liberate the East.

In the course of more than 20 years, during which, as the author asserts, he skimmed through all the Latin and Greek writers, a work was completed which not only combined history with mythology and theology, but also threw much light on astronomy, medicine, alchemy, necromancy, mathematics, and, last but not least, on naval, military and civic architecture. The epic summarized Trissino's life-work and ambitions. He was an all-round humanist with an encyclopædic knowledge, and immensely productive. He tried to revive the great Greek epic, and he introduced Greek tragedy in Italy with his *Sofonisba* (1514-5); his comedy *I Simillimi* (1548) followed Plautus, and his *Canzoni* imitated Pindar; he wrote *Eclogues* and poems in Latin and translated Horace. Linguistic problems, so much cherished by humanists of the period, attracted him particularly. He published an *Ars poetica* and books on grammar, and he is above all remembered for attempting to hellenize Italian spelling and pronunciation, and to create artificially a common Italian language. This was in opposition to the general humanist trend which with Bembo, Speroni, Varchi and so many others led to the acceptance of the *Volgare* (the Tuscan lan-

guage) as the language of scholarship and learning, a movement which was crowned by the work of the Accademia della Crusca. Trissino's brand of humanism was aristocratic and in a way anachronistic; he advocated a formal, esoteric and dogmatic classicism, free from any popular tendencies.[1]

In the fifth book of *L'Italia liberata* is the description of a palace, which gives a good impression of the working of his mind. After a cumbersome discourse on the precincts and the entrance follows an account of the courtyard:

> A cloister runs around the little courtyard
> Its spacious arches resting on round pillars
> Whose height is equal to the pavement's width;
> Their thickness is their height by eight divided.
> Each column has a silver capital
> Whose height repeats the measure of its thickness,
> Whereas the shaft stands on a metal base
> Which is again exactly half as high.

This account which opens up visions of an academic modular structure is a poetic paraphrase of Vitruvius; and Vitruvius was an author in whom Trissino had, as we shall see, more than a general interest. Inside the palace, by name Acrazio, are all sorts of disagreeable surprises for the conquering army; to avoid disaster God himself sent Belisarius' guardian angel to earth as guide and helpmate. It is he who renders the introductory exposition of the place, and his name is Palladio.

When the young sculptor Andrea di Pietro da Padova came into Trissino's orbit he gave him, after the fashion of humanist circles, the classical name 'Palladio,' whose association with the image of Pallas indicated what he expected from the young artist. A chronological scrutiny clearly reveals that the name was first chosen for the angel of the epic, who is so well versed in architecture, and this made the conferring of the name on the architect doubly allusive.[2]

Andrea di Pietro was born in 1508.[3] At the age of 16, in April 1524,

[1] Cf. G. Toffanin, *Il Cinquecento*, 'Storia letteraria d'Italia,' Milan, 1929, p. 448 f.

[2] Work on *L'Italia liberata* was begun in 1526 and in 1529 approximately half the poem was finished; cf. Bernardo Morsolin, *Giangiorgio Trissino*, Vicenza, 1878, p. 348. Palladio appears first with his humanist name in documents of 25th February and 10th March, 1540. In all the documents before that date he is called 'Andrea' or 'Andrea di Pietro.' Cf. Zorzi in *Archivio Veneto-Tridentino*, 1922, p. 136.

[3] The old puzzle of Palladio's birth (1508 or 1518) was finally settled by documentary evidence in favour of 1508, cf. Zorzi, *op. cit.*, p. 120 ff. For the controversy about his place of birth (which turned out to have been Padua rather than Vicenza) see A. M. Dalla Pozza, *Palladio*, Vicenza, 1943, p. 9 ff., Zorzi in ARTE VENETA, III, 1949, p. 140 ff.

he was inscribed at Vicenza in the guild of the bricklayers and stonemasons.[1] For the next ten years he figures in documents as engaged on sculptural work, and in a document of 1542 he is still called 'lapicida.'[2] But some time before that, probably in 1536 or 1537, the event took place which had so far-reaching an effect on European architecture. Trissino, at that time engaged on the building of his villa at Cricoli near Vicenza, discovered the talent of the young man who worked there as a mason. Trissino was not only responsible for Palladio's change of profession, but also had a formative influence on his approach to architecture.[3]

The Villa at Cricoli has usually been attributed to Palladio, but there is strong evidence that Trissino himself was its designer.[4] Some of his architectural drawings have survived and one is inscribed: 'Alcune piante della casa di Cricoli.'[5] His keen interest in architectural problems is further documented by the existence of an undated manuscript fragment which, though very short, reveals the trend of his thought. He had undertaken, he declares, the task of writing a treatise on architecture because he had noticed that much enlightenment was needed: 'for after having read Vitruvius attentively . . . I find that those things which at his time were very familiar are now entirely unknown . . . and that this Vitruvius is very badly understood and that he teaches nobody sufficiently in that art; therefore, while he endeavours to show that he knew things extremely well, he teaches very few of them. Leon Battista Alberti wanted to follow in his footsteps . . but apart from the length

[1] F. Lampertico, *Scritti stor. e lett.*, 1882, I, pp. 336, 366 f.

[2] Zorzi, *loc. cit.* (see p. 58, n. 2), and also G. Fiocco, *Andrea Palladio Padovano*, 1933, p. 5 ff. From 1545 on Palladio is regularly named 'architetto.'

[3] A document of 19th February, 1538 (cf. Zorzi, *op. cit.*, pp. 137, 143) is the first proof of familiarity between the two men.

[4] The villa was built between 1530 and 1538. Cf. Rumor in *Archivio Veneto-Tridentino*, 1926, p. 202 ff. In spite of the evidence to the contrary Rumor as well as Fiocco, *op. cit.*, p. 10, maintain the old attribution to Palladio. But other authors before them were doubtful, e.g. O. Bertotti Scamozzi, *Les Bâtimens et les desseins de André Palladio*, 1786 (2nd ed.), II, p. 32 f., and Burger, *Die Villen des Andrea Palladio*, 1909, p. 31.—Girolamo Gualdi's letter to Trissino of May 20th, 1538, seems conclusive; it mentions 'la maggior parte del disegno (*scil.* Cricoli) di Vostra Signoria' ('la maggior parte,' because older parts were left standing); cf. Morsolin, *op. cit.*, p. 230. Dalla Pozza (*op cit.*, pp. 48, 50 ff.), using similar arguments to ours, excludes Palladio's participation in the planning of Cricoli. Zorzi (in PALLADIO IV, 1954, p. 107) believes that Trissino began the villa as early as 1523 and finished it before 1537.

[5] In the Brera at Milan. The inscription by Trissino himself, confirms the relation of these plans to Cricoli. These drawings were discussed, but not published, by Morsolin, p. 225 f. The one published by Dalla Pozza, *op. cit.*, p. 51, shows that Trissino began his planning with a reconstruction of Vitruvius' Roman house.

of his treatise, it appears to me that one misses in it many things while one finds many which are superfluous.'[1]

Trissino built his Villa at Cricoli in order to realize his dream of creating a learned academy, the 'Accademia Trissiniana' as it was later called, in rural solitude. The rooms were decorated with Greek and Latin inscriptions and over three doors was written: 'Genio et studiis,' 'Otio et musis' and 'Virtuti et quieti.' Study, Arts and Virtue—these key-words embraced the programme of the Academy. Students lived at Cricoli and their work was regulated from day-break to night-fall. Trissino seems to have wished to blend the ideals of monastic life with the traditions of the Greek schools of philosophers. Strict moral conduct as well as physical cleanliness were peremptory demands. The study of Latin and Greek, guiding the student to an accomplished Italian style, was the medium through which he hoped to infuse civic virtues into the young generation. Trissino had been an active participant in the meetings of the *Orti Oricellari* where these ideas were discussed at length among the leading Florentine humanists.[2] Here is the thread that links Trissino's enterprise to the old Platonic Academy in Florence. True to this encyclopædic tradition the subjects of study included philosophy, astronomy, geography, and, above all, music. In the late 1530's and '40's all the young noblemen of Vicenza frequented Trissino's Academy, and though Palladio was then no longer young, nor of noble birth, he seems to have taken part in the life at Cricoli.[3]

About the very close ties between Palladio and Trissino there cannot be any doubt. In the preface to the *Quattro libri dell' architettura* Palladio singles him out as the 'splendore de' tempi nostri,' and in the preface to his edition of Caesar he relates that it was the 'dottissimo' Trissino who taught him the secrets of ancient military science.[4]

[1] Cf. Nozze Peserico-Bertolini, *Dell'Architectura, Frammento di Giangiorgio Trissino*, Vicenza, 1878.

[2] The importance of rhetoric as an incentive to political virtues in this circle was discussed by Cantimori in the JOURNAL OF THE WARBURG INSTITUTE, I, 1937-8, p. 83 ff. See also F. Gilbert, *ibid.*, XII, 1949, p. 114 ff.

[3] Morsolin, *op. cit.*, p. 232 ff., gives a detailed account of the Academy, with further literature. Cf. also Lampertico, *op. cit.*, p. 154 ff. Teachers of the Academy were men of high reputation like Bernardino Donato and Bernardino Partenio. Paolo Manuzio's letter of May 20th, 1555, to Partenio about his election as teacher of the Academy gives an idea of the prestige enjoyed by that institution. Manuzio writes: '. . . con voi mi rallegro, e con quella magnifica città dell'honorato pensiero intorno all'academia: della quale usciranno, come dal cavallo Troiano, in poco tempo eccellentissimi giovani, ch'empieranno non pur Vicenza, loro patria, ma Italia tutta della gloria del nome loro . . .' (Atanagi, *Lettere di XIII Huomini illustri*, Venice, 1560, p. 280).

[4] 'Io n'hebbi i principij dal Sig. Gio. Giorgio Trissino gentil'huomo dottissimo, e che alle molte discipline, di che egli era sicuro possessore, haveva anco aggiunta la perfetta cognitione di questa . . .'

Giuseppe Gualdo, Palladio's contemporary, wrote in his reliable life of the architect,[1] that 'when Trissino noticed that Palladio was a very spirited young man with much inclination for mathematics, he decided in order to cultivate his genius to explain Vitruvius to him, and to take him to Rome three times . . .' In view of Trissino's Vitruvian record the truth of Gualdo's statement seems incontestable. We know, moreover, that Trissino, in the autumn of 1545, travelled to Rome with three of his young friends, one being the painter and poet Giambattista Maganza, the second the poet Marco Thiene and the third Palladio. Their stay lasted almost two years and they set out on their return journey in July 1547.[2]

While Trissino thus introduced Palladio to Vitruvius and to the monuments of antiquity, he himself demonstrated at Cricoli how all this knowledge should be applied in practice. Of the existing house, built after the traditional 'castello' type, he preserved the towers and linked them by a portico of Raphaelesque quality;[3] and in the ground-plan he applied those principles of symmetry and proportionate relationship of the rooms which Palladio fully developed (Pl. 20a, b).

[1] Published in Giovanni Montenari, *Del Teatro Olimpico*, 1749, as the work of Giuseppe's son Paolo (1553-1621). The latter, however, seems to have made only additions to his father's notes; cf. Calvi, *Biblioteca, e storia degli scrittori di Vicenza*, 1778, IV, p. 155 ff. Gualdo's often attacked reliability has been vindicated by the more recently discovered documents. Cf. also Dalla Pozza's chapter: 'Il valore storico della biografia del Gualdo' (*op. cit.*, pp. 36-39). Giangiorgio Zorzi reprinted Gualdo's Life of Palladio with copious notes (in SAGGI E MEMORIE DI STORIA DELL'ARTE, II. 1958-59, pp. 93-104).

[2] Cf. Morsolin, *op. cit.*, p. 321 ff., with documents. Palladio probably accompanied Trissino to Rome also in 1541. Later, Trissino returned to Rome only once and then alone, in the year of his death, 1550. Zorzi (*I disegni delle antichità di Andrea Palladio*, Venice, 1958, pp. 20, 21) assumes that Palladio travelled briefly to Rome in 1549 and again in 1554.

On Marco Thiene, who is still remembered for his poem on Venice, cf. Morsolin in ATTI R. ISTITUTO VENETO, SERIES VII, vol. VI., 1894-5, pp. 839-874.

[3] Fiocco, *op. cit.*, p. 10, emphasized the dependence of the portico on the Loggia Cornaro in the garden of the Palazzo Giustiniani at Padua, erected by Falconetto in 1524 (see also Fiocco in DEDALO XI, 1930-1, p. 1217). This observation is only partly right; there are important differences between the two buildings: viz, Ionic pilasters below, Corinthian pilasters above at Cricoli instead of Doric half-columns below and Ionic pilasters above; three large bays and one half bay at each end at Cricoli instead of five large bays; uniform entablature in both tiers instead of the break in the entablature above the orders. In all these particulars Cricoli corresponds to Serlio's illustration of Raphael's loggia of the Villa Madama (bk. III, p. 148 f.). But Serlio's third book did not appear until 1540, at a time when Cricoli was finished. Trissino had access either to Serlio's material before it was published (Serlio was in Venice from 1528 on) or brought a similar drawing back from Rome. The close relationship between Cricoli and Serlio's illustration was noticed by H. von Geymüller, *Raffaello studiato come architetto*, 1884, p. 87; cf. also Dalla Pozza, *op. cit.*, p. 53 ff.

The relationship of the humanist and philosopher Luigi (Aluise) Cornaro to his

The classical studies which he began under Trissino remained Palladio's life-long preoccupation, and his architecture cannot be dissociated from the humanist training in this circle. It always remained scientific, scholarly and to a certain degree dogmatic, and complex ideas must be taken into account in order to understand his buildings.[1]

His literary efforts were a fruit of this training. By nature Palladio seems to have been reserved and not willing to use many words where the facts speak for themselves, as is often the case with creative artists.[2] Yet his contribution to the humanities was probably greater than that of any other architect of his period, and by no means confined to architecture. The first fruits of his journeys to Rome were two small guide-books, of greater importance than their size might indicate. Both appeared in Rome in 1554.[3] One, *Le antichità di Roma*, consists of brief descriptions of the classical ruins and their history, arranged in groups, for the information of travellers. The book replaced the mediaeval *Mirabilia Urbis Romae* which, as Palladio put it, were 'full of strange lies.' Classical material was now presented in accordance with the new standards of Renaissance research. 'Knowing,' wrote Palladio, 'how great is everybody's wish to understand truly these antiquities' he undertook to measure the ruins and to collect reliable information about them. His scholarship is impressive; he not only used the works of the modern Roman antiquarians, Biondo, Fulvio, Fauno and Marliani, but also classical authors, Dionysius of Halicarnassus, Livy, Pliny, Plutarch, Appianus Alessandrinus, Valerius Maximus and Eutropius. By the middle of the 18th century Palladio's little work had gone into more than thirty editions, and had helped to shape the travellers' conception of ancient Rome for 200 years. His

architect Falconetto (about his studies of ancient architecture in Rome cf. Vasari, ed. Milanesi, V, p. 319) anticipates that of Trissino to Palladio. On Cornaro cf. J. Burckhardt, *Die Kultur der Renaissance*, 10th ed., II, p. 56 ff. Like Trissino, Cornaro too tried his hand in writing down his ideas on architecture. His brief treatises were published by G. Fiocco, 'Alvise Cornaro e i suoi trattati sull' architettura,' ATTI DELLA ACCADEMIA NAZ. DEI LINCEI, Classe di Scienze morali, storiche e filologiche, Serie VIII, vol. IV, 1952, p. 195 ff. For Trissino's and Cornaro's different approach to architecture, cf. Schlosser, *Die Kunstliteratur*, Vienna, 1924, p. 222. For Cornaro see now G. Fiocco, *Alvise Cornaro. Il suo tempo, le sue opere*, Venice, 1965.

[1] The arguments for and against Trissino's influence on Palladio's early career have both found their advocates. Dalla Pozza, in his valuable book on Palladio, unduly stresses Serlio's influence (pp. 65-87).

[2] Cf. the *proemio* to the *Quattro libri*; 'Et in tutti questi libri io fuggirò la lunghezza delle parole, & semplicemente darò quelle avvertenze, che mi parranno più necessarie.' See also the preface to the third book. In the preface to his *Antichità* he declared that he had written 'con quanta più brevità ho potuto.'

[3] According to Gualdo, Palladio was in Rome in that year.

second book, the *Descritione de le Chiese, Stationi, Indulgenze & Reliquie de Corpi Sancti, che sonno in la Citta de Roma*, also grew out of the old *Mirabilia*, which, apart from the antiquities, contained a description of Roman churches under a purely religious aspect for the use of pilgrims. Though clearly indebted to the traditional pattern, Palladio re-arranged the itinerary and for the first time introduced artistic appreciations; his work was the nucleus from which, until the 18th century, most Roman guide-books derived.[1]

Toward the end of his career, in 1575, Palladio published Caesar's Commentaries with 41 plates.[2] Indicative of his absorption in ancient writers is the fact that he studied Caesar together with his sons Leonida and Orazio, who prepared the illustrations. Both died prematurely and the father dedicated the book to their memory. He relates in the preface that for many years he had investigated ancient military science and 'read all the ancient authors and historians who had treated of it.' The preface contains an abstract of what he had found in them. He also applied his knowledge of ancient historians when illustrating Polybius, but this work, which he dedicated to the Grand Duke of Tuscany, is lost.[3]

All these publications were modest by-products in comparison with his ambitious *Quattro libri dell' architettura*, published in 1570, in which he set out to survey the whole field of architecture. The first book deals with the orders and elementary problems, the second with domestic buildings, the third with public buildings and town-planning, and the fourth with the temples 'without which no civilization is possible.'[4] In the dedication of the first two books to Conte Giacomo Angarano, Palladio provides a good idea of the impulses which animated his undertaking. The remains of antiquity were his constant measure of permanent values. He regarded the ancient 'enormous ruins as a shining and sublime testimony of Roman excellence (*virtù*) and grandeur,' and professed to have been deeply stirred by studying that 'quality of virtue' and having concentrated all his thoughts on these studies.[5] In the preface to the third book he returns to the idea that

[1] For the *Antichità* and the *Descritione* cf. Ludwig Schudt, *Le Guide di Roma*, 1930, pp. 26 ff., 126 ff., with complete bibliography of the editions.

[2] *I Commentarij di C. Giulio Cesare, con le figure in rame de gli allogiamenti, de fatti d'arme, delle circonvallationi delle città* . . . Venezia, Pietro de'Franceschi, 1575.

[3] The dedication of 1569 published by Magrini, *Memorie intorno la vita e le opere di Andrea Palladio*, Padua, 1845, appendix, p. 16. Palladio's illustrations existed in print (cf. *ibid.*, p. LI), but so far not a single copy has turned up.

[4] Preface to the third book.

[5] '. . . rendono anco nelle grandissime ruine loro chiaro, & illustre testimonio

'the vestiges of so many of their sumptuous buildings' give us 'a certain knowledge of Roman virtue and greatness, which perhaps had not otherwise been believed.'[1] We are probably not wrong in concluding that for him the practice of good architecture was a moral obligation and, more than this, that in conformity with the doctrine of Trissino's Academy he regarded architecture as an important discipline of the arts and sciences the union of which embodied the ideal of *virtus*. But it is likely that architecture as a manifestation of virtue had also more specific implications for Palladio, and this will be shown later in this chapter.

Palladio's plans for publication were interrupted by his death. In the preface to the first book he gave a summary of the whole scheme which was to comprise theatres, amphitheatres, arches, thermae, aqueducts, fortifications and ports. More than once he referred in his text to his forthcoming 'libri dell'Antichità'[2] or his 'libro degli Archi,'[3] and, according to Gualdo, a volume containing 'Tempi Antichi, Archi, Sepolture, Terme, Ponti, Specole e altri pubblici edificii dell'antichità Romana' was left to Giacomo Contarini, Palladio's friend and patron, ready for publication. Of all this material only the Roman thermae were published, by Lord Burlington, 150 years after Palladio's death.[4]

della virtù, & della grandezza Romana: in modo che ritrovandomi io grandemente esercitato, & infiammato ne gli ottimi studij di questa qualità di Virtù, & havendo con gran speranza messo in lei tutti i miei pensieri . . . '

[1] English translations from the *Quattro libri* are quoted, sometimes with small alterations, from Isaac Ware's edition of 1738.

[2] Bk. I, p. 15.

[3] *Ibid.* and I, p. 47 and *passim*. See also his dedication to the third book.

[4] Palladio's book had long been in preparation and seems to have been ready for the press in a different form as early as before 1555. Cf. A. F. Doni, *La seconda libreria*, Venice, 1555, p. 155, who has a remarkable passage about the work which at that period had not yet a title 'ma da quello che in esso si può imparare, si puote chiamare: Norma di vera Architectura.' Daniele Barbaro, in his Commentary to Vitruvius, 1556, p. 179, says that 'presto verirà in luce un libro delle case private, composto e dissegnato dal Palladio.' About the changes in Palladio's plans for publication cf. also Tommaso Temanza, *Vita di Andrea Palladio*, Venice, 1762, p. xlii ff., Cicogna, *Iscr. Ven.*, IV, p. 408 f., Magrini, *op. cit.*, p. 105 ff., Dalla Pozza, *op. cit.*, p. 109. ff., Zorzi, *I disegni delle antichità di A.P.*, Venice, 1958, p. 148 ff.

The great majority of known drawings by Palladio are now in the R. Inst. of British Architects, from the collection of Lord Burlington. About 60 of these drawings were purchased by the latter in the Villa Maser, built by Palladio for his friend Daniele Barbaro (cf. Burlington in the preface to his *Fabbriche Antiche disegnate da Andrea Palladio*, 1730). Others had been acquired by Burlington from the collection of Inigo Jones who may have got some of them in Italy (1614–15) from Scamozzi (cf. W. Grant Keith in JOURNAL R.I.B.A., XXXIII, 1925, p. 95 ff). A smaller series of drawings, possibly a portion of those mentioned by Gualdo as in the possession of Giacomo Contarini, reached the Museo Civico in Vicenza through the hands of Scamozzi, Francesco Albanese, Muttoni (cf. *Architettura di A. Palladio* . . . con le osservazioni dell'Architetto N.N. [Muttoni], 1740, I, pp. vii, xii), Temanza, Dal Peder and Pinali; cf. Magrini, *op. cit.*, pp. 43, 295 ff., Giangiorgio Zorzi in *La Provincia di Vicenza*, May 17, 1910, no. 133. A few drawings are in the Pinacoteca at Brescia and one is in the Museo Civico at Verona. Four reconstructions of classical buildings, as far as we can see never before mentioned, are in the Vatican Library, cod. Vat. lat. 9838. Other series of drawings seem to be lost, e.g. 12 drawings which, in the 19th century, were in the collection of Giuseppe Vallardi, Milan, cf. Magrini, p. 305 ff. —In addition there are the drawings for S. Petronio in Bologna, see G. Zucchini, *Disegni . . . per la facciata di S. Petronio*, 1933, pls. XVI, XIX-XXI. A full statement of the history and whereabouts of Palladio's drawings (not entirely in agreement with the above summary) was given by Zorzi, *I disegni*, *op. cit.*, p. 40 ff.

Palladio emphasized that in preparing his book he had studied the works of those who had written on architecture before;[1] on more than one occasion he stressed the importance of Alberti, and, indeed, Alberti's influence on him was very great.[2] But above all the modern books he placed Vitruvius whom he has chosen 'per maestro, e guida.'[3] He was probably more familiar with Vitruvius than any other contemporary architect and, in keeping with Trissino's own views, he believed that Vitruvius revealed the deepest secrets of ancient architecture. His imaginative and penetrating interpretation of Vitruvius is apparent in the illustrations to Barbaro's edition of 1556. Concerning Palladio's collaboration in this work we may let Barbaro himself speak: 'For the designs of the important illustrations I used the works of Messer Andrea Palladio, architect of Vicenza, who of all those whom I have known personally or by hearsay, has according to the judgment of excellent men best understood the true architecture, having not only grasped its beautiful and subtle principles, but also practised it, whether in his most delicate and exquisite drawings of plans, elevations and sections, or in the execution and erection of many and superb buildings both in his own country and elsewhere; works which vie with the ancients, enlighten his contemporaries, and will arouse the admiration of those who come after us. And with regard to Vitruvius, the building of Theatres, Temples, Basilicas, and those things which have the most beautiful and most hidden reasons for their proportions (*compartimenti*), have all been explained and interpreted by him (Palladio), with ready skill of mind and hand; he it is who has selected the most beautiful styles of the ancients from all over Italy and has made measurements of all their works in existence.'[4]

[1] In the dedication to the first book: 'ho rivolto con faticoso studio di molti anni i libri di coloro, che . . . hanno arricchito . . . questa scientia nobilissima.'

[2] Cf. above Part I, p. 21, and below Part IV, pp. 108, 110.

[3] Preface to the first book.

[4] *I dieci libri dell' Architettura di M. Vitruvio* tradutti et commentati da Monsignor Barbaro, Vinezia, Francesco Marcolino, 1556, Bk. I, chap. 6, p. 40. Barbaro pays

Daniele Barbaro belonged to Palladio's generation (b. 1513) and, like Trissino, he embodied the Renaissance ideal of a comprehensive education based on classical scholarship. He was an eminent mathematician, poet, philosopher, theologian, historian and diplomatist; he founded the botanical garden at Padua and tried his hand at interior decoration. Himself one of the most outstanding personalities of the mid-16th century, he was bound by close friendship to men like Aretino, Bembo, Varchi and Speroni. His report to the Venetian Senate on his mission to England, 1548-50, is a model of clarity and precision, and has gained renown as the first really comprehensive account of English life and customs by an Italian for Italians.[1] His publications ranged over a wide field; among them is a dialogue on eloquence (1557) and a treatise on perspective (1568) in which he used Dürer extensively.[2] But, like Trissino, he was above all an Aristotelian scholar.[3] He published, with a learned commentary, the Latin translation by his great-uncle Ermolao Barbaro of Aristotle's *Rhetoric* (1544) and edited Ermolao's translation of the *Nicomachean Ethics* (1544) as well as his compendium of the Aristotelian works on natural history (1545); all this was preceded by a treatise on Porphyry's *Osagoge*, which consists of a discussion of Aristotle's categories and was traditionally published as a preface to his *Organon* (1542). Daniele Barbaro died in 1570 as Patriarch of Aquileia and left in his will to Palladio, 'nostro amorevole architetto,' a token sum of 15 ducats. It was for him and his brother Marcantonio that Palladio built the famous Villa Maser near Asolo which, decorated with Veronese's frescoes and Vittoria's statues, is one of the most perfect Renaissance creations in Northern Italy.[4]

Barbaro's commentaries on Vitruvius are most extensive and he often uses a line of the text as the starting point for long and learned exposi-

tribute in other places to Palladio's help, particularly for the reconstruction of the Ionic volute (III, iii, p. 95, cf. Magrini, *op. cit.*, p. 30 f.) and the Roman theatre (V, viii, p. 167). Palladio, in the *Quattro libri*, refers his readers several times to the illustrations in Barbaro's Vitruvius (cf. bk. III, chap. 19 and bk. IV, chap. 3). The style of the illustrations in both books is very similar and some of them are almost identical.

[1] Cf. *Calendar of State Papers, Venetian*, V, 1534-54, p. 338 ff.

[2] A life of Daniele Barbaro has not yet been written. Most comprehensive is Giovanni Poleni, *Exercitationes Vitruvianae primae*, 1739, pp. 73-82. There are some notes in Ch. Yriate, *La vie d'un patricien de Venise au XVIe siècle* (n.y.) pp. 109 ff., 355. Barbaro's history of Venice for the years 1512-1515 was published in *Arch. stor. Ital.*, 1844, p. 949 ff.

[3] According to De Thou, *Historiae sui temporis*, Geneva, 1620, II, p. 615, Barbaro used to say 'nisi Christianus esset, se in Aristotelis verba juraturum fuisse.'

[4] Cf. Burger, *op. cit.*, p. 104 ff., and below Part IV, p. 135 f.

tions on a particular problem. His method reveals immediately his Aristotelian training, it is purely logical and deductive, leading from definition to definition; while his thought is often thoroughly Platonic. He begins with a preface in which he gives a philosophical definition of the arts and of architecture. First comes a definition of the arts in a general system of human pursuits, based on Aristotle's five intellectual virtues—arts, science, prudence, wisdom and intellect.[1] We need not follow Barbaro's procedure in detail and can restrict ourselves to the trend of thought which has an immediate bearing on our subject. Science and Intellect are concerned with 'certain truth' ('il vero necessario'), i.e. the truth in the objects themselves, which is found by unassailable proof. But Science is acquired, while Intellect is innate and reflects the power and virtue of the soul. The Arts are concerned with 'uncertain truth' ('il vero contingente'), i.e. the truth dependent on human will-power which is manifest in human creations. However, there is a link between the spheres of 'certain' and 'uncertain' truths. Mathematics has its life from the intellect; and those arts which are founded on numbers, geometry and the other mathematical disciplines, have greatness and in this lies the dignity of architecture.[2]

Having thus explained the close relation of the arts to other intellectual provinces, Barbaro continues with a detailed definition of the arts. With the clear-cut sentence 'nasce ogni arte da isperienza' he repeats exactly Aristotle's maxim that 'experience created art.'[3] He also follows Aristotle in his dictum that experience relies on the senses and is concerned with single instances, while the arts rest on universal principles, though these must be discovered by experience. The arts are therefore near to Wisdom, which is the virtue correlated to science and intellect as being concerned with a clear knowledge of the proofs of 'certain truth.'

The thread of these ideas is carried on in the Vitruvian text and here the Aristotelian system is given a Platonic bias. Where Vitruvius talks about the capacities an architect ought to possess (I, i, 3), Barbaro comments: 'The artist works first in the intellect and conceives in the

[1] *Nic. Ethics*, V, 3-8.

[2] Plato, *Philebos*, 34.—These are ideas which had long been current, cf. Federigo da Montefeltre's patent of 1468 for Luciano Laurano in which he speaks of 'la virtù dell'Architettura fundata in l'arte dell'aritmetica e geometria, che sono delle sette arti liberali e delle principali, perchè sono in primo gradu certitudinis, et è arte di gran scienza et di grande ingegno, et da noi molto stimata et apprezzata' (Gaye, *Carteggio*, I, p. 214).

[3] *Metaphysics*, 981a.

mind and symbolizes then the exterior matter after the interior image, particularly in architecture.' Architecture, in other words, is nearer to the Platonic idea than any other art. He carries on: 'Therefore architecture above any other art signifies, i.e. represents, *le cose alla virtù*,' by which he means that the form comes close to the idea. In agreement with this he affirms in another place (I, i, 1): 'la virtù consiste nell' applicazione.'

Many passages show that Barbaro saw architecture not as an isolated discipline but as one of the innumerable manifestations of the human mind all of which follow the same laws. Characteristic of this, and again Aristotelian, is his comment to the second chapter where Vitruvius discusses the six categories—ordinatio, dispositio, eurythmia, symmetria, decor, distributio—of which architecture consists. Barbaro declares that we find these elements in many things, and it follows that 'these terms are general and common and as such have their definition in the general and common science which is the first and is called metaphysics. But when an artist wants to apply one of those elements to his own profession, then he restricts that universality to the particular and special needs of his own art.'[1]

It would be strange if Palladio could have escaped Aristotelian influence; his practical sense seems to reflect a belief in Aristotle's doctrine of experience and his adherence to ancient prototypes a familiarity with Aristotle's doctrine of imitation; the latter, established in the *Poetics* as the supreme principle in the arts, found an intense echo in the North Italian circles from Trissino to Castelvetro. A fusion of these Aristotelian tenets with Plato's conception of ideas seems marked in Palladio's architecture; and an attentive reader will find in his *Quattro libri* clear traces of this synthesis. In any case there is no doubt that Palladio was intimately familiar with the content of Barbaro's Vitruvian commentaries, and Barbaro's own statement is proof that many of them were even worked out in common consultation. Palladio's work embodied for Barbaro his own ideal of scientific, mathematical architecture, and it may be supposed that Palladio himself thought in the categories which his patron had so skilfully expounded. It is probable that by associating in the *Quattro libri* virtue with architecture, Palladio like Barbaro regarded as the particular 'virtue' inherent in architecture

[1] These indications are not meant as a summary of the complex logical structure of Barbaro's commentary. Also no attempt can here be made to trace Barbaro's sources, apart from Aristotle and Plato. Among others, he appears to have used the Aristotelian commentary of Caporali's edition of Vitruvius, Perugia, 1536.

the possibility of materializing in space the 'certain truth' of mathematics. This interpretation is supported by the title-page of the *Quattro libri* which shows allegories of Geometry and Architecture pointing upwards to the crowned figure of Virtue ('Regina Virtus') with sceptre and book.

It may be argued that from Alberti's day onwards architecture was conceived in terms of applied mathematics; but hardly ever before Barbaro was this subject submitted to such closely-knit logical analysis. Palladio's *Quattro libri*, almost entirely concerned with practical issues, are similarly marked by acuteness, precision, and clear and rational arrangement. And as Trissino with his application of Aristotle's *Poetics* gave structure, unity and clarity to drama and epic, so Palladio aspired to unchallengeable lucidity of architectural planning based on the authority of classical rules.

In 1555 the Accademia Olimpica was founded in Vicenza, with Palladio as one of its chief promoters. The programme was still that of the older Italian academies, the cultivation of the 'uomo universale.' And so Palladio found himself again in a circle of men who believed in the ideals which had inspired his early days in Trissino's company. Theatrical performances soon became one of the notable activities of the Academy, beginning with a memorable representation of Trissino's *Sofonisba* in 1562, in a theatre built for this purpose by Palladio inside the Sala of the Palazzo della Ragione.[1] Later on Palladio was commissioned to erect a permanent theatre. Barbaro had been dead for ten years when the foundation stone was laid on March 23, 1580. He rather than anyone else would have been able to appreciate Palladio's project. For to all intents and purposes it corresponded to the reconstruction of the Roman theatre which Barbaro, with Palladio's help, had published in his Vitruvius.[2] Palladio himself died six months after building had started. In 1585 the theatre was opened and, like a tribute to the *manes* of Trissino, who had introduced the taste for Greek tragedy, the first performance was Sophocles' *Oedipus Tyrannus*.

[1] Pierfilippo Castelli, *La vita di Giovangiorgio Trissino*, Venice, 1753, p. 26, believed that on that occasion the model for Palladio's Teatro Olimpico was shown. See also Calvi, *op. cit.*, IV, p. 275 ff.

[2] In a brilliant study L. Magagnato (JOURNAL OF THE WARBURG AND COURTAULD INSTITUTES XIV, 1951, p. 209 ff.) discussed the non-antique elements in the design of the Teatro Olimpico. See also, *id.*, *Teatri italiani del Cinquecento*, Venice, 1954, p. 50 ff.; and L. Puppi, *Il Teatro Olimpico*, Venice, 1963.

2. *Palladio's Geometry: The Villas*

In a chapter on abuses in architecture, Palladio remarks as follows: 'Although variety and things new may please every one, yet they ought not to be done contrary to the precepts of art, and contrary to that which reason dictates; whence one sees, that although the ancients did vary, yet they never departed from some universal and necessary rules of art, as shall be seen in my books of antiquities.'[1] He makes this statement in a definite context, but it may be generalized, and we shall now try to explore how Palladio interpreted the universal precepts of architecture. The villas in particular lend themselves to such an investigation. For the planning of his villas and palaces he followed certain rules from which he never departed. He demanded a hall in the central axis and absolute symmetry of the lesser rooms at both sides. 'And it is to be observed that those on the right correspond with those on the left, so that the building may be the same in one part as in the other.'[2]

Renaissance architects always regarded symmetry as a theoretical requirement in design, and rigidly symmetrical plans are already found in Filarete, Francesco di Giorgio and Giuliano da Sangallo.[3] But in practice this theory was rarely applied. A comparison of a Palladian plan (Pl. 21c) with a typical Renaissance building such as the Farnesina in Rome (1509, Pl. 21b) reveals immediately his complete break with the older tradition. It is the systematization of the ground-plan which became the distinguishing feature of Palladio's palaces and villas.[4] At Cricoli Trissino anticipated Palladio's plans; everything later undertaken by Palladio is a development of this archetype.

The earliest building which can with certainty be ascribed to Palladio is the Villa Godi Porto at Lonedo (Pl. 21a, c) for which he received payments from 1540 onwards.[5] In comparison with Cricoli this villa is retrogressive. The asymmetrical arrangement of windows in the façade can be found in innumerable country-houses of the Venetian *terra ferma*,[1] and the break caused by the three-arched portico and the recessed centre are also traditional features.[2] The ground-plan too is simplified in comparison with Cricoli (Pl. 20b), but with its four rooms of equal size at each side of the central axis the principle of symmetry is strictly kept.[3] This surprisingly unpretentious plan contains all the elements of Palladio's further development.

The local and traditional character which is so marked in the front of the Villa Godi disappeared completely after Palladio's stay in Rome. But the plans of the many country-houses, which he built as the fashionable architect of Vicenza from the 1450's onwards, are all different orchestrations of the same theme (see Fig. 8). The pattern of these plans is founded on the straight-forward needs of the Italian villa: loggias and a large hall in the central axis, two or three living-rooms or bedrooms of various sizes at the sides, and, between them and the hall, space for small spare rooms and the staircases. An analysis of a few typical plans ranging over a period of about 15 years will prove that they are derived from a single geometrical formula. The Villa Thiene at Cicogna,[4] built during the 1550's, shows the pattern most clearly. The rooms together with the porticos are defined by a rectangle divided by two longitudinal and four transverse lines. A variation of this type is the Villa Sarego at Miega, begun about 1564, only parts of which are preserved;[5] here the portico also extends across the width of the staircases. Before 1560 Palladio had designed a simpler version of this plan for the Villa Poiana.[6] The Villa Badoer at Fratta, Polesine,[7] *c.* 1560, follows the same pattern, but with one portico now placed outside the cube of the building. Villa Zeno at Cessalto,[8] between 1558 and 1566, belongs to this class (reversed), but at each side of the hall two small rooms have been joined forming large rooms with their axes

[1] *Quattro libri*, I, chap. 20, p. 48.
[2] *Ibid.*, I, chap. 21, p. 48.
[3] Cf. Geymüller-Stegmann, *Die Architektur der Renaissance in Toscana*, vol. XI 'Gesamtüberblick,' figs. 41-49.
[4] The regular plans of Roman thermae offered Palladio convincing proof that symmetry was also an indispensable requirement in ancient domestic architecture.
[5] Payments continue until 1552, cf. Bertotti Scamozzi, *op. cit.*, II, p. 16, but the building seems to have been finished in the main in 1542 (date of the inscription on the façade). See also Burger, *op. cit.*, p. 16 ff. Palladio's own illustration (II, p. 63) shows a revised front. An excellent book on the villas: J. S. Ackerman, *Palladio's Villas*, New York, 1967.

[1] It derives from the Venetian palace tradition. For 15th and 16th century houses with this feature, cf. Fasolo, *Ville del Vicentino*, pls. 24-27, 32, and Giuseppe Mazzotti, *Le ville venete*, Treviso, 1954.
[2] Cf. for instance Villa Ricci, Ca'Brusa, late 15th century, Fasolo, *op. cit.*, pls. 14, 15.
[3] In two of the rooms are small staircases which alter the shape of these rooms. But by not showing a dividing wall between the stairs and the rooms, Palladio indicated in his illustration that he wanted the ideal shape of the room to be 'read.'
[4] Palladio II, p. 60. The building, which was never finished, has not survived, cf. Burger, *op. cit.*, p. 37 ff.; Ackerman, *Villas*, p. 75.
[5] Palladio II, p. 66, Burger, p. 93, Zorzi, in ARTE VENETA IX, 1955, p. 120 f.
[6] Palladio II, p. 56, Burger, p. 98, Zorzi, *op. cit.*, p. 96; Ackerman, p. 62 ff.
[7] Palladio II, p. 46, Burger, p. 110 ff., Mazzotti, *op. cit.*, p. 477, dates the villa 1568–70; Ackerman, p. 47 ff.: *c.* 1560.
[8] Palladio II, p. 47, Burger, p. 47 ff.

at right angles to the hall. We find this feature again in the Villa Cornaro at Piombino Dese,[1] mentioned in 1566, where the staircases have been transferred to the wings; the hall, which is therefore nearly square, is now the same width as the porticos. By another variation of these elements the earlier plan of the Villa Pisani at Montagnana emerges,[2] which in reverse, can be found again in the Villa Emo at Fanzolo, *c.* 1560.[3] If the staircases of the Villa Cornaro are placed inside along the small rooms the hall acquires the cruciform shape of the Villa Malcontenta (1560),[4] a type which was varied in some other buildings, particularly in the Villa Pisani of 1561-62, at Bagnolo.[5] Finally, it will now be seen that the plan of the Villa Rotonda[6] is the most perfect realization of the fundamental geometrical skeleton.

What was in Palladio's mind when he experimented over and over again with the same elements? Once he had found the basic geometric pattern for the problem 'villa,' he adapted it as clearly and as simply as possible to the special requirements of each commission. He reconciled the task at hand with the 'certain truth' of mathematics which is final and unchangeable. The geometrical keynote is, subconsciously rather than consciously, perceptible to everyone who visits Palladio's villas and it is this that gives his buildings their convincing quality.

Yet this grouping and re-grouping of the same pattern was not as simple an operation as it may appear. Palladio took the greatest care in employing harmonic ratios not only inside each single room, but also in the relation of the rooms to each other, and it is this demand for the right ratio which is at the centre of Palladio's conception of architecture. This rather complex matter will be discussed in the last part of this book.

* * * * *

The façades of Palladio's villas present a problem essentially similar to that of the plans. In contrast to French and English, Italian monu-

[1] Palladio II, p. 51, Burger, p. 95 ff.

[2] Palladio II, p. 50, Brunelli e Callegari, *Ville del Brenta*, 1931, p. 337 ff. For the date, 1553-55, see Zorzi, *op. cit.*, p. 116.

[3] Palladio II, p. 53, Burger, p. 102 ff.

[4] Palladio II, p. 48, Burger, p. 88 ff., Brunelli-Callegari, *op. cit.*, p. 16 ff.

[5] Palladio II, p. 45, Burger, p. 40 ff. For the date, see Zorzi, ARTE VENETA IX, 1955, p. 97. Ackerman, p. 38 ff., argues that the villa was planned in the 1540's.

[6] Palladio II, pp. 16, 17, Burger, p. 53 ff., Zorzi, *op. cit.*, p. 100 ff. The building of the Rotonda has always been dated in or shortly after 1550, but C. A. Isermeyer (in *Zeitschrift f. Kunstgeschichte*, 1967, p. 207 ff.) has shown that the building was erected between 1566 and 1570.

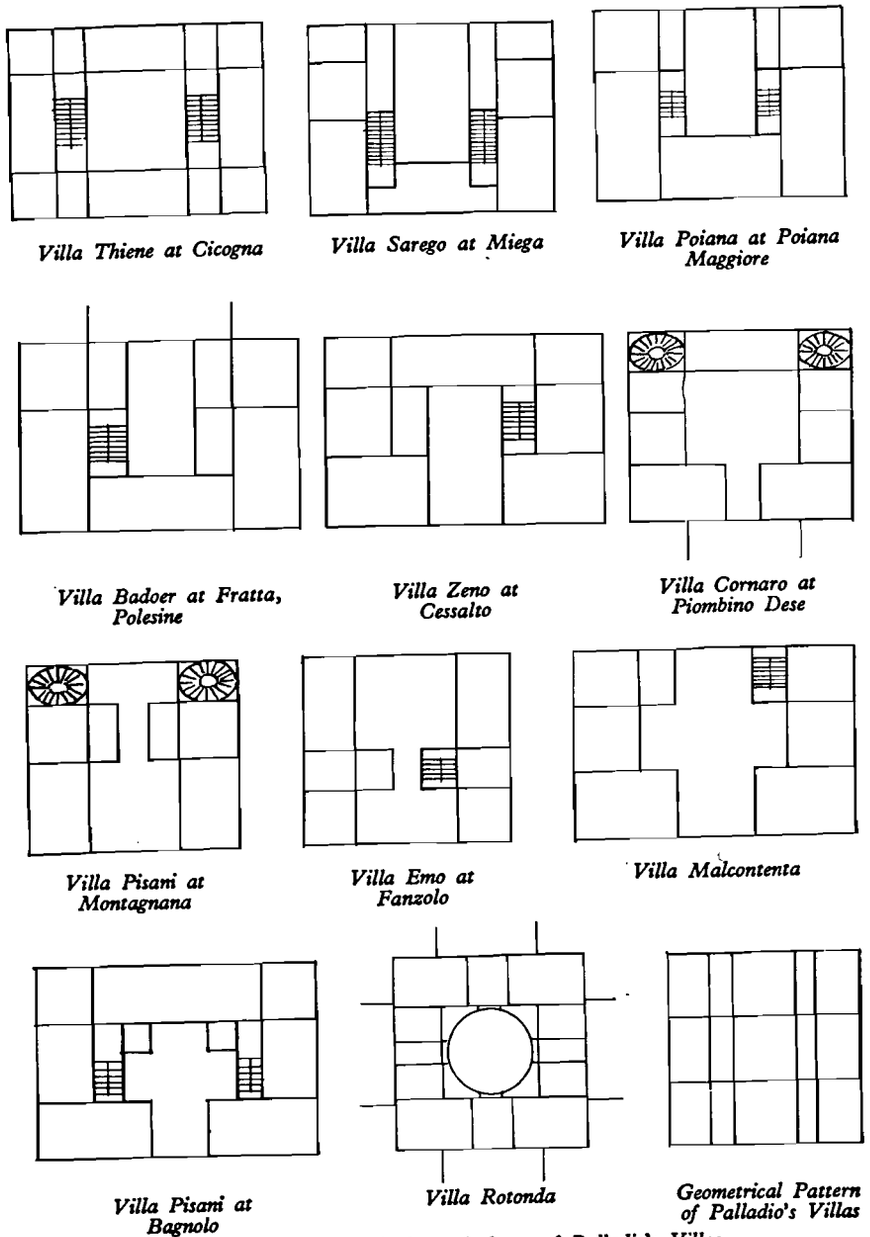


Fig. 8. *Schematized plans of eleven of Palladio's Villas*

mental architecture is conceived, whenever feasible, in terms of a solid three-dimensional block. Italian architects strove for an easily perceptible ratio between length, height and depth of a building, and Palladio's villas exhibit this quality most lucidly. The block had to be given a façade. He turned to the classical temple front, which offered a motif associated with dignity and nobility, and invariably adapted it to the façades of his villas. The reasons for this were given by Palladio himself in a passage which shows how for him practical considerations and principles of a higher order went hand in hand. 'I have made the frontispiece (i.e. the pediment of the portico) in the main front of all the villas and also in some town-houses ... because such frontispieces show the entrance of the house, and add very much to the grandeur and magnificence of the work, the front being thus made more eminent than the rest; besides, they are very commodious for placing the ensigns or arms of the owners, which are commonly put in the middle of the front. The ancients also made use of them in their buildings, as is seen in the remains of the temples, and other public edifices, and, as I have said in the preface to the first book, they very probably took the invention and the principles (of them) from private buildings, i.e. from the houses.'[1]

Façades of ancient domestic buildings were unknown, but with the application of the temple front to the house Palladio believed that he had re-created them in form and spirit; his reconstruction of the front of the ancient house in Barbaro's Vitruvius shows a large eight-column portico[2] (Pl. 23c). His conclusion was founded on two fallacies, an erroneous theory of the development of society, and an erroneous theory of the genesis of architecture. He thought 'that man formerly lived by himself; but afterwards, seeing he required assistance of other men to obtain those things that might make him happy (if any happiness is to be found here below) naturally sought and loved the company of other men; whereupon of several houses, villages were formed, and then of many villages, cities and in these, public places and edifices were built.' Therefore, he concludes, private houses were the nuclei of public buildings; in other words, temples reflect the appearance of the ancient house.[3] The idea that the temple is a magnified house

[1] Palladio II, chap. 16.

[2] Bk. VI, chap. 2.

[3] Palladio I, preface. Palladio's comparison of the city with a large house and, conversely, of the house with a small city (Bk. II, chap. 12) was dictated by practical considerations. For the totality of the Palladian villa (not discussed in this book), see Fausto Franco, 'Classicismo e funzionalità della villa Palladiana "città piccola",' *Atti del I° congresso nazionale di storia dell'architettura*, Florence, 1938, 249 ff.

throws an interesting light on Palladio's own crystalline conception of architectural composition. He cannot think in terms of evolution, but envisages ready-made units which, under certain conditions, may be transferred from one class of building to another and may also be extended or contracted.[1] Thus to utilize the temple front for private buildings appeared to him a legitimate regression to an ancient custom. But, in fact, his peculiar reasoning led him to ennoble aristocratic domestic architecture by borrowing the principal motif from ancient sacred architecture. With this unclassical transposition, the motif acquired a new vitality which he fully exploited. He was the first consistently to graft the temple front on to the wall of the house,[2] and through him the type was most widely disseminated. The nearest approach to the classical portico with its broad and majestic staircase is to be found in the Villa Rotonda (Pl. 22a); but even here the portico must be seen against the background of and in relation to, the cube of the building. The portico of the Villa Malcontenta (Pl. 22b) is also free-standing; here, however, it has been integrated into the architecture of the house, for it rises above a domestic basement, while it is joined laterally by flights of stairs which are conducted along the wall of the front.[3] A further step in this direction is the placing of the temple front in the plane of the wall exemplified by the Villa Emo (Pl. 22c). Finally, the whole façade may be transformed into a temple front as shown in the Villa Thiene at Quinto[4] and in the Villa Maser[5] (Pl. 23a, b). The range of possibilities is very large and Palladio made full use of

[1] See also the statement, obviously influenced by Alberti, in Bk. II, chap. 12: 'la Città non sia altro che una certa casa grande, e per lo contrario la casa una città picciola.'

[2] Attempts in this direction had been made before him, cf. for instance Giuliano da Sangallo's villa at Poggio a Caiano.

[3] The relation of this villa and of the Villa Rotonda to Palladio's reconstruction of the Temple of Clitumnus (S. Salvatore) near Trevi was discussed by Achille Bertini Calosso, 'Andrea Palladio e il Tempio del Clitunno' in *Saggi sull' architettura Etrusca e Romana*, Rome, 1940, p. 183 ff.

[4] Only a small portion of the villa, probably begun in 1549, was executed (cf. Burger, p. 68 ff. and his pl. 24; Zorzi, ARTE VENETA IX, 1955, p. 96). The 'temple front' illustrated on our plate 23a is the surviving wing of a very extensive front. It will be noted how close Palladio came here to Alberti's transformation of the ancient temple front into a consistent wall architecture, cf. above, p. 52 f.

[5] Begun before 1566; see Zorzi, p. 98. R. Pallucchini (in *Palladio, Veronese e Vittoria a Maser*, Milan, 1960, p. 74) dates Veronese's frescoes as early as *c.* 1560-61. The solution of the Villa Maser was anticipated in the early Villa Angarano near Bassano (1548) which was entirely rebuilt in the beginning of the 18th century, cf. Burger, p. 26 ff. Ackerman, p. 55 ff., dates the Villa Maser 1555–59.

them. These few examples will suffice to show that he constantly varied a conception the merits of which he regarded as conclusive. While in looking at these façades nobody can escape the impression that an inexhaustible wealth of ideas has gone into their design, one should not lose sight of the fact that they are all generated from the same basic pattern.

3. *Palladio and Classical Architecture: Palaces and Public Buildings*

In the preceding section Palladio's buildings have been considered as variations on a geometric theme, different realizations, as it were, of the Platonic idea of the Villa. But it would be wrong to conclude that there was no development. This section will therefore be largely concerned with the variable factors in his architecture; and as his measure was always classical antiquity the problem of Palladio's development presents itself as an examination of his changing approach to the architecture of the ancients.[1]

Palladio's first great public success was the commission given him to support the mediaeval Palazzo della Ragione at Vicenza with a surrounding structure (Pl. 24a).[2] His screen consists of an uninterrupted sequence, in two storeys, of the celebrated 'Palladio motif.' Palladio monumentalized here a conception common in Bramante's circle and later popularized through Serlio's fourth book on Architecture (1537) (Pl. 24b).[3] When discussing the ancient basilicas in the *Quattro libri* Palladio inserted a chapter on 'The Basilicas of our Time,' in which he argued that the name can rightly be used for buildings like the Palazzo del Comune in Brescia and the Palazzi della Ragione at Padua and Vicenza, in spite of the differences in custom and building methods between ancient and modern times. There is an important *tertium comparationis* between the old and the new basilicas, for both are the seats of jurisdiction.[1] And in this chapter, following the reconstruction of the ancient basilica after Vitruvius, appear two plates of his own building at Vicenza, accompanied by these words: 'I do not doubt but that this building may be compared with the ancient edifices, and ranked among the most noble and most beautiful fabrics that have been made since the ancient times, not only for its grandeur and its ornaments, but also for the materials . . . .'[2] He regarded his own building as an adaptation of the antique basilica type for modern usage. The classical forms as interpreted by Bramante were the medium through which he accomplished this revival.

According to Temanza the façade of the Palazzo Porto-Colleoni had an inscription: 'Joseph Porto MDLII.'[3] Work on the building was therefore probably begun before 1550. The derivation of the façade from a group of palaces built in Rome by Bramante and Raphael is too obvious to need any comment (Pls. 24c, 25a).[4] These buildings are in a class of their own and represent a climax of the High Renaissance palace between 1515 and 1520. Their functional differentiation of a rusticated ground-floor and smooth *piano nobile*, their majestic sequence of double half-columns, their use of few great forms, and their economy of detail, the organic separation of one member from another (e.g. balconies and bases of columns), the compact filling of the wall and the energetic projection of mass—all this, though unprecedented in ancient as well as modern times, gave these palaces the stamp of truly imperial grandeur. They had something of the serene and grave quality of ancient Roman buildings, and it was this palazzo type that, fused with Venetian elements first by Sanmicheli (Palazzo Pompei, Verona) and then by Palladio, was constantly imitated and varied all over Europe by architects with a classical bias.

Palladio kept more strictly to his models than Sanmicheli, but by

[1] Cf. also Herbert Pée, *Die Palastbauten des Andrea Palladio*, Würzburg, 1939, and the critical review by W. Lotz in ZEITSCHRIFT FÜR KUNSTGESCHICHTE, IX, 1940, p. 216 ff.

[2] Palladio received payment for four drawings on October 27th, 1545 (cf. Magrini, *op. cit.*, p. 17), at a time when he had already left for Rome together with Trissino. Almost three years later, on September 6th, 1548, his model was practically accepted for execution (*ibid.*, p. 20 ff., also for other documents on the progress of the work). Dalla Pozza, *op. cit.*, pp. 95-142, has given the history of the building with new documents. Also G. G. Zorzi, *Le opere pubbliche e i palazzi privati di A. P.*, 1965, p. 43 ff.

[3] In Italy the motif is therefore usually called 'Serliana'. I have discussed the genesis of this motif in a different context; cf. *England and the Mediterranean Tradition*, edited by the Warburg and Courtauld Institutes, 1945, p. 142 f.

[1] Bk. III, preface, p. 1; chap. 16, p. 27; chap. 20, p. 37. For Alberti's remarks about the ancient basilica as the seat of jurisdiction, cf. above, Part I, p. 6.

[2] Bk. III, chap. 20, p. 37.

[3] *Op. cit.*, p. viii.

[4] Palazzo Vidoni-Caffarelli, 1515, by Raphael, and the so-called Casa di Raffaello (destroyed) built by Bramante for Count Caprina, finished by Raphael in *c.* 1517. See also Palazzo Bresciano (1515) in the Borgo (Venturi, XI, 1, p. 237), Peruzzi's Palazzo Ossoli (*ibid.*, fig. 343), and others.

Palladio's first palace, the Palazzo Civena at Vicenza (1540-42) is even closer to this Roman palace type than the Palazzo Porto. For the attribution of the Palazzo Civena to Palladio, now generally accepted, see Zorzi, 'Una restituzione palladiana', ARTE VENETA III, 1949, p. 99 ff.

psychological barrier and, simultaneously, an optical and psychological link to a world not accessible to the layman.

Palladio applied the lesson of the Redentore to the slightly later project for a centrally planned church (Pl. 40).[1] In the first of the two plans he repeated the solution of S. Giorgio Maggiore, in the second (the later one) that of the Redentore. It is evident from these plans that the device of screening columns helps to preserve the integrity of the centralized space and, at the same time, to overcome its limitations. Optical and psychological conceptions of this kind were adumbrated in Palladio's earlier works, but it was the ideas realized in the Redentore that were extraordinarily fertile not only with such different Italian masters as Longhena, Bernini, Guarini, Juvarra and Vittone, but also with architects north of the Alps.

[1] W. Timofiewitsch (in ARTE VENETA XIII-XIV, 1959-60, p. 79 ff.) showed rather convincingly that these drawings (which I previously related to the church at Maser) belong to Palladio's project for S. Nicola da Tolentino in Venice (1579), later executed by Scamozzi from a different design.

PART FOUR

THE PROBLEM OF HARMONIC PROPORTION IN ARCHITECTURE

THE CONVICTION that architecture is a science, and that each part of a building, inside as well as outside, has to be integrated into one and the same system of mathematical ratios, may be called the basic axiom of Renaissance architects. We have already seen[1] that the architect is by no means free to apply to a building a system of ratios of his own choosing, that the ratios have to comply with conceptions of a higher order and that a building should mirror the proportions of the human body; a demand which became universally accepted on Vitruvius' authority. As man is the image of God and the proportions of his body are produced by divine will, so the proportions in architecture have to embrace and express the cosmic order.[2] But what are the laws of this cosmic order, what are the mathematical ratios that determine the

[1] Cf. above, pp. 14 f., 22 f.

[2] In addition to earlier references given above, p. 15, some mid- and late-16th century authorities may be quoted. Daniele Barbaro in his comm. to Vitruvius III, i, ed. 1556, p. 63, writes: 'La natura maestra ce insegna come havemo à reggersi nelle misure e nelle proportioni delle fabbriche à i Dei consecrate, imperoche non da altro ella vuole che impariamo le ragioni delle Simmetrie, che ne i Tempi usar dovemo, che dal Sacro Tempio fatto ad imagine, et simiglianza di Dio, che è l'huomo, nella cui compositione tutte le altre meraviglie di natura contenute sono, e però con bello avvedimento tolsero gli antichi ogni ragione del misurare dalle parti del corpo humano . . .'

Cf. also Lomazzo's *Trattato dell'arte della pittura*, etc., 1584, I, chap. 30: 'Come ancora le misure delle navi, tempij, ed edifizj sono tratte dal corpo umano.' A similar chapter in the same author's *Idea del tempio della pittura*, 1590, chap. 34, begins thus: 'il corpo umano, il quale è un opera perfetta, e bellissima fatta dal grande Iddio a simiglianza della sua Immagine, con grandissima ragione è stato chiamato mondo minore. Perchè contiene in se con più perfetta composizione, e con più sicura armonia, tutti i numeri, le misure, i pesi, i moti, ed elementi. Onde da lui principalmente, e non da altra fabbrica che uscisse dalla mano d' Iddio e dalle sue membra fu tolta la norma, ed il modello di formar i Tempj, i Teatri, e tutti gli edificj con tutte le sue parti come colonne, capitelli, canali, e simili; naviglij, machine, ed ogni sorte d'artificio.'

Michelangelo, in a letter of about 1560, wrote that 'there is no question but that architectural members reflect the members of Man' and that those who do not know the human body cannot be good architects (Milanesi, *Le lettere di Michelangelo Buonarroti*, Florence, 1875, p. 554).

harmony in macrocosm and microcosm? They had been revealed by Pythagoras and Plato, whose ideas in this field had always remained alive but gained new prominence from the late fifteenth century onwards.

1. *Francesco Giorgi's Platonic Programme for S. Francesco della Vigna*

Hardly any more telling evidence in proof of this has survived than a document relating to S. Francesco della Vigna at Venice (Pl. 42a). On the 15th of August, 1534, the Doge Andrea Gritti laid the foundation stone of the new church, and the structure was begun in accordance with Jacopo Sansovino's design. But differences of opinion soon arose about the proportions of his plan, and the Doge commissioned Francesco Giorgi, a Franciscan monk from the monastery attached to that church, to write a memorandum about Sansovino's model.

Andrea Gritti's choice of his expert is interesting. This Francesco Giorgi had made his name by a study of the problem of proportion in all its aspects. In 1525 he had published a large folio on the harmony of the universe[1] in which Christian doctrines and Neoplatonic thought were blended, and the old belief in the mysterious efficacy of certain numbers and ratios was given new impetus. The memorandum on the

Palladio (bk. II, chap. 2) compares in a brief sentence the structure of the human body with that of a building.

Vincenzo Danti's work on proportion, planned in 15 books of which only the first appeared, in 1567, would have contained in book 14: 'proporzioni dell' architettura cavata de la proporzione de la figura del huomo,' and in book 15: 'pratica di questa arte in universale'; see A. Comolli, *Bibliografia storico-critica dell' Architettura*, Rome, 1788, I., p. 16.

For the unity of the cosmological and æsthetic aspect of proportion during the Renaissance as well as for related questions see the fundamental article by Panofsky, 'Die Entwicklung der Proportionslehre als Abbild der Stilentwicklung,' MONATSHEFTE FÜR KUNSTWISSENSCHAFT, 1921, p. 208 ff. English version in *Meaning in the Visual Arts*, Doubleday, 1955, p. 89 ff. See also G. Nicco Fasola's introduction to Piero della Francesca, *De prospectiva pingendi*, Florence, 1942, particularly p. 15 ff.

[1] *De harmonia mundi totius*, Venice, 1525. This work has hardly been noticed by modern scholars although its influence during the sixteenth century seems to have been not inconsiderable. A new edition appeared in Paris, 1545, a French translation in Paris, 1579. Panofsky, in *Monatshefte f. Kunstw.*, 1921, p. 209, was the first to draw attention to Giorgi's work; cf. also *id.*, *The Codex Huygens*, 1940, p. 113. There are short notes on Giorgi in Thorndike, *Hist. of Magic*, 1941, VI, p. 450 ff. D. Mahnke, *Unendliche Sphäre und Allmittelpunkt*, 1937, p. 106 f., discussed some of the sources of Giorgi's book. About Giorgi's influence on French thought cf. Frances A. Yates, *The French Academies of the Sixteenth Century*, The Warburg Institute, 1947, pp. 88, 91 f. and *passim*. Another recent analysis of Giorgi's ideas in D. P. Walker, *Spiritual and Demonic Magic from Ficino to Campanella*, London, 1958, p. 112 ff.

proportions of S. Francesco is a practical application of the theories of that book.[1]

Giorgi suggests making the width of the nave 9 paces, which is the square of 3: 'Numero primo e divino.' In the Pythagorean conception of numbers, three is the first real number because it has beginning, middle and end.[2] It is divine as the symbol of the Trinity. The length of the nave he wants to be 27 paces, i.e. 3 times 9. The square and cube of 3, Giorgi goes on, contain the consonances of the universe as Plato has shown in the *Timaeus*; and neither Plato nor Aristotle, who knew the forces effective in nature, went beyond the number 27 in their analysis of the world. However, it is not the actual numbers but their ratios that are of importance; and that the cosmic ratios are to be regarded as binding for the microcosm also, is evident from God's command to Moses to build the Tabernacle after the pattern of the world and Solomon's resolve to give the proportions of the Tabernacle to the Temple. Giorgi also expresses the suggested proportion of width to length of the nave (9 : 27) in musical terms; it forms, as he says, a diapason and a diapente. A diapason is an octave and a diapente a fifth. 9 : 27 constitutes an octave and a fifth, if seen in the progression 9 : 18 : 27; for 9 : 18=1 : 2=an octave, and 18 : 27= 2 : 3=a fifth.

To understand Giorgi's reasoning it should be recalled that it was Pythagoras who discovered that tones can be measured in space. What he had found was that musical consonances were determined by the ratios of small whole numbers. If two strings are made to vibrate under the same conditions, one being half the length of the other, the pitch of the shorter string will be one octave (diapason) above that of the longer one. If the lengths of the strings are in the relation of two to three, the difference in pitch will be a fifth (diapente), and if they are in the relation of three to four, the difference in pitch will be a fourth (diatessaron). Thus the consonances, on which the Greek musical system was based—octave, fifth and fourth—can be expressed by the progression 1 : 2 : 3 : 4. And this progression contains not only the

[1] Though often mentioned, the memorandum was printed only by Gianantonio Moschini, *Guida per la Città di Venezia*, 1815, I, i, pp. 55-61. Considering its extraordinary importance, never sufficiently realized, I have given the full text in English as Appendix I (p. 155 ff.), which should be consulted for the following paragraphs.

[2] For the Pythagorean symbolism of 'three' see Aristotle, *de coelo* I, 1 (268a) and Plutarch, *Sympos.* IX, quaest. 3. Marsilio Ficino, in his commentary to Plato's *Timaeus*, followed this definition of 'three' (*Opera*, 1576, II, p. 1459): 'Trinitas numerorum prima, principium et medium, finemque rerum continere videtur, atque sola inter numeros ratione quadam individua continere.'

simple consonances octave, fifth and fourth, but also the two composite consonances which the Greeks recognized, namely octave plus fifth (1 : 2 : 3) and two octaves (1 : 2 : 4). One can understand that this staggering discovery made people believe that they had seized upon the mysterious harmony which pervades the universe. And on this was built much of the number symbolism and mysticism, which had an immeasurable impact on human thought during the next 2000 years. In the wake of the Pythagoreans, Plato in his *Timaeus* explained that cosmic order and harmony are contained in certain numbers. Plato found this harmony in the squares and cubes of the double and triple proportion starting from unity, which led him to the two geometrical progressions, 1, 2, 4, 8 and 1, 3, 9, 27.[1] Traditionally represented in the shape of a *Lambda* $\overset{1}{4}\ \overset{2}{8}\ \overset{3}{27}$ the harmony of the world is expressed in the seven numbers 1, 2, 3, 4, 8, 9, 27 which embrace the secret rhythm in macrocosm and microcosm alike. For the ratios between these numbers contain not only all the musical consonances, but also the inaudible music of the heavens and the structure of the human soul.[2]

In his *Harmonia mundi* Giorgi, closely following Ficino, gave proof of his familiarity with these ideas. His fifth book deals with the Pythagorean-Platonic theory of numbers. It begins with the words: 'It is absolutely evident to all Pythagoreans and Academicians that the world and the soul were defined first by Timaeus of Locri and then by Plato by certain laws and musical proportions, just as a heptachord made of seven strings (*limitibus*), beginning with unity, duplicating up to the cube of two (i.e. $2^3=8$) and trebling up to the cube of three (i.e. $3^3=27$). According to the writings of Pythagoras it was believed that in these numbers and proportions the fabric of the soul and the whole world was arranged and perfected. And from the odd as from the male, and from the even as from the female—from these powers together everything is generated. But in the cube of the one and the other, they said, the work was terminated. For one cannot proceed beyond the third dimension in length, width and depth. And also all power of

[1] This is not the place to describe Plato's ideas more fully than in Giorgi's own words which follow. For further explanations, cf. F. M. Cornford, *Plato's Cosmology*, London, 1937, pp. 49, 66 ff.

[2] Cf. *Timaeus*, 35B-36B (F. M. Cornford, *ibid.*, p. 66 ff., and A. E. Taylor, *A Commentary on Plato's Timaeus*, Oxford, 1928, p. 116 ff.).

For the 'harmony of the spheres' cf. Plato's myth of Er, *Rep.* X (616 ff.); also Aristotle's survey of Pythagoreanism in *Met.* A.5, and his explanation and refutation of this theory in *de coelo*, 290 b 12 ff.

activity and passivity is contained in these numbers and proportions, and all consonances are accumulated in them.'[1]

It is now clear why Giorgi does not want to go further than the number 27, and why ratios measured in space and as tones are for him synonymous. What Giorgi suggests for S. Francesco is the progression of the side of the Platonic triangle beginning with the 'perfect' three (3, 9, 27). His further recommendations fall in line with these principal ratios. The 'cappella grande' at the far end of the nave, like the head of the body, shall be 9 paces long and 6 wide, so that its length repeats the width of the nave and its width is related to that of the nave in the ratio of 2 : 3, a diapente (fifth) in musical terms. At the same time the ratio of 2 : 3 is also valid for the width to the length in the cappella itself. The choir behind the 'cappella grande' should repeat the measures of the 'cappella grande'—6 : 9. The whole length of the church is therefore 5 times 9. He calls it a fivefold proportion or, in musical terms, a bisdiapason (*scil.* disdiapason) and diapente.[2] The transept should be 6 paces wide, thus corresponding to the width of the 'cappella grande.' He suggests making the chapels at each side of the nave 3 paces wide, which is what he calls a triple proportion to the width of the nave itself (3 : 9), or musically (3 : 6 : 9=) a diapason (3 : 6) and a diapente (6 : 9=2 : 3). The relation of the width of the small chapels to that of the 'cappella grande' is 3 : 6, i.e. a diapason. And the relation of the width of the chapels of the transept to that of those of the nave should be 4 : 3, or a diatessaron, 'proportione celebrata.'

So far Giorgi's recommendations were carried out. Most of the actual proportions do not correspond exactly to his ratios, but the divergences are small and due to the kind of irregularities which occur in practice. The three steps leading up to the chapels and the 'cappella grande,' which he suggested and which, indeed, Sansovino had already planned, were also executed. He was not followed, however, in the height of the ceiling which he wanted flat and coffered, and related to the width of the nave in the ratio 4 : 3.

By basing in this somewhat extraordinary way all the proportions of the building on the Pythagoreo-Platonic philosophy of harmonic numbers, Francesco Giorgi may have created a precedent. But the

[1] *Op. cit.*, fol. 81 verso.

[2] But here Giorgi seems to have committed an error which we are unable to explain without having seen the original text. 9: 18: 36 is two octaves, or a disdiapason, and 36: 45=4: 5 and not 2: 3 (the diapente). Giorgi may have had in mind 36: 54 which is a diapente. On the other hand, it would be most surprising to find such an error in a man for whom the system of harmonic ratios was of such overriding importance.

three men who were consulted about the memorandum seem to have shown no undue surprise; for they approved of it. They were a painter, an architect and a humanist. This fact shows that proportion in architecture was not regarded as the province of architects alone; the unity of all arts and sciences made every literato a trustworthy judge in these matters. And the eminence of the three people chosen as consultants is a clear sign of the importance attached to Giorgi's ideas. The painter was no less a man than Titian; the architect was Serlio, who was at that time in Venice preparing his work on architecture, the first part of which (Book IV) appeared in 1537, and who, already in 1534, seems to have been regarded as particularly well versed in the theory of architecture. The humanist was Fortunio Spira, who is now almost forgotten but who enjoyed a high reputation in his own day for his many accomplishments. Francesco Sansovino[1] called him 'Filosofo celeberrimo, di profonda scientia' and Aretino praised his 'maestà nella presentia, gentilezza ne'costumi, maniera nell' attioni, gratia nei gesti, bontà nella natura, felicitade nell'ingegno, fama nelle opere, e gloria nel nome'—'regal appearance, his polite manners, promptness in action, graceful gestures, the goodness of his nature, his happy talent, the renown of his works, the glory of his name.'[2]

Giorgi demands at the end of his memorandum that the ratios of the interior should be repeated in the façade, 'che per esso si puosi comprendere la forma della fabbrica, et le sue proportioni.' It appears certain that Palladio, a generation later, knew Giorgi's memorandum and derived from it the mysterious 27 moduli which he applied to the width of the central portion of his façade.[3] Titian's and Serlio's approval of the memorandum suggests not only a familiarity with these ideas among artists, but also a readiness to apply them in practice, and it can be assumed that Palladio appreciated Giorgi's Platonic speculations. His knowledge of Platonism must have been considerable. In Trissino's circle he absorbed the spirit of the Platonic Academy, his humanist friends were steeped in the study of Plato and Aristotle, and his close

[1] *Venetia . . . descritta*, 1581; in the ed. of 1663, p. 154.

[2] Aretino, *Del primo libro de le lettere*, Paris, 1609, p. 187. Spira died about 1560. A rich collection of material about him is to be found in Cicogna, *Iscr. Venez.*, 1830, III, p. 307 ff.

[3] Cf. above Part III, p. 96. The height from the ground to the main entablature repeats the same measure.

association with Daniele Barbaro, particularly during the preparation of the Vitruvius edition, must have deepened his insight into ancient philosophical thought.[1]

2. *The Mean Proportionals and Architecture*

It has been shown in the First Part that architects were dependent on Platonic speculations in recommending the circular form for churches. In view of this fact and with Giorgi's Platonic memorandum before us, it seems appropriate to inquire how far the harmonic ratios of the Greek musical scale influenced architectural proportion of the Renaissance in theory and practice. Alberti and Palladio are our main sources for an accurate estimate of Renaissance opinion on this point. Before discussing their contributions, it may be recalled that we found at least a deliberate insistence on the ratios of the small integers not only in Alberti's façade of S. Maria Novella but also in other Renaissance buildings.[2]

At a first glance Palladio's pragmatic *Quattro libri* seem to yield disappointingly little, for there is hardly a word on the principles of proportion. The work abounds in definite statements about proportions without any explanation why one particular ratio rather than another has been chosen. Proportion is, it need hardly be said, the whole issue in any consideration of the orders, and Palladio opens the account of his celebrated system of the orders with the laconic remark that they must be related 'con bella proportione' to the whole building.[3] Behind Palladio's matter-of-fact rules there is usually more thought and accumulated wisdom than might be apparent to the modern reader. It is obvious that his notes on proportion cannot be arbitrary, but must refer tacitly to some generally accepted mathematical rule.

One example may be given as an illustration. It is of central importance and leads right into the problem of harmonic proportion. Palladio supplies general rules for the proportions of the height of rooms to their width and length, that is for the relationship of the three dimensions which constitute the shape of a room. Before discussing this important subject he gives what he considers the most beautiful

[1] Cf. above p. 65 ff.

[2] Cf. above, p. 46 and also p. 20 (S. Maria delle Carceri), p. 26 (Bramante's S. Peter's), and p. 41 (S. Francesco in Rimini).

[3] Bk. I, chap. 11.

ratios of width to length of rooms, that is, he talks in terms of two dimensions. For various reasons it seems opportune to follow Palladio's plan although we shall concentrate on his ratios of three quantities. He recommends seven shapes of rooms in the following sequence: (1) circular, (2) square, (3) the diagonal of the square for the length of the room, (4) a square and a third, i.e. 3 : 4, (5) a square and a half, i.e. 2 : 3, (6) a square and two-thirds, i.e. 3 : 5, (7) two squares, i.e. 1 : 2. With the exception of the third case, all these ratios are commensurable and as simple as possible.[1] However, the diagonal of a square in relation to its side is $\sqrt{2} : 1$. The shapes of the rooms recommended by Palladio show him following in the footsteps of his predecessors. Similar lists of approved shapes for rooms were given by Alberti[2] and Serlio[3] and both mention the incommensurability of the diagonal of the square while Palladio, with his usual restraint, does not make the point. As far as we can see this is the only irrational number widely propagated in the Renaissance theory of architectural proportion.[4] It came straight out of Vitruvius,[5] where its occurrence—amidst a module system, which otherwise presupposes commensurable ratios—has been thought with good reason to be a residue of the Greek architectural theory of proportion, all but forgotten in Roman times.[6] It is probably right to say that rarely did Palladio or any other Renaissance architect use irrational proportions in practice,[7] and this is an argument *per negationem* in favour of the case we are going to state. We must repeat that Palladio's conception of architecture, as indeed that of all Renaissance architects, is based on commensurability of ratios.[8] This creed he expressed in these words:[9] '. . . in all fabrics it is requisite that their parts should correspond together, and have such proportions, that there may be none whereby the whole cannot be measured, and likewise all the other parts.'

[1] Bk. I, chap. 21. For the ratios 1 : 1, 1 : 2, 2 : 3, 3 : 4 the reader may be referred back to p. 103; the ratio 3 : 5 will be discussed later.

[2] Cf. below, p. 114 f.

[3] *Libro primo d' architettura*, in the Venetian ed. of 1560-62, p. 15.

[4] For the diagonal of the square in Francesco di Giorgio's theory, cf. his *Trattato di architettura*, ed. Promis, 1841, p. 57 f.

[5] VI, iii, 3.

[6] Cf. Jay Hambidge, *The Parthenon and other Greek Temples*, 1924, p. 2 f. Also *id.*, *Dynamic Symmetry*, 1920, p. 145.

[7] Palladio himself asserts (Bk. II, chap. 6) that he dimensioned the atrium of the Convent of the Carità in Venice according to the diagonal of the square, following thus Vitruvius VI, 4.

[8] The time for a reliable survey of Renaissance buildings has not yet come, but I feel confident that it would confirm my assumption.

[9] Bk. IV, chap. 5.

When we turn to the relations of three magnitudes, the theoretical position is surprisingly simple. Palladio declares three different sets of ratios for height to width and length to be good proportions for rooms.[1] For each of the three cases he gives a method of calculating the height from the length and width by a geometrical as well as by an arithmetical process. We need not follow his procedure; it will suffice to record the result. His first example : suppose a room measures 6×12 feet; its height will be 9 feet. Second example : a room is 4×9 feet;[2] its height will be 6 feet. Third example : a room is again 6×12 feet; its height will be 8 feet. In his exposition Palladio sticks strictly to the practical side of the *métier* without mentioning what these proportions really signify. In actual fact, in these three examples the height of the room represents the arithmetic, geometric and 'harmonic' mean between each of the two extremes. These three types of proportion are traditionally attributed to Pythagoras[3] and without them no rational theory of proportion can be imagined.

We have to be more explicit: In the arithmetic proportion the second term exceeds the first by the same amount as the third exceeds the second[4] (b—a=c—b, as in 2 : 3 : 4, i.e. Palladio's first example); in the geometric proportion the first term is to the second as the second to the third (a : b=b : c, as in 4 : 6 : 9, i.e. Palladio's second example). The formula for the 'harmonic' proportion, Palladio's third case, is more complicated. What we now call three terms in 'harmonic' proportion is defined in the *Timaeus* (36) as 'the mean exceeding one extreme and being exceeded by the other by the same fraction of the extremes.' In other words, three terms are in 'harmonic' proportion when the distance of the two extremes from the mean is the same fraction of their own quantity (i.e. $\frac{b-a}{a} = \frac{c-b}{c}$).[5] In Palladio's example

[1] Bk. I, chap. 23. Compare Alberti's much more complicated answer to the same problem (Bk. IX, chap. 3). Scamozzi, on the other hand, simplified Palladio still further; in the five types of perfectly shaped rooms recommended by him the height is always the arithmetic mean between width and length (*Idea dell' arch. univ.* I, p. 308 f.). This is typical of Scamozzi's academic transformation of Palladio's precepts.

[2] Concerning this ratio which does not occur among Palladio's seven approved shapes of rooms, cf. below, p. 114 f.

[3] Cf. Moritz Cantor, *Vorlesungen über Geschichte der Mathematik*, 1907, I, p. 166; Sir Thomas Heath, *A History of Greek Mathematics*, 1921, p. 85.

[4] My definitions follow Porphyry's *Commentary on Ptolemy's Harmonics*, cf. Ivor Thomas, *Selections illustrating the History of Greek Mathematics* (Loeb Class. Libr.), 1939, I, p. 133.

[5] Whenever the term harmonic appears in inverted commas, I refer to this type of proportion. Without inverted commas the term is used here in its wider meaning as commensurable ratios or proportions agreeing to musical consonances.

6 : 8 : 12 the mean 8 exceeds 6 by $\frac{1}{3}$ of 6 and is exceeded by 12 by $\frac{1}{3}$ of 12 (i.e. $\frac{8-6}{6} = \frac{12-8}{12}$).

Ficino in his Commentary to the *Timaeus* had discussed the three means very clearly at considerable length,[1] and possibly through him they became of overwhelming importance in Renaissance æsthetics. In the Venetian circle of Palladio's time they were examined by Giorgi[2] as well as by Daniele Barbaro,[3] but it seems probable that Palladio's source was Alberti who had treated of them in terms more easily accessible to an architect.[4]

Before explaining the three types of means, Alberti discussed the correspondence of musical intervals and architectural proportions. With reference to Pythagoras he stated that 'the numbers by means of which the agreement of sounds affects our ears with delight, are the very same which please our eyes and our minds,'[5] and this doctrine remains fundamental to the whole Renaissance conception of proportion. Alberti continues: 'We shall therefore borrow all our rules for harmonic relations ('finitio') from the musicians to whom this kind of numbers is extremely well known, and from those particular things wherein Nature shows herself most excellent and complete.'[6] It is probably correct to interpret this passage as meaning that, for Alberti, harmonic ratios inherent in nature are revealed in music. The architect

[1] *Opera*, Basle, 1576, II, p. 1454 f.; 'Item comparationem eiusmodi esse triplicem, scilicet arithmeticam, geometricam, harmonicam. Arithmeticam in numeri paritate consistere. Sic inter tria & septem medius est quinarius, numero eodem, scilicet binario alterum terminum superans, ab altero superatus, per proportionem utrinque bipartientem. Geometricam vero in rationis aequalitate sitam esse, in qua sunt multiplex atque superparticularis: quando videlicet ita comparamus, sicut se habent tria ad novem, ita novem ad septem atque viginti, nam utrobique tripla. Item quod est novenarius iuxta senarium, idem est senarius iuxta quaternarium. Nam et hic et ibi est proportio sesquialtera. Denique proportionem harmonicam in quadam similitudine collocant, per quam tribus terminis in ordinem positis, sicut maximus terminus aspicit minimum, similiter differentia inter terminos maior minorem respicit differentiam. Sic enim ponas tria, quatuor, sex, differentia inter sex and quatuor est binarius: differentia inter quatuor & tria, unitas, sicut autem inter sex & tria dupla ratio est, ita inter duo & unum est ratio dupla. Viget hic altera quoque similitudo, scilicet portionum: Simili namque extremorum portione medius terminus excedit atque exceditur.'

[2] *Harmonia mundi*, I, v, fol. 82.

[3] Comm. to Vitruvius, bk. III, preface.

[4] *De re aed.*, bk. IX, chap. 6.

[5] *Ibid.*, chap. 5: 'Certissimum est naturam in omnibus sui esse persimilem. Sic se habet res. Hi quidem numeri per quos fiat ut vocum illa concinnitas auribus gratissima reddatur, iidem ipsi numeri perficiunt, ut oculi animusque voluptate mirifica compleantur.'

[6] Ed. of 1485, fol. yii verso: 'Ex musicis igitur quibus ii tales numeri exploratissimi sunt: atque ex his praeterea quibus natura aliquid de se conspicuum dignumque praestat tota finitionis ratio producetur.'

who relies on those harmonies is not translating musical ratios into architecture, but is making use of a universal harmony apparent in music: 'Certissimum est naturam in omnibus sui esse persimilem'[1]— 'It is indisputable that Nature always manifests herself consistently.'

Alberti as well as later artists were, no doubt, conscious of the fact that the musical consonances are determined by the mean proportionals;[2] for that the three means constitute all the intervals of the musical scale had been shown in the *Timaeus*.[3] Classical writers on musical theory discussed this point at great length. An exhaustive exposition is to be found in Boethius' *De musica*,[4] first printed in Venice in 1491-2, and of very great importance for the doctrine of numbers throughout the Middle Ages and during the Renaissance. Francesco Giorgi, reinterpreting the *Timaeus*, gave a summary of the position, based on the relevant chapters of Ficino's commentary.[5] In order to be able to find the 'harmonic' and arithmetic means as whole numbers between the terms of Plato's original series (1, 2, 4, 8 and 1, 3, 9, 27), he suggests using 6 as the lowest term. By multiplication with 6 we get the series 6, 12, 24, 48 and 6, 18, 54, 162. Into these geometric progressions the 'harmonic' and arithmetic means can be inserted without fractions: 'For the means lying between 6 and 12 are 8 and 9, where 9 is exceeded and exceeds by the same quantity. But 8 exceeds and is exceeded by the same fraction of the extremes themselves. Between 12 and 24 the means are 16 and 18, between 24 and 48 they are 32 and 36. One set of means is "harmonic", the other arithmetic,' while the geometric means are contained in the progression 6, 12, 24, 48 itself.

So far Giorgi was only concerned with the mathematical definition of the means. Now follows their application to musical theory:

> However, they all belong to harmony. For the ratio of the greater extreme to the smaller is a double proportion and makes the diapason (6 : 12). From the minor extreme to the major mean is a sesquialtera proportion and makes the diapente (6 : 9). But from the same extreme to the minor mean is a sesquitertia proportion and makes the

[1] See also Luca Pacioli, *Summa de Arithmetica*, Venice, 1494, dist. VI, tract. 1, artic. 2: '. . . impossibile e alcuna cosa in natura persistere: se la non e debitamente proportionata a sua necessita.'

[2] However, not every proportion with a mean results in a musical consonance. Alberti was well aware of this; cf. his introductory passages to the mean proportionals in IX, chap. 6.

[3] 35 C, 36; cf. Cornford, *op. cit.*, p. 70 f.

[4] Ed. Oscar Paul, Leipzig, 1872, bk. II, chaps. 12-17.

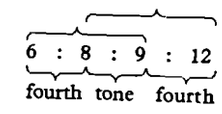
[5] Ficino, *op. cit.*, II, particularly p. 1461 f., chap 36.

diatessaron (6 : 8). And the same results from the ratio of the major mean to the major extreme (9 : 12). A diapente results from the minor mean to the major extreme (8 : 12). From one mean to the other results a sesquioctave, which makes a tone (8 : 9).[1] . . . In the same way is related the other side (*scil.* of the triangle of numbers) which is multiplied by 3, where the first extremes are 6 and 18 between which the means are 9 ('harmonic') and 12 (arithmetic). The other extremes are 18 and 54 between which lie the means 27 and 36. On the other hand, the means between 54 and 162 are 81 and 108. . . . From the mass which has been written this much may be added about what the geometric, arithmetic and harmonic means are: The arithmetic mean is the proportion of excess, the geometric mean is the proportion *par excellence* ('proportio proportionum').[2] From the two, results the harmonic mean.[3] . . . With these rules all the intervals can be filled, short of the semitones and quarter-tones. . . .[4]

Thus by applying the Pythagorean theory of 'means' to the ratios of the intervals of the Greek musical scale, the latter received a mathematical *raison d'être*, for the geometric progression constitutes the octaves, and the 'harmonic' and arithmetic means determine the intervals of the fourth and fifth and the tone. The interlocking of these ratios is well shown in Giorgi's diagram (see Pl. 42b). Whenever one meets ratios of the series 6, 8, 9, 12, 16, 18, 24, 27, 32, 36, 48, etc., it is safe to presume that this is not casual but the result of reflections which depend directly or indirectly on the Pythagoreo-Platonic division of the musical scale. And when Palladio recommended one of the three means—and only these—for the height of his rooms, he was, no doubt, aware that 'they belong to harmony.'

* * * * *

[1] 8 : 9 is the interval between fourth and fifth for:



and is therefore the ratio of the major tone.

[2] Regarded as such in antiquity, for a geometric progression from unity to squares and cubes represents line, surface and solid. See T. L. Heath, *The thirteen Books of Euclid's Elements*, 1908, II, p. 292 f, and *Timæus* 31 C.

[3] This will be understood by comparing the three formulas (1) $b=\frac{a+c}{2}$ ('proportion of excess'), (2) $b=\sqrt{a\,c}$ ('proportio proportionum'), (3) $b=\frac{2\,a\,c}{a+c}$ ('harmonic' proportion).

[4] Giorgi, *op. cit.*, V, iii, p. 82 f.

A thorough investigation would certainly lead to the discovery of similar principles with other architects of the Renaissance. However, the foregoing pages prove sufficiently that the three means which determine musical consonances take up a central position in the deliberations on proportion of those architects who absorbed humanist and neo-Platonic ideas.

We may now conclude that, when Palladio wants churches to be built 'in such a manner and with such proportions, that all the parts together may convey a sweet harmony (*una soave armonia*) to the eyes of the beholders,'[1] he did not think of a vague, indefinable appeal to the eye but of the spatial consonances produced by the interrelation of universally valid ratios. The memorandum which he was asked to write about the new design for the Cathedral of Brescia in 1567 is mainly concerned with proportion, and one sentence shows that he was thinking in the same terms as Francesco Giorgi: 'The proportions of the voices,' he said, 'are harmonies for the ears; those of the measurements are harmonies for the eyes. Such harmonies usually please very much, without anyone knowing why, excepting the student of the causality of things.'[2] We may safely surmise that Palladio regarded himself as one who knew why. The parallelism of musical and spatial proportions is an oft-repeated commonplace, and yet, against the background of a mass of Renaissance material, it appears to have been more than a simile.

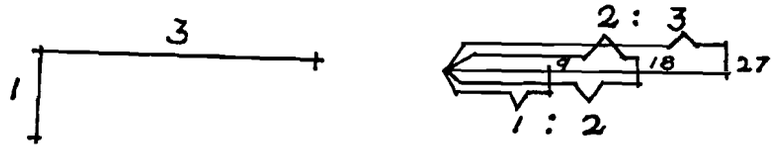
3. *Alberti's 'Generation' of Ratios*

The Renaissance identification of musical and spatial ratios was only possible on the basis of a specific interpretation of space which, as far as we can see, has not been properly understood in modern times. When Francesco Giorgi called the relation of width to length of the nave of S. Francesco della Vigna a diapason and diapente he expressed the simple ratio 1 : 3 (9 : 27) in terms of the compound ratio 1 : 2, 2 : 3 (9 : 18, 18 : 27). Is this only a theoretical proposition of applying musical ratios to space or does it imply a particular mode of space

[1] *Quattro libri*, Bk. IV, preface.

[2] Cf. Magrini, *Memorie intorno Andrea Palladio*, 1845, Appendix, p. 12: '. . . secondo che le proportioni delle voci sono armonia delle orecchie, così quelle delle misure sono armonia degli occhi nostri, la quale secondo il suo costume sommamente diletta, senza sapersi il perchè fuori che da quelli che studiano di sapere le ragioni delle cose.'

perception? If we suppose the latter it would mean that for Giorgi the length of the nave is not simply a triplication of its width, but that the length itself is charged with definite relations; for one unit (9) is seen in relation to its duplication, and the two units together (18) are visualized in relation to the whole length of three units (27). A graph of the two different approaches makes the position abundantly clear:



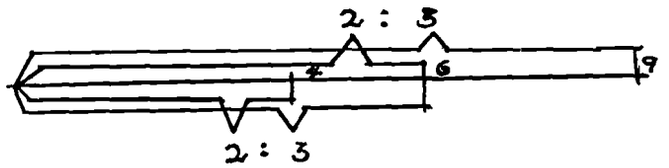
We may say Giorgi perceives the length like a monochord, on which by stopping at $\frac{1}{2}$ and $\frac{2}{3}$ of its length respectively the octave and the fifth are produced. That for Giorgi these intervals are not simply theoretical breaks is proved by the fact that they coincide with important cæsuras in the building: the first unit of 9 with the centre of the central chapel and the second unit, 18, with the end of the nave proper. With this kind of 'generation' of the compound ratio 9 : 27 from the simple ratios 9 : 18 and 18 : 27 Giorgi expressed himself in a language which was generally understood in his day. He expounded a method for which Alberti had laid the theoretical foundation.

* * * * *

Alberti differentiates between three types of plans: small, medium and large ones.[1] Each type can be given three different shapes. To the small plans belong the square (2 : 2) and shapes of one to one and a half (2 : 3) and one to one and a third (3 : 4). These ratios comply with the simple musical consonances and need no further explanation. Medium-sized plans 'duplicate' the ratios of small plans, i.e. one to two, one to twice one and a half and one to twice one and a third. With these more complicated ratios the matter becomes very interesting. To draw a plan of one to twice one and a half, the architect puts down a unit which we may call 4, extends it up to the ratio one to one and a half, i.e. 4 : 6, and adds to the unit 6 another ratio of one to one and a half, i.e. 6 : 9; the result is a ratio of 4 : 9.[2] In other words,

[1] Bk. IX, beginning of chap. 6.
[2] Cf. ed. of 1485, fol. yiii.

Alberti anticipates exactly Francesco Giorgi's procedure, for he breaks up the ratio 4 : 9 into two 'basic' ratios of 2 : 3 in the following manner:



We may now say that the ratio of 4 : 9 is generated from the two ratios 4 : 6 and 6 : 9. In the same way the ratio of one to twice one and a third, 9 : 16, is generated from 9 : 12 : 16, for 9 : 12 = 1 : $1\frac{1}{3}$ and 12 : 16 = 1 : $1\frac{1}{3}$.

The three classes of large plans are formed first, by adding to the double square, 2 : 4, one half so that the proportion 1 : 3 is generated from 2 : 4 : 6; secondly, by adding to the double square, 3 : 6, one third so that the proportion 3 : 8 is generated from 3 : 6 : 8; and, thirdly, by doubling the double square so that the quadruple proportion 2 : 8 is generated from 2 : 4 : 8. Now, the double proportion 1 : 2 (musically an octave) is a composite of the two ratios 2 : 3 and 3 : 4 (for $\frac{1}{2} = \frac{2}{3} \times \frac{3}{4}$) so that it is generated from 2 : 3 : 4 or 3 : 4 : 6 (musically from fifth and fourth or fourth and fifth). We can now say that, for instance, the proportion of 1 : 4 is generated from 2 : 3 : 4 : 8, or 2 : 3 : 4 : 6 : 8 (i.e. from fifth and fourth, and fifth and fourth), or 3 : 6 : 9 : 12, or 3 : 4 : 6 : 9 : 12 (i.e. from fourth and fifth, and fifth and fourth), etc. After the foregoing pages it hardly needs pointing out that all these ratios should also be interpreted in terms of mean proportions. For Alberti the splitting up of compound proportions into the smallest harmonic ratios is not an academic matter, but a spatial experience, as is shown by his explanation of the architect's procedure when planning the proportion 4 : 9. Harmonic ratios like the double, the triple and the quadruple are compounds of simple consonant ratios. Alberti is very explicit that sub-ratios of a compound ratio cannot be used indiscriminately by architects; they must be exactly those ratios which belong to the compound ratio. If one wants, for instance, to build the wall of a room, the length of which is double its width, one would not use for the length the sub-ratios of the triple proportion, but those of which the double is compounded. The same is true for a room in the

proportion of one to three; no other than the numerical relations of which the triple is composed should be used.[1]

* * * * *

The splitting up of ratios for the sake of making the proportions of a room harmonically intelligible appears to us very strange. And yet, this is the way the whole Renaissance conceived of proportions. A wall is seen as a unit which contains certain harmonic potentialities. The lowest sub-units, into which the whole unit can be broken up, are the consonant intervals of the musical scale, the cosmic validity of which was not doubted. In some cases only one way of generation is possible, but in others two or even three different generations of the same ratio can be carried through; as we have seen, the ratio 1 : 2 , the octave, can be seen as fourth and fifth (3 : 4 : 6) or as fifth and fourth (2 : 3 : 4). But the ratios of the musical intervals are only the raw material for the combination of spatial ratios. Alberti's harmonic progressions 4 : 6 : 9 and 9 : 12 : 16 are a sequence of two fifths and two fourths respectively, i.e. musically they represent dissonances. The ratios of musical intervals are regarded as binding, and not the building up of consonant intervals into musical harmonies. Nothing shows better than this that Renaissance artists did not mean to translate music into architecture, but took the consonant intervals of the musical scale as the audible proofs for the beauty of the ratios of the small whole numbers 1 : 2 : 3 : 4.

In analysing the proportions of a Renaissance building one has to take the principle of generation into account. It can even be said that, without it, it is impossible fully to understand the intentions of a Renaissance architect. We are touching here on fundamentals of the style as a whole; for simple shapes, plain walls and homogeneity of articulation are necessary presuppositions for that 'polyphony of proportions' which the Renaissance mind understood and a Renaissance eye was able to see.

[1] Ed. of 1485, fol. yiiii: 'His numeris quales recensuimus utuntur architecti non confuse et promiscue: sed correspondentibus utrinque ad armoniam. Utique parietes velit attollere in area fortassis: cuius longitudo sit ad sui latitudinem dupla: is istic utatur respondentiis non quibus tripla: sed iis tantum: quibus eadem ipsa componatur dupla. Acque itidem sequetur in area tripla: nam suis quoque utetur respondentiis: utetur inquam non aliis quam suis. Itaque diffiniet diametros ternatim numeris quos recensuimus: ut accommodatiores eos venire suum ad opus intelligat.'
Alberti's conception of the generation of ratios, made abundantly clear in his text, has been misunderstood by the students of his theory: cf. I. Behn, *L. B. Alberti als Kunstphilosoph*, 1911, particularly p. 104, and Paul-Henri Michel, *La pensée de L. B. Alberti*, Paris, 1930, p. 454 f.

4. *Musical Consonances and the Visual Arts*

From all that has been said so far it will be realized that the Renaissance analogy of audible and visual proportions was no mere theoretical speculation; it testifies to the solemn belief in the harmonic mathematical structure of all creation. But, in addition, music had a particular attraction for Renaissance artists because it had always been ranked as a mathematical 'science'. There was an unbroken tradition coming down from antiquity[1] according to which arithmetic, the study of numbers, geometry, the study of spatial relationships, astronomy, the study of the motion of celestial bodies, and music, the study of the motions apprehended by the ear, formed the *quadrivium* of the mathematical 'arts'. By contrast to these 'liberal arts', painting, sculpture, and architecture were regarded as manual occupations. In order to raise them from the level of the mechanical to that of the liberal arts, they had to be given a firm theoretical, that is to say, mathematical foundation. This transformation was the great achievement of 15th century artists. No wonder that they turned to music as the only respectable liberal art and studied musical theory for guidance in grappling with their own problems. A familiarity with musical theory became a *sine qua non* of artistic education.[2]

It comes as a confirmation of one's expectations to find that Brunelleschi, according to his biographer Manetti, studied the musical proportions of the ancients.[3] Manetti, writing after 1471 and under the influence of Alberti, may have read these ideas into the past; his remark, in any case, shows how acutely aware his generation was of the importance of the problem, and this is also illustrated by Alberti's famous warning to Matteo de' Pasti during the erection of S. Francesco at Rimini that by altering the proportions of the pilasters 'si discorda tutta quella musica'—'all the musical relationships are destroyed.'[4] Nobody expressed his belief in the efficacy of harmonic ratios behind

[1] For the ancient tradition, cf. John Burnet, *Greek Philosophy: Thales to Plato*, London, 1932, p. 213 ff. and *passim*. For the mediaeval tradition, cf. R. Allers in *Traditio* II, 1944, particularly p. 375 ff. For the Renaissance: R. Wittkower, *The Artist and the Liberal Arts*, London, 1952, and P. O. Kristeller, 'The modern System of the Arts,' JOURNAL OF THE HISTORY OF IDEAS XII, 1951 and XIII, 1952.

[2] Classical antiquity showed the way, for Vitruvius (I, i, 3) requested musical training for the architect. For Palladio's musical education in Trissino's circle, cf. above, p. 60.

[3] Manetti, *Filippo Brunellesco*, ed. Holtzinger, 1887, p. 16.

[4] Corrado Ricci, *Il Tempo Malatestiano*, 1924, p. 587; Cecil Grayson, *An Autograph Letter from Leon Battista Alberti to Matteo de' Pasti*, New York, 1957.

all visual phenomena with more conviction than Leonardo. We may recall in particular his well-known saying that music is the sister of painting. This was not meant as a vague simile but as indicating a close relationship; for both, music and painting, convey harmonies; music does it by its chords and painting by its proportions. Musical intervals and linear perspective are subject to the same numerical ratios, for objects of equal size placed so as to recede at regular intervals diminish in 'harmonic' progression.[1]

The 'exactissima harmonia' of the human body was the subject of Pomponius Gauricus' *De sculptura*, 1503. Gauricus asks 'what geometrician, what musician must He have been who has formed man like that?' —thus apostrophizing the fundamental unity of geometry and music. The *Timaeus*, quoted more than once by Gauricus, seems also for him the book of wisdom in which the mystical harmony in the universe was revealed. These ideas remained alive throughout the sixteenth century. Lomazzo, in his scholastic *Trattato dell' arte della pittura* (1584), talked of human proportions in musical terms. He carried on a habit of thought which is first to be found in Alberti's writings. Alberti interprets, for instance, the ratio 4 : 9 which he analysed as the product of two ratios of 1 : $1\frac{1}{2}$,[2] also as a double proportion (4 : 8) plus one *tone* (8 : 9),[3] and the ratio 9 : 16, generated from two ratios of 1 : $1\frac{1}{3}$, also as a double proportion (9 : 18) minus a *tone* (18 : 16).[4] Failing an algebraic symbolism, musical terminology was ready at hand for an adequate description of proportions. In the same vein Lomazzo regarded the applicability of musical terms to the proportions of the body as so self-evident that he not only omitted a discussion of the common laws of musical and spatial proportions, but referred constantly to spatial ratios as if they were an acoustic experience. For instance, the distance from the top of the head to the nose 'resounds (*risuona*) with the distance from there to the chin in triple proportion, producing the *diapason* and *diapente*; and the said distance from the nose to the chin and that from the chin to the meeting of the collarbones resounds with a double proportion which makes the *diapason* . . .'[5]

[1] Cf. J. P. Richter, *The literary Works of Leonardo da Vinci*, 1939, I, pp. 72 f., 76 ff. For an analysis of Leonardo's procedure, cf. R. Wittkower, in JOURNAL OF THE WARBURG AND COURTAULD INSTITUTES XVI, 1953, p. 285 ff.

[2] Cf. above, p. 114.

[3] *De re aed.*, 1485, fol. y iii: 'Excedat igitur longitudo maxima istic brevissima ex dupla atque amplius ex duplae tono.'

[4] *Ibid.*: 'Ergo hic maior linea exceditur a dupla minoris uno minus tono.'

[5] *Trattato*, ed. 1844, I, p. 63 f.

In his later *Idea del Tempio della Pittura* (1590) Lomazzo formulated theoretically what was implied in the quotation we have just given. Here he declared that masters like Leonardo, Michelangelo and Gaudenzio Ferrari 'have come to the knowledge of harmonic proportion by way of music';[1] the human body itself is built according to musical harmonies. This microcosm 'created by the Lord in his own image' contains 'all numbers, measures, weights, motions and elements.'[2] Therefore all the buildings in the world together with all their parts follow its norm.[3]

Lomazzo's information about the great Renaissance artists strikes a familiar note. Seventeenth-century artists, particularly those who carried on the classical tradition, shared the enthusiasm for the study of musical theory. Lucio Faberio in his commemoration speech at Agostino Carracci's funeral tells us that the latter was a student of philosophy, arithmetic and geometry, astrology, and, above all, music; arithmetic, the foundation of music, taught him the origin of the musical consonances.[4] Domenichino who made arithmetic, perspective and architecture his special study, speculated with zest about ancient musical theory;[5] and based on Zarlino, Poussin compared the different styles of painting with the modes of ancient music.[6]

The belief in the importance of 'musical proportions' for art and architecture was by no means confined to Italy. Artists and scholars in France, above all,[7] but also in England[8] and Spain were steeped in these ideas. Spain, it seems, had a long tradition regarding the application of musical proportions to architecture. Simón García, in his *Compendio de arquitectura y simetría de los templos conforme a la medida del cuerpo humano* of 1681,[9] was as explicit in this respect as the Venetian Francesco Giorgi had been. García's treatise was to a large extent

[1] 2nd ed., p. 112.

[2] Reference to *Wisdom of Solomon*, XI, 20; cf. below, p. 132, note 2.

[3] *Ibid.*, p. 117. The whole passage is given in Italian above, p. 101, note 2. Compare this with L. Pacioli's words quoted above, Part I, p. 15.

[4] Cf. Malvasia, *Felsina Pittrice*, 1678, I, p. 428.

[5] *Ibid.*, II, p. 339. Cf. also Domenichino's letter to Albani, December 7, 1638, Bottari, *Racc. di lettere*, 1822, V, p. 47.

[6] Anthony Blunt in *Bull. de la Soc. de l'Histoire de l'Art Français*, 1933, p. 125 ff., Frances Yates, *The French Academies of the Sixteenth Century*, London, 1947, p. 298. On Zarlino cf. below, p. 133.

[7] See pp. 121, 144 ff.

[8] See p. 143.

[9] Ed. José Camón, Salamanca, 1941; in addition, *id.*, in ARCHIVO ESPAÑOL DE ARTE, XIV, 1940-41, p. 300 ff., and G. Kubler, in GAZ. DES BEAUX ARTS, XXVI, 1944, p. 135 ff.

compiled from a work by Rodrigo Gil de Hontañon (c. 1500-77), the architect associated with the building of Segovia and Salamanca Cathedrals. Juan de Herrera, Emperor Charles V's architect, too, applied musical proportions in his design of the Cathedral of Valladolid.[1]

* * * * *

Lomazzo reports a story which shows that in his day the analogy between musical harmonies and architectural proportions was taken more literally than ever before. The architect Giacomo Soldati added to the three Greek and two Roman orders a sixth 'which he calls harmonic and which by sound he makes intelligible to the ear, but it can hardly be noticed by the eye; with this order he wanted to imitate the ancients who not less by sound than by design and building made known to the world the harmony of their five orders.'[2]

Not much is known about this Giacomo Soldati.[3] However, he must have been a man of great reputation in his own day. In 1561 he was, together with Pellegrino Pellegrini, 'architetto della Regia Camera dello Stato' at Milan and in 1570 he belonged to the court of arbitration which had to decide about the attacks by Bassi against Pellegrini. Six years later he was appointed court architect to Emanuele Filiberto of Savoy and he seems to have spent the last fifteen years of his life in that position at Turin. He made his name particularly with engineering and hydraulic works; his whole career shows that the man was a sober scientist rather than a visionary.

Palladio had contacts with Soldati's circle. He was one of the architects who had sent a report in answer to Bassi's inquiry in the above-mentioned quarrel with Pellegrini ;[4] before that date he had lived and worked in Turin[5] and as an expression of his gratitude for the

[1] R. C. Taylor, in ACADEMIA. ANALES Y BOLETIN DE LA REAL AC. DE SAN FERNANDO, 1952, p. 31f.

[2] *Lomazzo.*, p. 30: '... il sesto (ordine)... che egli chiama armonico, e col suono facilmente lo fa sentir a l'orecchie, ma agli occhi stenta rappresentarlo, volendo in questo imitar gl'antichi che non meno sonando, che disegnando, e fabbricando fecero conoscere al mondo l'armonia dei suoi cinque ordini.'

[3] Cf. Thieme-Becker, *Künstler-Lex.*, for further literature.

[4] Dated July 3, 1570 and often printed ; first in Martino Bassi's *Dispareri in materia d'architettura, et perspettiva*, Brescia, 1572, pp. 42-45. For an analysis of this letter cf. Panofsky: 'Die Perspektive als "symbolische Form",' *Vorträge der Bibl. Warburg*, 1924-25, p. 325 f.

[5] Cf. Temanza, *Vita di Andrea Palladio*, 1762, p. 45. Magrini, *op. cit.*, pp. 112, 249, xlviii. On Palladio's relations with Emanuele Filiberto cf. also *Nozze Gioco-Anti*, Vicenza, 1928 and C. Fenoglio in TORINO (RASSEGNA MENSILE DELLA CITTÀ), III, 1928, pp. 105, 121.

excellent treatment at the court he dedicated the 3rd and 4th books of the *Quattro libri* to Emanuele Filiberto 'who alone in our era through his prudence and valour is like the ancient Roman heroes.' Under Emanuele Filiberto, Turin became perhaps the most vigorous intellectual centre in Italy and it must have been on account of no common qualities that Soldati was appointed ducal architect.

Soldati's harmonic order is unknown, but the impulse for his undertaking is not too difficult to guess. A sixth order which should embrace all the qualities of the other orders and express more clearly than they did the basic harmonies of the universe became a preoccupation of architects. This order was believed to have been originally inspired directly by God when He charged Solomon to build the Temple, and architects therefore attempted to re-create this perfect archetype from which all the other orders were thought to be derived. Thus the Temple of Jerusalem became a natural focussing point for the cosmological-æsthetic theories of proportion. Here was a test-case for the philosophical endeavour of the Renaissance to reconcile Plato and the Bible; for was it not God Himself who had enlightened Solomon to incorporate the numerical ratios of the celestial harmony into his building? While Francesco Giorgi[1] used the Bible as a lever for the recommendation of the Pythagoreo-Platonic system of musical proportion, the French architect, Philibert de l'Orme, who had contact with the Venetian circle, proposed to apply systematically the proportions revealed in the Old Testament: 'les divines proportions venues du ciel.'[2]

Before the close of the sixteenth century Giovan Battista Villalpando developed these ideas further with an almost unbelievable amount of scholarship. His vast commentary on Ezekiel,[3] a work which had a

[1] See above, p. 103.

[2] De l'Orme, in his *Le premier tôme de l'architecture*, published in 1567, tells the reader that his second volume would contain a full exposition of Divine proportion 'conformémant avec les mesures et proportions qui se trouvent en la sainct Bible.' Although the volume never appeared, sufficient information can be gleaned from the first volume to reconstruct de l'Orme's trend of thought. For a full discussion, cf. Anthony Blunt, *Philbert de l'Orme*, London, 1958, p. 124 ff.

[3] H. Prado and G. B. Villalpando, *In Ezechielem Explanationes*, 1596-1604. The reconstruction of the Temple by Villalpando fills a large part of the second volume. On the influence of this work, cf. the author's note in the JOURNAL OF THE WARBURG AND COURTAULD INSTITUTES, VI, 1943, p. 221. Villalpando's new order was incorporated into a number of seventeenth and eighteenth century treatises on architecture. For a full discussion of Villalpando's reconstruction of the Temple, see R. C. Taylor, 'El Padre Villalpando (1552-1608) y sus ideas esteticas,' ACADEMIA. ANALES Y BOLETIN DE LA REAL ACADEMIA DE SAN FERNANDO, 1952.

continuous and international influence on architects, contains the most famous reconstruction of the Temple. It was, in fact, Platonic musical harmony that, according to Villalpando, had been revealed by God to Solomon. Villalpando's system is absolutely flawless. After discussing the three mean proportionals and after insisting on harmonic proportions throughout the building, he winds up with the familiar reference to music.[1] He follows explicitly Barbaro's Commentary on Vitruvius in accepting only the Pythagorean three simple and two composite consonances[2]—diatessaron, diapason, diapente, and diapason cum diapente, disdiapason—and rejecting Vitruvius' sixth consonance, diapason cum diatessaron.[3] An impressive example of the orthodox use of these five consonances is the relation of the parts of the entablature and of the triglyphs to the metopes 'in domo domini,' 'in atriis' and 'in domo regia' of the Temple. A glance at the diagram (Pl. 44a)[4] showing the ratios between triglyphs and metopes reveals the harmonic inter-relation not only inside one order, but also between the orders of the three parts of the Temple. Simple consonances were chosen for the ratios of the same order (2 : 3) and those between triglyphs of one order and the next, between metopes of one order and the next (1 : 2), and between the triglyph of a larger and the metope of a smaller order (3 : 4). The ratio between a metope of a larger and a triglyph of a smaller order is based on composite consonances (1 : 3), and so is the ratio between the largest and the smallest order (1 : 4). Thus, the ratios between the triglyphs and metopes of the three orders express the five musical consonances, and no other ratios than these are possible.

It may be argued that the speculation of a counter-reformatory theologian,[5] in which the spirit of the Middle Ages was peculiarly revived, have little in common with the work of architectural practitioners and that an unbridgeable gulf separates them from a book like Palladio's *Quattro libri*. Admittedly, there lies a whole world between the architect of the Venetian nobility of the mid-sixteenth century and the Spanish Jesuit of the next generation. Nevertheless, Villalpando's

[1] *Op. cit.*, II, p. 458: 'Illud vero huius aedificij proprium est, ac maxime observandum, idque ad harmonicam proportionem spectat; quod non alia ratione visus huius aedificij partibus contemplandis delectari videatur, quam auditus vocum, aut instrumentorum suavi modulatione perfruatur.'

[2] Barbaro, comm. to Bk. V, iv, 7. Cf. also Alberti, *de re aed.*, IX, chap. 5.

[3] Based on Ptolemy; cf. I. Düring, *Ptolemaios und Porphyrios über die Musik*, Göteborg, 1934, p. 29 (5, ii).

[4] *Op. cit.*, p. 449.

[5] On Villalpando cf. A. de Backer, *Bibl. des écrivains de la Compagnie de Jésus*, 1876, III, p. 1407.

ideas have their roots in Alberti, Francesco Giorgi, Barbaro and others, and the difference is one of emphasis rather than of fundamentals. It is not surprising that the bulkiest architectural treatise written in Italy, that of Palladio's pupil Scamozzi, produced in the familiar Venetian *ambiente* but in Villalpando's time, is heavy, dogmatic and scholastic and reads, compared with Palladio's *Quattro libri*, like a mediaeval exposition of the subject. Scamozzi upholds the traditional system of the Liberal Arts with philosophy as 'nutrice di tutte le scientie' and music in its old place in the *quadrivium* 'delle Matematiche,' and also reverts to the ancient division of music into 'musica theoricale' which is concerned with the harmonies of the spheres, and 'musica naturale' which is concerned with the sound of voices and instruments. Architects, Scamozzi maintains, should have a knowledge of music because they ought to be acquainted with the reasons for the consonances and dissonances of sounds. The whole circle of related ideas is revived by Scamozzi; he dwells at length on the importance of the Platonic numbers, on the anthropomorphic character of architecture, and, with reference to Aristotle, on the 'regola homogenea,' the modulus, which must be effective throughout the building, inside as well as outside.[1]

Not only Palladio himself but also the other architects of his generation were less eloquent than the late Mannerist Scamozzi. Vignola's *Regole delle cinque ordini* (1562) has no text at all and only a short introduction. But here too the *topos* of the analogy of musical and architectural proportions returns. His effort at systematizing the orders was centred in the problem of finding even for the smallest members 'certa corrispondenza et proportione de'numeri insieme' ('a definite correspondence and continuous proportion of figures'). The satisfaction attained by such a system has been proved by the theory of music.[2] In spite of more than a hundred years of theoretical studies by architects, Vignola was still convinced that music had a better scientific foundation than architecture. The leading musical theorist of the period, Gioseffo Zarlino, maintained in the dedication of his *Dimostrationi harmoniche* (1571) that 'per la certezza della Dimostratione' ('owing to the certitude of proof') music without any doubt was superior to architecture. It was

[1] Cf. Scamozzi, *Idea dell'architettura universale*, 1615, I, pp. 3, 23, 307 f., II, pp. 4, 31 f. and *passim*.

[2] From the preface to the *Regole*: Those orders are most beautiful which have 'certa corrispondenza et proportione de' numeri insieme . . . Laonde considerando più adentro quanto ogni nostro senso si compiaccia in questa proportione, et le cose spiacevoli essere fuori di quella come ben provano li Musici nella lor scienza . . .'

Vignola's aim to give architecture a 'certezza' of ratios equal to that in music.

* * * * *

The certainty inherent in mathematical deduction had always been the basis of musical theory. Franchino Gafurio, the famous Renaissance musical theorist, made this the subject of the frontispiece to his *De harmonia musicorum instrumentorum* of 1518 (Pl. 43a). He is shown lecturing to his pupils; on the left are three organ pipes of different length, marked 3, 4, 6, illustrating the ratios of the octave divided by the harmonic mean 4 into fourth and fifth. On the right there are three lines, repeating the ratios 3, 4, 6, and a pair of dividers, thus indicating that musical harmony is geometry translated into sound. At the same time the picture propounds the old thesis that harmony results not from the consonance of two tones, but from two unequal consonances which are drawn from dissimilar proportions[1] (i.e. 3 : 4 and 2 : 3, fourth and fifth which together form the octave). That is the reason why Gafurio preaches to his pupils: 'Harmonia est discordia concors' ('harmony is discord concordant') which appears written on a scroll near his mouth. Gafurio accepted Philolaos' Pythagorean definition of harmony,[2] which had such a far-reaching influence on Renaissance thought, and in a truly Platonic spirit he regarded this principle of harmony as the basis of macrocosm and microcosm, body and soul, painting, architecture and medicine.

Gafurio's earlier *Theorica musice* of 1492 had a striking frontispiece with a fuller illustration of musical consonances (Pl. 43b).[3] The top left picture shows Tubalcain, the biblical founder of music, presiding over a forge where six smiths are busy hammering iron on the anvil. In the next picture Pythagoras beats bells and glasses filled with liquid to different heights. In the lower row Pythagoras is shown striking chords to which weights of different size are fixed, and in the last picture Pythagoras and Philolaos appear with flutes. In all these cases the objects which are used to produce sound bear the figures 4, 6, 8,

[1] Bk. III, chap. 11: Harmony 'nempe duabus consonantiis inaequalibus constat, quae ex dissimilibus proportionibus . . . conducuntur.'

[2] Philolaos defined harmony as 'the unification of the composed manifold and the accordance of the discordant' (ἁρμονία δὲ πάντως ἐξ ἐναντίων γίνεται. ἔστι γὰρ ἁρμονία πολυμιγέων ἕνωσις καὶ δίχα φρονεόντων συμφρόνησις) cf. H. Diels, *Die Fragmente der Vorsokratiker*, Berlin, 1934, I, p. 410, fragm. 10.

[3] Dr. Paul Hirsch informs me that this woodcut appeared already in the first edition of 1480, while Pl. 43a was first published in Gafurio's *Angelicum* of 1508.

9, 12, 16, and the heads of the hammers, the bells, the liquid, the weights, the length of the flutes illustrate these ratios by the gradation of size. The figures comprise two octaves, the 'Greater Perfect System' of the Greeks,[1] with their fourth and fifth and the major tone (8 : 9). Pythagoras is shown testing the consonance of the octave 8 : 16; in the last picture he does it in concert with Philolaos, one blowing a flute half as long as that of the other (8 and 16), while Philolaos holds two flutes expressing a fifth (4 and 6) and Pythagoras two others expressing a fourth (9 and 12). The whole page is an illustration of the discovery of the musical consonances by Pythagoras, and the designer followed almost verbally the story as reported in Boethius' *De musica*.[2] It is not surprising to find that Gafurio was regarded by his contemporaries as a critic in architectural matters. In 1490 he was sent to Mantua in order to discuss with the architect Luca Fancelli the construction of the *tiburio* (tower above the crossing) of Milan cathedral.

What is shown with delightful naïveté in Gafurio's somewhat barbaric woodcut was represented by Raphael on the tablet facing the figure of Pythagoras in the School of Athens. He gave here, in an ingenious diagrammatic design of the four strings of the ancient lyra, the whole system of the Pythagorean harmonic scale (Pl. 44b).[3] This representation is interwoven with and expressive of Raphael's complex programme; however, it must suffice here to say that above the teacher Pythagoras appears the heroic figure of his great pupil carrying the *Timaeus* in one hand and pointing upward with the other. This is Raphael's interpretation of the harmony of the universe which Plato had described in the *Timaeus* on the basis of Pythagoras' discovery of the ratios of musical consonances.

[1] Cf. above, p. 103 f.

[2] Bk. I, chaps. 10, 11.

[3] At the bottom inside the 'lyra' and in the arches connecting the first string with the second and the third, the fourth string with the third and with the second, and the first string with the last, are inscribed the words ΔΙΑΤΕΣΣΑΡΩΝ, ΔΙΑΠΕΝΤΕ, and ΔΙΑΠΑΣΩΝ; at the top are the numbers VI, VIII, VIIII, XII, which show the ratios of the intervals. There is an arch between 8 and 9 and above it stands the word ΕΠΟΓΑΟΩΝ, i.e. the tone. No more convincing diagrammatic system of the Pythagorean scale could be devised. It is worth recording that sheer logic led Zarlino in his *Istitutioni harmoniche*, 1558, p. 59, to represent the basic consonances in exactly the same manner.

Under Raphael's musical diagram is the representation of the perfect Pythagorean number 10. As can be seen in Raphael's tablet, 10 is the sum of the first four figures which constitute all musical harmonies. Moreover, the Pythagorean δεκάς (number 10), which comprises all numbers, was regarded as sacred and as the 'mother of the universe.'

For further information cf. H. Hettner, *Italienische Studien*, 1879, p. 198 ff., who was the first to decipher and interpret Raphael's Pythagorean tablet.

We are back in the intellectual atmosphere which prompted Francesco Giorgi to apply the Pythagoreo-Platonic system of harmonic ratios directly to architecture. And when Raphael mentions, in a letter of 1514, that the Pope has appointed the aged Fra Giocondo as his architectural adviser so that he may learn 'whether he has some *bello secreto* in architecture,'[1] it hardly seems far-fetched to believe that these secrets were more than mere technicalities.

5. *Palladio's 'fugal' System of Proportion*

To the minds of the men of the Renaissance musical consonances were the audible tests of a universal harmony which had a binding force for all the arts. This conviction was not only deeply rooted in theory, but also—and this is now usually denied—translated into practice. It is true, that in trying to prove that a system of proportion has been deliberately applied by a painter, a sculptor or an architect, one is easily misled into finding those ratios which one sets out to find. In the scholar's hand dividers do not revolt. If we want to avoid the pitfall of useless speculation we must look for unmistakable guidance by the artists themselves. Strangely enough, no scholar has yet attempted to do this. Such guidance is not very common, but a careful survey would certainly yield considerable evidence. One must, above all, be able to decipher and interpret the artist's indications. One example may show what we mean.

At the end of his first book Serlio illustrates a geometrical scheme as a guide for the 'right' construction of the door of a church (see Fig. 10). He completes the central bay, in which the door should be placed, into a square (by drawing a line parallel to the base), draws the diagonals (AB, CD) and erects from the two corners of the base an isosceles triangle (AEC). The intersections between the diagonals and the sides of the triangle (F, G) mark the height and width of the door.[2] The drawing seems to suggest a geometrical procedure, not very different from the 'ad quadratum' method practised during the later Middle Ages. In both cases the geometric pattern leads to the arithmetically irrational focal points of the design (point F, for instance, divides the $\sqrt{2}$ diagonal CD as well as the $\sqrt{5}$ line AE into one part

[1] Cf. V. Golzio, *Raffaello*, 1936, p. 32.

[2] The letters, not in Serlio's woodcut, were here added.

and two parts). But in Serlio's case the geometrical scheme is posterior rather than prior to the ratios chosen for the door. His design was evidently the result of commensurable divisions of the large square. The door itself is a double square, its width and height in the light are related to the side of the square as 1 : 3 and 2 : 3, the frame of the door and the height of the pediment are related to the width of the

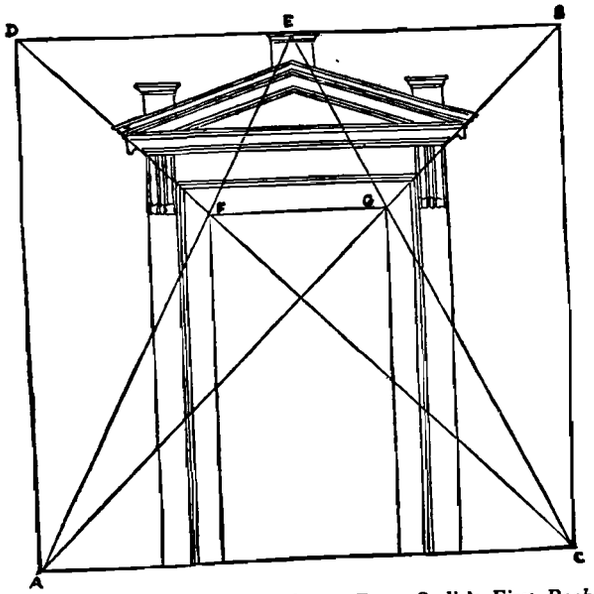


Fig. 10. *Construction of a door. From Serlio's First Book.*

opening as 1 : 3 and 1 : 2 respectively, and so forth. Thus an interrelated series of ratios of small integral numbers is really at the basis of Serlio's design. 'Mediæval' geometry here is no more than a veneer that enables practitioners to achieve commensurable ratios without much ado. But there is material at hand of a much less ambiguous nature.

* * * * *

By far the most important practical guide to a coherent system of proportion known to me is embodied in the illustrations of Palladio's *Quattro libri*. If properly interpreted, they are no less a key to the problem of harmonic proportion than Alberti's theories. Palladio's

second book contains his own buildings in elevation, plan, and section, and it is they that must now be considered. The many discrepancies between the plates and the actual buildings were and are usually attributed to careless publication.[1] Yet the plan of the whole work[2] reveals that Palladio did not publish his buildings merely as an autobiographical contribution. He made a statement to this effect in the preface to the *Quattro libri* with these words: 'In the second (book) I shall treat of the quality of the fabricks that are suitable to the different ranks of men: first of those of a city; and then of the most convenient situation for villas. . . . And as we have but very few examples from the antients, of which we can make use, I shall insert the plans and elevations of many fabricks I have erected . . .' In this light many differences between buildings and plates can be explained.[3]

The illustrations were to him a means of expounding his conceptions not only of planning but also of proportion, hence his theoretical measurements could deviate from the executed ones. If this is a right deduction, the hypothesis seems justified that Palladio wanted his inscribed measurements to convey ratios of a general character and of universal importance beyond the scope of the individual buildings.[4] In most of his plans ratios of width to length of the rooms are prominently placed and easily readable, while—with the exception of a few large-scale details—it is generally more difficult to read them in the elevations. For heights of rooms, which are given only in the relatively few sections, he often refers in his text to the method employed. These

[1] Cf. for instance O. Bertotti Scamozzi, *Les Bâtimens et les desseins de André Palladio*, 1776-83, I, p. 8, and T. Temanza, *Vita di Andrea Palladio*, 1762, pp. 15, 44.

[2] Cf. above, p. 63 f.

[3] Mistakes obviously occurred, as for instance when the width of the hall of Villa Saraceno at Finale is given as 18 feet instead of 28. But apart from such slips Palladio had often very good reason for changes between building and plate. One reason was that he did not want to hand down to posterity the designs of structures which he had built a long time ago and which no longer satisfied him. The most conspicuous case is that of the Villa Godi Porto at Lonedo, begun in 1540 (i.e. thirty years before the publication of the book), the front of which was retrogressive in style. This was 'over-hauled' in the plate and the principles of the late style were grafted on to the early building. In other cases Palladio adjusted irregularities which were forced upon him by circumstances. The Palazzo Valmarana had to be planned for an irregular site. In the plate he shows a regular plan such as he would have built on an ideal site. In his text he does not even mention that he gave the plan as he would have liked to build it, and not as it was built.

[4] That Palladio expected the intelligent observer to draw his own conclusions about the meaning of his measurements is clearly indicated by a sentence in his letter to Conte Giulio Capra to whom he sent his plans of the Redentore for criticism. The scale at the foot of the elevation, he remarks, replaces all explanations (Bottari, *Lett. pitt.*, 1822, p. 562).

arrangements seem to reveal a definite scheme which we propose to follow by confining ourselves to an examination of some of Palladio's plans.

What kind of proportion did Palladio exemplify, with his inscribed measurements? The early Villa Godi at Lonedo (Pl. 21c) contains the gist of the story in a simple form. Each of the eight small rooms—four at each side of the hall—measures 16 × 24 feet, i.e. width : length = 1 : 1½ which is one of the seven shapes of rooms recommended by Palladio.[1] The ratio of width to length is 2 : 3. The portico has the same size of 16 × 24, while the hall behind it measures 24 × 36; its ratio—1 : 1½ or 2 : 3—is therefore equal to that of the small rooms and the portico. The use of the same ratio throughout the building is apparent. But beyond this, the equation $\frac{16}{24} = \frac{24}{36}$ shows that rooms and hall are, one might say, proportionately firmly interlocked. The series underlying the plan as a whole is the progression 16, 24, 36, which we know from Alberti's analysis of the ratio 4 : 9 as 4 : 6 : 9 and which can be expressed in musical terms as a sequence of two diapente. Thus, for those who understood the language of proportion, Palladio's meaning was made abundantly clear by the conspicuous inscriptions of measurements in the plans; without them the reader would be left with no key to the architect's intentions. On the other hand, the notation of the measurements as executed would have interfered with the clarity of the harmonic concept, for the depth of the portico is actually 14·9 feet instead of 16 feet and the widths of the two adjoining rooms are 15·5 and 17·3 feet.

The ratios of Palladio's later structures are somewhat more complicated as can be illustrated in the Villa Malcontenta (Pl. 45b). The smallest room on either side of the cross-shaped hall measures 12 × 16 feet, the next one 16 × 16 and the largest 16 × 24, while the width of the hall is 32 feet. Thus, the consistent series 12, 16, 24, 32 is the keynote to the building. As if in an overture the first and last members of this series appear in the ratio 12 : 32 of the portico, which is a diapason and diatessaron (i.e. 12 : 24 : 32). The intercoluminiation of the centre (6 ft.) is related to the depth of the portico (12) as 1 : 2. The smaller intercolumniations are 4½ feet; they are related to the central one as 3 : 4 which, incidentally, is the ratio of the smallest rooms. Finally, the diameter of the columns, 2 ft., represents the smallest unit, the

[1] Cf. above, p. 108.

module, and by a process of multiplication beginning with two all the ratios of the building can be derived.[1]

An organic structure developed from the module, the 'regola homogenea,' has no room for incommensurable quantities; however, the application of the module does not necessarily mean that the ratios throughout a whole building must be harmonic.[2] But the systematic linking of one room to the other by harmonic proportions was the fundamental novelty of Palladio's architecture, and we believe that his wish to demonstrate this innovation had a bearing on the choice and character of the plates and the inscription of measurements. Those proportional relationships which other architects had harnessed for the two dimensions of a façade[3] or the three dimensions of a single room were employed by him to integrate a whole structure.

The demand that 'the parts should correspond to the whole and to each other' was generally adhered to in churches, for the relation of nave, aisles and chapels, and here the Renaissance could build on mediæval traditions. But for domestic buildings the decisive step was taken by Palladio.[4] He formulated his views on this point in one very important sentence which will add weight to our analysis of two of his villas: 'But the large rooms ought to be so related (*compartite*) to the middle ones, and these to the small, that, as I have said elsewhere, one part of the building may correspond with the other, so that the whole body of the edifice may have in itself a certain harmony (*convenienza*) of members which may make it entirely beautiful and graceful.'[5]

A thorough acquaintance with Renaissance ideas on proportion is often necessary to understand the legitimacy of the ratios given by

[1] The only measurement in this building which is not easily intelligible is the length of the hall measuring 46½ feet, where one would have expected 48 feet. The measurement can be analysed in more than one way, for instance as 6× 7 plus 4½ (6 and 4½ being the widths of the intercolumniations), but I cannot offer a fully satisfactory explanation.

[2] Cf. below, p. 136, note 1.

[3] Cf. our analysis of the façade of S. Maria Novella, above, p. 46.

[4] It would not be difficult to give earlier examples which show similar tendencies. But as far as we can see, none of Palladio's predecessors developed this problem systematically. Francesco di Giorgio seems to be the only one who discussed it theoretically in his treatise on architecture; cf. Promis, *Trattato di architettura civile e militare di Francesco di Giorgio Martini*, 1841, pls. 1, 2. See also E. Langenskiöld, *Michele Sanmicheli*, Uppsala, 1938, p. 191 and figs. 92, 93.

[5] Bk. II, chap. 2: 'Ma le stanze grandi con le mediocri, e queste con le picciole deono essere in maniera compartite, che (come ho detto altrove) una parte della fabrica corrisponda all'altra, e cosi tutto il corpo dell' edificio habbia in se una certa convenienza di membri, che lo renda tutto bello, e gratioso.'

Palladio. In the Villa Emo (Pl. 46a) rooms of 16 × 16, 12 × 16, 16 × 27 frame the portico (also 16 × 27) and the hall (27 × 27). The ratio 16 : 27 can only be understood by splitting it up in the way Alberti has taught us; it has to be read as 16 : 24 : 27, i.e. as a fifth and a major tone (=2 : 3 and 8 : 9) and similarly the compound ratio 12 : 27 can be generated from 12 : 24 : 27, i.e. an octave and a major tone (=1 : 2 and 8 : 9). Thus the figures 27, 12, 16 which, written one under the other, strike the reader's eye, are perfectly intelligible by means of the generation of ratios. Ratios of the same order are to be found in the wings; 12 is again the middle term, this time inscribed between 24 and 48. The harmonic character of this series is obvious (2 : 1 : 4, 1 : 4 being two octaves=1 : 2 : 4). The whole building appears now like a spatial orchestration of the consonant terms 12, 16, 24, 27, 48.[1]

The same theme was developed in other structures with different measurements. The Villa Thiene at Cicogna (Pl. 45a) has 4 as module (diameter of columns) and the rooms are based on the harmonic series 12, 18, 36. In the four corners are square rooms measuring 18 × 18 feet; they flank a double square room, 18 × 36, and this ratio is repeated in the two porticos which flank the hall which is 36 × 36 feet, i.e. four times the size of the small corner rooms. The progression 18 : 18, 18 : 36, 36 : 36 is broken between the small squares and the porticos by rooms measuring 12 feet in width, so that the sequence 18, 12, 18 (3 : 2 : 3) is repeated four times.[2]

Progressions of 1 : 1, 1 : 2, 2 : 2 used in the Villa Thiene occur in other buildings. Rooms of 20 × 20, 20 × 30, 30 × 30 form the core of the Palazzo Porto-Colleoni, and ratios based on the series 12, 16, 18, 24, 27, 32, 36 are frequent.[3] All these spatial proportions have their equivalent in the consonances of the Greek musical scale. But we are far from suggesting that Palladio, while planning his buildings, was consciously translating musical into visual proportions. Francesco Giorgi, in his memorandum, did not set out to prove the applicability of musical consonances to architecture, but worked with them for the design of S. Francesco della Vigna as a matter-of-course procedure.

[1] The depth of the rooms in the wings is 20; the ratios of the depth to the widths of the rooms (12, 24, 48) will be explained in the next section.

[2] This description follows the inscribed numbers. One can, of course, also read 18, 12, 36 (length of the portico).

[3] For instance Villa Pojana (18, 36), Villa Trissino at Meledo (12, 18, 36), Villa Sarego at Santa Sofia (12, 18, 24, 36), Villa Cornaro at Piombino (16, 24, 27, 32). In all these buildings one finds, together with this basic series, other figures which would need further explanation.

'The rules of arithmetic,' said Daniele Barbaro, elaborating Vitruvius,[1] 'are those which unite Music and Astrology: for proportion is general and universal in all things given to measure, weight and number.'[2] We have Palladio's own word for it, that for him the proportions of sounds and in space were closely related, and he must have been convinced of the universal validity of one and the same harmonic system. These were convictions which belonged to the general intellectual make-up of the Renaissance, and it needed no particular sophistication to translate them into practice.

6. *Palladio's Ratios and the Development of Sixteenth-Century Musical Theory*

It should now be said that ratios based on the small integral numbers of the Greek musical scale (1 : 2 : 3 : 4) are by no means the only ones to be found in Palladio's plans. Palladio showed a predilection for rooms measuring 18 × 30 or 12 × 20, i.e for a ratio of 3 : 5. There are buildings with ratios of 4 : 5 and 5 : 6[3] and these and similar ratios occur not only in the proportions of one room but also in the relation of one room to another—4 : 5 in the Villa Valmarana at Lisiera, 5 : 6 in the Villa Ghizzole, 3 : 5 in the design for the Palazzo Angarano, 5 : 9 in that for Count della Torre at Verona, and this list could be considerably extended.

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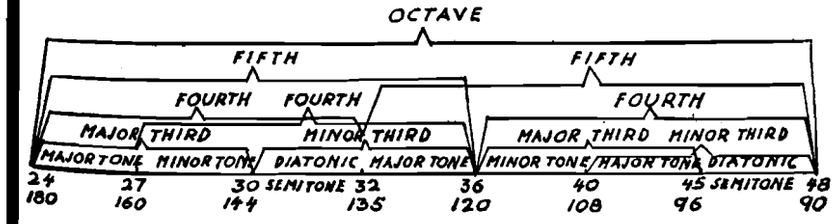
All these buildings present new problems which cannot be understood without considering the fundamental changes in the approach to proportion during the sixteenth century. In the course of this century ratios became perceptible which were outside the grasp of fifteenth century artists. The development of musical theory during that period, particularly in Northern Italy, is a reliable guide. It was Ludovico Fogliano of Modena who, in his *Musica theorica* of 1529, first protested

[1] Commentary to bk. I, i, 16.

[2] The theological connotation is evident, cf. *Wisdom of Solomon*, XI, 20: 'But by measure and number and weight thou didst order all things.' This passage was often quoted in support of the Christian belief in the all-embracing virtue of numbers. Luca Pacioli in his *Summa de Arithmetica*, Venice, 1494, dist. VI, tract. 1, artic. 2 (2nd ed. 1523, f. 68 v.) refers to it with reference to St. Augustine.

[3] Such ratios occur in some of the structures which we have discussed. In fact, they are so frequent that no detailed list need here be given.

against the sole authority of the Pythagorean consonances; according to him experience teaches that, apart from the five Pythagorean consonances, minor (5 : 6) and major third (4 : 5) minor (5 : 8) and major sixth (3 : 5), and major (2 : 5) and minor tenth (5 : 12), eleventh (3 : 8), and minor and major sixth above the octave (5 : 16 and 3 : 10) are all consonances.[1] But it was Zarlino, the great Venetian theorist of the mid-sixteenth century who, with his rigorously scientific approach,[2] classified the entire harmonic material which had come down from antiquity. It is a phenomenon which Zarlino calls 'veramente maraviglioso' ('truly miraculous')[3] that the consonances are determined by the arithmetic as well as by the 'harmonic' mean. The arithmetic mean 3 between 2 and 4 divides the octave into fifth and fourth (2 : 3 and 3 : 4); the same result, inverted, is achieved by the 'harmonic' mean 8 between the extremes 6 and 12 (6 : 8 = 3 : 4 and 8 : 12 = 2 : 3). Zarlino could show that the same law applies to the division of the fifth, for 2 : 3 or 4 : 6 with the arithmetic mean 5 determines the ratios of major and minor third (4 : 5 and 5 : 6) and with the 'harmonic' mean —as in 10, 12, 15—the ratios of minor and major third. A further division of the major third is possible; the insertion of the arithmetic mean between 4 and 5 leads to the ratio 8 : 9 : 10, 8 : 9 being the major tone and 9 : 10 the minor tone, while the 'harmonic' mean 80 between the extremes 72 and 90 divides the series into minor and major tone. Zarlino can now show in a diagram the '*divisione harmonica della Diapason nelle sue parti*' ('harmonic division of the octave into its parts'):[4]



[1] *Musica theorica*, Venice, 1529, II, chap. 1, fol. xi verso. Cf. H. Riemann, *Geschichte der Musiktheorie im IX.-XIX. Jahrhundert*, Leipzig, 1898, p. 326: 'haec autem quae addimus sunt consonantiae quae a *practicis* appellantur (follow the consonances mentioned in the text) . . . quae omnia intervalla esse *veras et valde delectabiles consonantias non potest negari.*'

[2] *Le Istitutioni harmoniche*, Venice, 1558, p. 21: 'la Musica è scienza, che considera li Numeri, e le proportioni.'—'Music is a science which is concerned with numbers and proportions.'

[3] *Ibid.*, p. 161.

[4] *Ibid.*, part II, chap. 39, p. 122. We have slightly altered Zarlino's diagram by

If we take this new development into consideration, most of the problematic ratios in Palladio's buildings become intelligible. A comparatively simple example for the combination of the old with the new consonances is the Villa Pisani at Bagnolo (Pl. 45c). The smallest room measures 16 × 16 feet, the middle one 16 × 24 and the largest one 18 × 30, while the cross-shaped hall is 32 × 42 feet. We have met with the sequence 16 × 16, 16 × 24 in the Villa Malcontenta. The measurement 30 of the largest room is not inscribed, but Palladio says in his text that these rooms are 'lunghe un quadro e due terzi' ('one two-thirds long', i.e. 18 plus 12). This shape, recommended by Palladio as one of the seven 'più belle e proportionate maniere di stanze' ('most beautiful and proportionate types of rooms'), is musically a major sixth (3 : 5) and it can be divided into 18 : 24 : 30, i.e. 3 : 4 : 5, a fourth and a major third. The figures 16 of the square room and 18 of the largest room express the firm proportional relationship of the major tone (8 : 9); in addition, 18 and 16 are linked to the 24 of the room between them by the ratios 3 : 4 (fourth) and 2 : 3 (fifth). All these affinities are suggested by the inscription of the numbers 16, 24, 18 in the right-hand side of the plan. Moreover, the length of the central room, 24, is related to the (uninscribed) length of the largest room, 30, as 4 : 5 (major third). The length of the hall, 42 feet, results from the addition of 18 and 24 (the lower part of the hall forms a square of 18 × 18); and the figures 18, 24, 32 (width of the hall) represent two ratios of 3 : 4.

In the Villa Sarego at Miega (Pl. 46b) the sequence 12 : 16, 16 : 16, 16 : 27 recurs which we have met in a different order in the Villa Emo. But the central part of the building, between the three flanking rooms of each side, seems to follow a different system of ratios. In the portico are inscribed the numbers 10, 15 and 40, in the hall 20 and 40 and in the rooms connecting the hall with the wings 9 and 24. The numbers 10, 15, 20, 40 form a series of the order known to us (2, 3, 4, 8). 9 : 24 is an octave and a fifth (9 : 18 : 24), and both terms are not only linked in many ways with the adjoining rooms but also connect the series of terms in the outlying rooms with those in the centre: thus 9 : 12 is a fourth, 9 : 20 an octave and a minor tone (9 : 18 : 20); while 24 is related to 12, 16 and 27 as octave, fifth, and major tone, and to 20 and 40 of the hall as minor third (5 : 6) and major sixth (3 : 5; this proportion can also be expressed as fourth and major third, i.e. 24 : 32 : 40). All this, however, does not exhaust the relations which Renaissance men could here envisage. With the development of sixteenth century musical theory in mind we can now grasp something of the harmonic 'cross-currents' in such a building. The ratios of 9 and 10, 10 and 12, 15 and 16, 12 and 20, although not occurring in adjoining rooms, must be understood as parts of the same theme.

translating his terms and also by quoting the arithmetic series 24, 36, 48 together with Zarlino's harmonic series 180 to 90. The diatonic semitone 15: 16 is necessary, for without it one cannot proceed from the major third to the fourth.

Instead of carrying this analysis further, we may turn to another building, the Villa Maser (Pl. 47a), in which the basic harmonic unity of all the inscribed numbers may be demonstrated in detail. The long wings behind the main building contain three groups of three rooms each—two of these groups are repeated at each side of the central group—the widths of which are inscribed as 16, 12, 16; 20, 10, 20; 9, 18, 9. It is obvious that the ratios in each set of rooms are consonant (4 : 3 : 4; 2 : 1 : 2; 1 : 2 : 1).[1] But one can go a step further. In the front of the main building are three rooms—of which the middle one is part of the cruciform hall—all 12 feet wide (together 36); in the corresponding part of the wing the three rooms reappear with the different orchestration 9, 18, 9 (together 36). Twelve is the harmonic mean between 9 and 18 and divides the octave into fourth and fifth; the two inscribed figures 12 and 18, one above the other, are indicative of Palladio's intentions. We find the figure 12 again in the outside group of rooms of the wings, while the depth of the front rooms, 20, is repeated in the width and depth of the middle group of the wings. In other words, the three groups of rooms of the long wing repeat and develop the theme of the main building. At the same time, the figures inscribed in the three groups of the wings are interrelated, the smaller class of rooms as 9 : 10 : 12 (minor tone and minor third), the larger class of rooms as 16 : 18 : 20 (major tone and minor tone). The relation between the lengths of rooms, 20 and 32 (farthest group), is 5 : 8

[1] The plan published by Palladio does not show that each group of rooms represents a distinct unit through the treatment of the ceilings. The central group of rooms has barrel vaults, and inside this group there is a gradation of heights: the higher room in the main axis is framed by the two smaller rooms with lower barrel vaults. In the adjoining groups of three rooms which are covered by flat ceilings the relation is reversed: the higher rooms frame a lower one. The principal structure projecting in front of the long wings has barrel vaults in the arms which intersect in the crossing. The vaults of these arms are considerably lower than the barrel vault of the room behind. Thus the gradation of the heights of the rooms and the variation in the construction of the ceilings help to make Palladio's harmonic scheme a poignant visual experience. Since no measured sections of the villa exist, it is at present not possible to say at what relations (between the heights of rooms inside one group and between different groups) Palladio was aiming.

(minor sixth, or minor third and fourth—20 : 24 : 32). The stables, the court-yard, the colonnade all form part of this symphony.[1] 12, the basic term of the building, returns in the width of the fountain in the main axis at the farthest end of the yard and also in the width of the colonnade. Divisions of the key number 12 (6, 3, 4) are inscribed in the smallest room of the house and in the niches and the passage of the esedra leading to the fountain. The depth of the cortile, 32, corresponds to the length of the farthest group of rooms, and the width of the esedra, 60, is a fivefold proportion of 12 or a triple proportion of the equally important term 20. As the ratios of this building are evolutions of one and the same harmonic pattern, the proportional affinities could be stated in still greater detail.

However the reader may doubt whether Palladio's inscribed figures are really so full of implications. In spite of our close adherence to his own figures we may be accused of the error, so often made by modern writers on proportion, of interpreting into a building relations which were never intended by its architect. Yet nobody can deny that Palladio's numbers were meant to be indicative of certain ratios, and it is not this fact but only the degree of interpretation which may be questioned. Now the position in architecture is exactly paralleled by that in musical theory and practice. Such a brilliant student of musical theory as Matthew Shirlaw described the art of harmonic composition in Zarlino's time with these words:

> The older art, although it was not on harmony alone that it depended for its æsthetic effect, was nevertheless capable of a very high degree of harmonic expressiveness. Composers of that time did not consider that there was any lack of harmonic material; for them a rich means of harmonic variety existed in the various consonances, and in the various ways of combining them. Not only so, but by different

[1] However, two measurements occur—14 (width of horizontal arm of hall) and 46 (length of stables)—which do not fit into the harmonic pattern. For Zarlino all harmonies are contained in the progression 1, 2, 3, 4, 5, 6, which includes even the minor sixth (5: 8, generated from 5: 6, minor third, and 6: 8, i.e. 3 : 4, fourth); however, 7 forms no part of his harmonic series. And yet, both figures, 14 as well as 46, are firmly linked to the rest of Palladio's terms. This will be evident by reading the whole series from which the proportions of the building were generated: 2, 3, 4, 6, 8, 9, 10, 12, 14, 16, 18, 20, 32, 46, 60.—14 and 46 are the arithmetic means between 12 and 16, and 32 and 60. Moreover, the distance of the mean 46 from the extremes 32 and 60 is 14.

The 'dissonant' ratio 6 : 7 as well as the arithmetic mean are to be found in other buildings. The Villa Zeno at Cessalto is generated from the terms 12, 14, 21½, 29; 21½ being the arithmetic mean between 14 and 29, but no two numbers correspond here to musical intervals.

> arrangements of these consonances it was possible to obtain a great many different tone-combinations which varied in harmonic effect and expressiveness: a delicate and subtle art which has since been to a great extent lost.[1]

* * * * *

Any uneasiness about Palladio's intentions can be resolved by reading the relevant chapters of the Commentary to Vitruvius by Daniele Barbaro, the very man for whom Palladio built the Villa Maser. Vitruvius' work contains no real theory of proportion.[2] Barbaro could not let this pass and so, after Vitruvius' preface to the third book, he inserted a circumstantial discourse on proportion.[3] He considered it of such importance that he introduced it with a formal address to the reader who is desirous to look 'più a dentro, à ritrovare la verità delle cose' ('behind the surface in order to rediscover the truth [hidden] in things').

The discourse begins with that complicated classification of numerical ratios which was in use from the times of Nicomachus' Arithmetic[4] to the seventeenth century, when the modern fractional notation was generally introduced. After this introduction, Barbaro turns to 'proportionalità' which he declares to be the essence of every work of art, exclaiming: 'The whole secret of art consists in *proportionalità*.' Following the traditional usage of the Latin words 'proportio' and 'proportionalitas,' Barbaro defines 'proportione' as the ratio of two magnitudes and 'proportionalità' as 'the comparison not of one magnitude with another, but of one proportion with another.'[5] Barbaro then

[1] Matthew Shirlaw, *The Theory of Harmony*, London, 1918, p. 37.—It would be illuminating and full of interesting implications if one were to find that Zarlino, Daniele Barbaro and Palladio belonged to the same circle. So far as I am aware, no documents in support of intimate contacts have been published, but it is worth noting that Zarlino in his *Sopplimenti musicali* (Venice, 1588, pp. 179, 288, *passim*) quotes Barbaro's Vitruvius edition more than once and with great personal respect for the author.

[2] This statement has recently been challenged by P. H. Scholfield (*The Theory of Proportion in Architecture*, Cambridge, 1958, p. 16 ff.), although he admits that Vitruvius' theory of proportion is neither full nor detailed and lacks coherence as well.

[3] Ed. 1556, p. 57 ff.

[4] Cf. the table of Nicomachus' terminology in Heath, *A History of Greek Mathematics*, 1921, I, p. 101 ff.

[5] Barbaro, p. 58: 'si come la proportione è rispetto, & convenienza di due quantità comprese come due estremi sotto un'istesso genere, cosi la proportionalità è rispetto, & comparatione non d'una quantità all'altra, ma d'una proportione all'altra.' Compare with this definition Boethius' 'proportionalitas est duarum vel plurium proportionum similis habitudo' (*De musica*, ed. Friedlein, p. 137), which is the Greek ἀναλογία, cf.

explains in great detail methods of subtraction, addition, multiplication and division of ratios and of finding the common denominator of two and more 'proportioni.' He winds up with compound ratios which he considers of the utmost importance and for which he follows, as he professes himself, the system of 'Alchindo.'[1]

Barbaro's discourse contains nothing new for the theory of numbers. What is important about it is that he regarded his expositions as fully applicable to architecture; and he comes to the conclusion that 'the possibilities of using now one, now another proportion are unlimited, for instance in subdividing the bulk of buildings ('i corpi delle fabbriche'), or in *atria*, *tablina*, halls, loggias, basilicas, and other cases of great importance.'[2] It would be entirely wrong to interpret this sentence outside its context, as if the architect were free to handle proportion without the firm basis of science—on the contrary, the system is so complex and the definitions are so detailed that there is no room left for arbitrary proportions. Beauty results only from the right proportions: 'Divina è la forza de'numeri tra se con ragione comparati.'[3] This means that numbers have a divine power when the proportions are consonant. Other passages clearly reveal the trend of Barbaro's thought. Barbaro leaves us in no doubt: 'Every work of art must be like a very beautiful verse, which runs along according to the best consonances one followed by the other, until they come to the well ordered end.'[4] The proportions of the human body are consonant and

Timaeus 31c and Aristotle's 'Proportion is equality of ratios' (*Eth. Nic.* V, 6, 1131 a 31). Barbaro's admiration of 'proportionalità' was firmly rooted in Renaissance thought; see Ghiberti's 'Ma la proportionalità solamente fa pulcritudine' (J. von Schlosser, *Lorenzo Ghibertis Denkwürdigkeiten*, 1912, p. 105).

[1] Al-Kindi's *Libellum sex quantitatum* (9th century) was already referred to by Ghiberti (cf. Julius von Schlosser, *Leben und Meinungen des flor. Bildhauers Lorenzo Ghiberti*, Basel, 1941, p. 185) and probably used by Leonardo, cf. Richter, *op. cit.*, I, p. 243. For Al-Kindi cf. G. Sarton, *Introduction to the History of Science*, 1927, I, p. 559 f.

[2] Barbaro, *op. cit.*, p. 101. I cannot agree with the conclusions of a valuable paper by V. P. Zoubov ('Vitruve et ses commentateurs du XVIe siecle,' *La science au seizième siècle*, Colloque international de Royaumont, Paris, 1957, p. 79 ff.), according to whom Barbaro differentiated between an abstract system of mathematical rules and the concrete problem of architectural practice. For the latter, Zoubov maintains, Barbaro advocated artistic liberty. In my view (see the text above), Barbaro's postulate of the variability in the application of proportions is a far cry from their abrogation.

[3] *Ibid.*, p. 57. Barbaro continues: 'One can say that neither in the structure of this world nor in the microcosm is there anything more extensive and full of dignity than propriety of weight, number and measure from which time, space, movement, virtue, speech, art, nature, knowledge, in short everything divine and human is composed, has grown, and has been perfected.' Once again, the reference to *Wisdom of Solomon*, xi, 20, is evident.

[4] Barbaro, p. 24, ad Vitruvium I, ii, 3.

harmonious like the chords of a guitar. Of singers it is expected that their voices should be in tune, and the same applies to the parts in architecture. 'Questa bella maniera si nella Musica, come nell'Architettura è detta Eurithmia, madre della gratia, e del diletto. . . .' ('This beautiful manner in music as well as in architecture is called harmony, mother of grace and of delight').[1]

The theme of proportions runs through Barbaro's whole commentary like a guiding thread and he returns to it with ever renewed emphasis. Perhaps the most illuminating passage is that following the part from which we have just quoted. In commenting further on Vitruvius' notions of 'symmetria' and 'eurythmia' Barbaro says:

> Symmetry is the beauty of order as 'eurythmia' is the beauty of disposition. It is not enough to order the measurements singly one after the other, but it is necessary that those measurements be related to each other, that is to say that there must be some proportion between them.

This sentence seems to imply a recommendation of Palladio's 'symphonic' principle of proportion. To be sure, the conclusion drawn by Barbaro in the next sentence reveals his sympathy with Palladio's practice:

> Thus, where there is proportion there can be nothing superfluous. And as nature's instinct is the ruler of natural proportion, so the rule of art is master of artificial proportion. From this it results that proportion belongs to form and not to matter, and where there are no parts there cannot be proportion.

Here Barbaro touches on the manner in which proportion was perceived during the Renaissance.[2] Falling back on Aristotle's notions of matter and form, he regards it as the prerequisite of 'formed matter' that it should consist of parts which are proportionately related to each other.

> For proportion originates from composite parts and their relationship to each other; and, as has been shown, there must be at least two terms in each relation.

[1] *Ibidem.*

[2] Cf. above, p. 113 ff.

He ends with a panegyric on proportion, and throws light on the ideas which guided him when he inserted, in the third book, his discourse on proportion:

> One cannot sufficiently praise the effect of proportion, on which is based the glory of architecture, the beauty of the work and the miracle of the profession. This will become apparent when we talk about proportion and explain the secrets of this art demonstrating the innate quality of proportion, its terms, use and effect and by what power it determines the appearance of things.[1]

Those who work through Barbaro's chapter on proportion—not an easy task nowadays—will put it aside with the conviction that this man expected and saw in a building proportional relationships which are outside our range of perception. The reader, we hope, will agree that Palladio, like Barbaro, firmly believed that proportion contained 'all the secrets of art.' Moreover, the analysis of some of Palladio's buildings may have convinced him that this architect was a master in the application of 'proportionalità'. Considering Palladio's friendship with Barbaro and their community of interests,[2] one is tempted to say that the former was pre-destined to realize in Barbaro's own villa those subtle harmonic relationships in which patron and architect equally believed.

After all the foregoing, it can hardly be doubted that Palladio controlled and corrected his innate sense of proportion by a rational theory.[3] There exists, moreover, an interesting proof of this. In the letter to Martino Bassi in which he stated his reasons for supporting

[1] The whole passage (p. 24) runs as follows: 'La Simmetria è la bellezza dell' Ordine, come la Eurithmia della Dispositione. Non è assai ordinare le misure una dopo l'altra, ma necessario è, che quelle misure habbiano convenienza tra loro, cioè sieno in qualche proportione, & però dove sarà proportione, quivi non può essere cosa superflua; & si come il maestro della natural proportione è lo instinto della natura, cosi il maestro dell'artificiale è l'habito dell'arte, di qui nasce che la proportione piu presto della forma, che della materia procede (later edition: è propria della forma, & non della materia), e dove non sono parti, non può essere proportione: perchè essa nasce dalle parti composte, & dalla relatione di esse, & in ogni relatione è forza, che ci sieno almeno due termini (come s'è detto) ne si può lodare abastanza l' effetto della proportione, nella quale è posta la gloria dell' Architetto, la fermezza (later ed.: bellezza) dell'opera, & la maraviglia dell'Artificio, come si vedrà chiaramente, quando ragioneremo delle proportioni, & apriremo i secreti di questa Arte, dimostrando qual rispetto s'intende essere nella proportione, quali termini siani i suoi, qual' uso & quanti effetti, & di che forza essa faccia le cose parere.'

[2] Cf. above, Part III, p. 65 ff.

[3] But Palladio reserved for himself the right to break the rules. This is an important ingredient of his art and theory. He concludes his survey of rules for the proportion of rooms with the words: 'There are still other heights for rooms which fall under no rule, and the architect has to use them according to his judgment and need' (Bk. I, p. 50). Similarly, the next chapter on 'The Measurements of Doors and Windows' begins with the statement that 'one cannot give a certain and absolute rule about their height and width.' Such unorthodox statements punctuate Palladio's treatise, and in the stress laid on individual judgment and practical experience, reflected also in his work (cf. above p. 130, n. 1, and p. 136, n. 1), one might see the typically North Italian Aristotelian accretion (cf. above, p. 68) to the Platonic substance with which the foregoing pages were concerned.

Bassi's case against Pellegrino Pellegrini,[1] Palladio mentions that he wanted to hear the opinion of 'huomini intendenti' ('men of competence'). He had therefore shown Bassi's suggestions to the painter Giuseppe Salviati, a specialist on perspective, and to Silvio Belli, 'the most excellent geometrician whom we have here.' This Silvio Belli, in whose judgment Palladio had such confidence, was the author of a work on proportion, entitled *Della Proportione, et Proportionalità*, which appeared in 1573 and which covered much the same ground as Barbaro's discourse. The lucidity and simplicity of Belli's presentation is congenial to Palladio's conception of architecture. Belli was not only a mathematician, he was above all a practical man. He had won laurels as an engineer; and as a co-founder of the Olympic Academy he must have been in close contact with Palladio for many years.[2]

A contemporary scholar coupled the names of Palladio and Belli in a remarkable passage at a time when the two men were still alive. It appears to us a strange and unexpected tribute when he says in their praise: 'Certainly everybody knows how much talent and nature means even without learning; or if he does not know it, let him turn to Andrea Palladio and Silvio Belli. For these with a minimum of erudition, but a maximum of meditation and skill bring back into use the measurements, forms and works according to the rules of Archimedes, Euclid and Vitruvius and embellish our age with very beautiful buildings.'[3] Measured by our standards Palladio's considerable learning was closely tied up with his whole approach to architecture. But to absorb Euclid and Vitruvius and other classical knowledge was for the mid-sixteenth century architect no more than what in our time would be a

[1] Cf. above, p. 120.

[2] On Belli cf. Angiolgabriello di Santa Maria [Calvi], *Biblioteca, e storia di . . . scrittori . . . di Vicenza*, 1772-82, Vol. IV, pp. 103-107.

[3] Sebastiano Montecchio, *De Inventario haeredis*, Venice, 1574, p. 163 (quoted after Magrini, *op. cit.*, p. 2): 'Nemo quippe ignorat quantum valeat ingenium et natura etiam sine disciplina; vel si ignorat, respiciat in Andream Palladium et Sylvium Bellum. Hi enim ut minimum eruditioni, ita plurimum meditationi artificioque attendentes, Archimedis, Euclidis, Vitruvii regulis, dimensiones, figuras, opificia in usum revocant, nostramque aetatem pulcherrimis exornant substructionibus.'

young architect's university training. It was the foundation upon which talent could build.

* * * * *

The case of Palladio, it would appear, has typical significance. The theory and practice of Renaissance proportion were not divorced from each other, nor should proportion in Renaissance buildings be regarded in isolation as a purely æsthetic phenomenon. Under a Renaissance dome a Barbaro could experience a faint echo of the inaudible music of the spheres.

7. *The Break-away from the Laws of Harmonic Proportion in Architecture*

It need hardly be recalled that the doctrine of a mathematical universe which, with all its emanations, was subject to harmonic ratios, was triumphantly reasserted by a number of great thinkers in the seventeenth and eighteenth centuries. We find this conception of the world fully expounded in Kepler's *Harmonia mundi* (1619), we find it in Galilei,[1] and later in Shaftesbury, for whom, truly Platonic, the laws of musical harmony are effective also in human nature: '*Virtue* has the same fix'd Standard. The same *Numbers*, *Harmony*, and *Proportion* will have place in Morals; and are discoverable in the *Characters* and *Affections* of Mankind.'[2]

The poets echo these ideas.[3] Dryden thinks in terms of the Greek musical scale in 'A Song for St. Cecilia's Day':

> From harmony, from heav'nly harmony
> This universal frame began;
> From harmony to harmony
> Thro' all the compass of the notes it ran,
> The diapason closing full in man.

But long before this was written, the voice of doubt was to be heard. John Donne[4] had sung in 1611:

> And new Philosophy calls all in doubt,
> The Element of fire is quite put out;
> .....
> 'Tis all in peeces, all cohaerence gone;
> All just supply, and all Relation.

[1] Cf. E. Cassirer, *Das Erkenntnisproblem*, 1911, I, p. 383 ff.

[2] In 'Advice to an Author,' *Characteristicks*, ed. 1737, I, p. 353. See also the hymn on harmony in nature in 'The Moralists,' *ibid.*, II, p. 284 ff.

[3] For Shakespeare and Milton, cf. L. Spitzer, 'Classical and Christian Ideas of World Harmony,' *Traditio* III, 1945, p. 333 ff.

[4] In *An Anatomie of the World*. However, Donne's view of the world was still firmly grounded in the Platonic tradition. The image of the circle as a symbol of God (cf. Part I) constantly recurs in his poetry, see Milton Allan Rugoff, *Donne's Imagery*, New York, 1939, p. 64 ff.

With the rise of the new science the synthesis which had held microcosm and macrocosm together, that all-pervading order and harmony in which thinkers had believed from Pythagoras' days to the 16th and 17th centuries, began to disintegrate.[1] This process of 'atomization' led, of course, to a re-orientation in the field of æsthetics and, implicitly, of proportion.

But before discussing the new ideas which slowly emerged, it should be pointed out that a knowledge of the old belief in a universal harmony is to be found in seventeenth and eighteenth century writers on architecture. In England, Inigo Jones, a true descendent of the humanist tradition, founded his theoretical deliberations on the metaphysical belief in the universal efficacy and beauty of numbers.[2] This also accounts for his famous blunder about Stonehenge. To him it was the ruin of a Roman temple, because after taking careful measurements he had found that 'betwixt this Island of Great Britain and Rome itself there's no one Structure to be seen, wherein more clearly shines those harmonical Proportions of which only the best Times could vaunt, than in this Stone-Heng.' To Inigo's circle belonged Sir Henry Wotton, who was partial to the same ideas and in his *Elements of Architecture*, 1624, gave full expression to the importance he attached to harmonic proportions. As a student of Vitruvius, Alberti, Palladio and French theorists such as Philibert de l'Orme, he could write: 'In truth, a sound piece of good Art, where the *Materials* being but ordinary Stone, without any garnishment of Sculpture, do yet ravish the beholder (and he knows not how)[3] by a secret *Harmony* in the *Proportions*.' In his chapter on doors and windows he is more explicit, reminding the reader that Vitruvius himself wishes the architect 'to be no superficial, and floating *Artificer*; but a *Diver* into *Causes*, and into the *Mysteries of Proportion*.' And following Alberti's interpretation of Pythagoras he explains how to reduce 'Symmetry to *Symphony*, and the *Harmony*

[1] Cf. R. Allers, 'Microcosm,' *Traditio*, II, 1944, p. 393 ff. Frances Yates has shown how the universality of the 16th century encyclopedia in France, based on the traditions of the Florentine Platonic Academy, began to dissolve into specialized disciplines in the course of the 17th century (*The French Academies of the Sixteenth Century*, London, The Warburg Institute, 1947, p. 290 ff.)

[2] Wittkower, 'Inigo Jones, Architect and Man of Letters,' JOURNAL ROYAL INSTITUTE OF BRITISH ARCHITECTS, LX, 1953, p. 83 ff.

[3] See Palladio's wording of the same idea, above p. 113.

of Sound, to a kind of *Harmony* in *Sight*.'[1] 150 years later, Reynolds, steeped in classical art theory, still advocated the basic unity of all the arts and the validity of the same proportions in music and architecture, though one might argue that the following remark in the 13th Discourse lacks conviction: 'To pass over the effect produced by that general symmetry and proportion by which the eye is delighted, as the ear is with music, architecture certainly possesses many principles in common with poetry and painting.'

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It was Palladio's work which remained canonical for those academic architects who abided by the conception of harmonic ratios. But this conception, whenever and wherever adhered to in architecture, tended to lose its universal application, and soon, moreover, Renaissance ideas on proportion were completely reversed. There was an important French classicist current, the representatives of which kept alive the Platonic conception of numbers in a doctrinal and didactic sense. François Blondel was perhaps the first architect who gave this academic turn to the old Italian ideas on proportion. Almost a whole book of his *Cours d'architecture*, 1675-83,[2] deals with musical proportions in architecture. His approach to the problem is historical and apologetic, for, in contrast to his Renaissance predecessors, he has to prove a case of which many of his contemporaries were ignorant. Alberti's theory and Palladio's buildings were, as one would expect, used as test-cases for his theory; a whole chapter is devoted to an analysis of façades by Palladio, for the proportions of which Blondel found the key in the simple consonances 9, 6, 4; 6, 4, 3; 4, 2, 1, etc.[3] The answer to Blondel was given by Claude Perrault in his *Ordonnance des cinq espèces de colonnes*, 1683. He broke decisively with the conception that certain ratios were *a priori* beautiful and declared that proportions which follow 'the rules of architecture' were agreeable for no other reason than that we are used to them. Consequently, he advocates the relativity of our

[1] Sir Henry Wotton discourses here at length on the nature of the fifth and the octave, 'the two principall *Consonances*, that most ravish the eare.' Ed. of 1624, p. 53 f.

[2] Vth Part 5th book, p. 727 ff.

[3] Blondel's exposition culminates in a summary of Ouvrard's *Architecture Harmonique, ou l'Application de la doctrine des proportions de la Musique à l'Architecture*, a book which I was unable to see. Ouvrard was a musician, and his work was undoubtedly an important link in the revival of what Blondel calls the 'ancienne doctrine.' This is also shown by Ouvrard's attempt—possibly based on Soldati (cf. above, p. 120 f.)—to create a sixth harmonic architectural order, see A. Comolli, *Bibliografia storico-critica dell' architettura*, Rome, 1790, III, p. 228 ff.

æsthetic judgment and, quite logically, maintains that musical consonances cannot be translated into visual proportions.

Blondel's treatise was the result of his teachings at the 'Académie royale de l'architecture,' to which he was appointed the first director in 1671. Eighty years later Briseux wrote his *Traité du Beau essentiel dans les arts*, 1752, in defence of Blondel's principles, against Perrault. The author is well versed in Platonism, and he even harnesses Newton's theory of colour in support of the ancient truth. Much of his material was based on Blondel whom he follows entirely in the choice and interpretation of the Palladian examples. But in spite of Briseux's claim to the universality of harmonic ratios, he is largely concerned with the demonstration that 'les mêmes proportions produisent les mêmes effets,' thus revealing a shift of emphasis from universally valid to psychologically conditioned standards.

In his work Briseux tried to revive a tradition which was in danger of being forgotten. In fact, the chain was broken and proportion in architecture was regarded as a mystery the knowledge of which had to be rediscovered. William Gilpin, in his *Three Essays on Picturesque Beauty*,[1] mourned: 'The secret is lost. The ancients had it . . . If we could only discover their principles of proportion . . .' Half a century before him Robert Morris, an architect associated with the Burlington group, believed, in his *Lectures on Architecture*, 1734-36, that he had found the secret 'which was by the Antients found out, and but by a few Moderns known and practis'd.'[2] For this classicist, Palladio was, of course, the chief reviver of ancient wisdom[3] and, guided by his works, he developed a system of hard and fast rules of harmonic proportions based on the 'only seven distinct notes in music' the ratios of which 'produce all the Harmonick Proportions of Rooms.' From ready-made tables the reader or architect can pick out the shape of rooms, façades, doors and chimneys with the correct harmonic proportions.

* * * * *

The break with the great tradition of the sixteenth century and the isolation of the problem of proportion is also to be observed on Italian soil. The architect Octavio Bertotti Scamozzi, undoubtedly the most penetrating student of Palladio, asserted to have found that Palladio

[1] First ed. 1792, 2nd ed. 1794, p. 32.

[2] Preface.

[3] p. 52.

used musical ratios; but he made this discovery only after his work *Le Bâtimens et les desseins de André Palladio* (1776-83) was well on the way. In the preface to his third volume he submits his ideas on that point to the judgment of the critics. After having carefully studied the proportions of Palladio's buildings, he declares to have come to the conclusion that they depend on 'des principes beaucoup plus solides que ce qu'on appelle bon goût dans le sens vulgaire.' These 'principes solides,' the musical ratios, are discreetly pointed out by him in the descriptions of Palladio's buildings.[1] It is apparent that Bertotti Scamozzi had no idea of the general principles which directed a Renaissance mind. Though his results are often convincing, because they are obvious to those who are familiar with Palladio's methods, he developed his thesis entirely in a void. Briseux's book had come to his knowledge just before his work was finished, and he notes with satisfaction the similarity of their conclusions. What he did not know, however, was that discussions on harmonic proportions had been going on all the time and that in the neighbouring Treviso they were even translated into practice in his own days.

In 1762 appeared Tommaso Temanza's *Vita di Andrea Palladio*, which is still one of the most important sources for Palladio's life. Temanza states that in the ratios of length, width and height of his rooms Palladio made clever use of the arithmetic, geometric and 'harmonic' means 'as is clearly manifest in his works.'[2] On this matter ensued a controversy with the Trevisan architect Francesco Maria Preti, which is worth recording because it throws light on the ideas about proportion in architecture and music during the late eighteenth century. Preti, apparently still dependent on Zarlino,[3] advocates 'a firm and stable law' which is alone guaranteed by the musical progression 1, 2, 3, 4, 5, 6 (octave, fifth, fourth, major and minor third). He concludes dogmatically that there is no beauty outside these proportions, for—and here we find the old pattern—the same consonances 'che dilettano l'orecchio dilettano anche la visione' ('which please the

[1] Roberto Pane, the author of the latest biography of Palladio, is singularly insensitive to the humanist mode of thinking. He calls Bertotti Scamozzi's 'discovery' 'questa novella alchimia.' (*Andrea Palladio*, Turin, 1948, p. 15).

[2] p. 81.—Cf. above, p. 109.

[3] Cf. above, p. 136, n. 1.

[4] Bottari, *Lett. pitt.*, 1822, VIII, p. 277. Preti's letter dates from May 1, 1762 (publ. by Bottari with the wrong date 1760).

ear also please the eye').[1] Temanza, in his long-winded answer,[2] agreed that in the widest sense numbers regulate buildings as well as music. He still insists on commensurability throughout a structure; but apart from that, he maintains, proportion in music and architecture are widely different.[3] His criticism of the general applicability of musical consonances in architecture boils down to two objections which reveal an entirely new standpoint. The one objection is that the eye is not capable of perceiving simultaneously the ratios of length, width and height of a room;[4] the other that architectural proportions must be judged from the angle of vision under which the building is viewed.[5] In other words, architectural proportions cannot be absolute but must be relative. The emphasis has shifted from the objective truth of the building to the subjective truth of the perceiving individual. It is for this reason that Temanza regards the use of the mean proportionals as 'più misterioso che ragionevole' ('mysterious rather than rational').[6] It will be noticed that Temanza's theoretical position is not quite clear; for in spite of his introducing revolutionary factors into the problem of proportion, he still cannot get away from traditional notions. In a later letter addressed to Bottari in which Temanza again states his case, he insists that the use of harmonic proportions in architecture would lead to sterility.[7] For an eighteenth century classicist this was a very sound observation.

F. M. Preti, Temanza's opponent, had grown up in Treviso in a stubbornly academic tradition according to which only the 'harmonic' mean should be used to determine the height of a room. Giovanni Rizzetto (b. 1675), mathematician and architect, had worked out the theory. His son Luigi Rizzetto, Ottavio Scotti, Andrea Zorzi, Jacopo Riccati and the latter's sons Vicenzo, Giordano and Francesco and, last but not least, Francesco Maria Preti, all of them interested in mathematics and music, had consolidated their restricted system of proportion,

[1] Preti also maintains that these consonances are universal. But his wording is interesting: 'Per le osservazioni *da me* fatte entra la musica non sola in architettura, ma nel sistema universale del mondo' (p. 280).

[2] Dated June 29, 1762, cf. Bottari, *op. cit.*, V, pp. 462-80.

[3] *Ibid.*, pp. 470, 472, 473.

[4] *Ibid.*, p. 465: 'quel piacere che dal giudizioso accozzamento delle consonanze musicali risulta, convenebbe che l'uomo avesse l'organo della vista accomodato in modo di vedere nello stesso tempo, ed in un'occhiata sola, tutte e tre le dimensioni . . .'

[5] *Ibid.*, p. 474.

[6] *Ibid.*, p. 478.

[7] Letter dated March 19, 1768. *Ibid.*, VIII, pp. 203-206.

convinced that musical consonances had to be applied to architecture. Preti (d. 1774) was perhaps the most prolific theorist and practitioner of the school which left a number of buildings in Treviso and the province, erected according to the rule of the 'harmonic' mean.[1] His narrow dogmatism was no more than a late and provincial survival of the Renaissance tradition. He lacked Alberti's and Palladio's 'symphonic' approach to proportion as well as that cosmic vision which had given it breadth and universality. This fact is amply illustrated by the dry, neo-classical imitation of Palladio in that school (Pl. 35c).

In the same part of the country the learned Alessandro Barca, Professor in Padua, advocated a theory of musical proportions in lectures delivered before the Accademia delle Scienze of his city between 1793 and 1798 which were published as late as 1806.[2] Barca was well acquainted with the research of the Treviso architects as well as with the entire history of proportion in architecture. But he was not simply a revivalist, for he introduced a new note by focussing on the principle of the repetition of ratios.

It is true that the speculations about the applicability of musical proportions to art and architecture had a stronger appeal during the middle and second half of the eighteenth century than is generally realized. Girolamo Francesco Cristiani, engineer and mathematician, advertised the conclusions of the school of Treviso at Brescia;[3] and some men of reputation wrote treatises on the subject which—and this seems characteristic—remained unpublished: foremost amongst them were a *Dissertazione metafisica del bello* by the celebrated translator and commentator of Vitruvius, Marchese Galiani,[4] and works by the Roman painter Niccolò Ricciolini and the architect Antoine Derizet. They made, according to Galiani,[5] 'profondi studi, ricerche, esami, e

[1] For detailed information cf. P. Federici, *Memorie Trevigiane*, 1803, II, pp. 144 ff., 173 ff; Comolli, *op. cit.*, IV, 1792, p. 36 ff. See now also Mario Favaro-Fabris, *L'architetto Francesco Maria Preti*, Treviso, 1954, with a full discussion of his works. A late advocate of the validity of the harmonic mean in architecture was Leopoldo Cicognara in his work *Del Bello*, Milan, 1834, p. 77 ff.

[2] Alessandro Barca, *Saggio sopra il bello di proporzione in architettura*, Bassano, 1806. For a discussion of Barca's ideas, see P. H. Scholfield, *The Theory of Proportion in Architecture*, Cambridge, 1958, p. 80 and *passim*.

[3] *Della media armonica proporzionale da applicarsi nell' architettura civile. Due dissertazioni epistolari a M. G. Bottari*, Brescia, 1767.
About Cristiani's life and work, cf. Comolli, *op. cit.*, III, p. 133 ff.

[4] *Ibid.*, p. 234 ff. with short indications of content.

[5] Cf. Galiani's translation of Vitruvius, 1758, quoted by A. Prandi in *Roma*, XXI, 1943, p. 18 ff.—Comolli (*op. cit.*, p. 232) possessed a MS. by Derizet with an extract from Ouvrard's work (see p. 144, n. 3). Ricciolini's book went to press in 1773, but never appeared.
For further material on music and architecture, cf. Comolli's notes, vol. III, pp. 228-35.

scoperte sopra l'applicazione delle proporzioni musiche all'Architettura' ('profound studies, researches, examinations, and discoveries regarding the application of musical proportion to architecture').

Derizet was a friend of Anton Raphael Mengs, and from that fact we may perhaps derive an idea of the trend of his thought. Mengs' friend and the editor of his writings, Giuseppe Niccola D'Azara, reports how he found the painter whistling and singing while painting the Annunciation, his last picture. When asked for the reason, Mengs explained that what he was singing was a sonata by Corelli, for he wanted his picture to be in Corelli's musical style.[1] This 'materialistic' eighteenth-century approach to the translation of music into painting throws a clear light on the change which had come about since the days of the Renaissance, when the conception of one universal harmony bound together both music and the visual arts.

But another almost anachronistic architectural author and practitioner deserves mention, namely Bernardo Antonio Vittone from Turin, whose *Istruzioni elementari* of 1760 and *Istruzioni diverse* of 1766 are in a class of their own. The dedication of the *Istruzioni elementari*—probably unique of its kind—is addressed to God, 'the archetype of perfection' who has revealed harmony and beauty to mankind. Like Briseux, Vittone uses Newton's discoveries in support of the universal applicability of the law of numbers,[2] and he is deeply convinced that a knowledge of musical theory is essential for an understanding of proportion in architecture.[3] He therefore includes a chapter[4] on the 'Generation and Nature of Musical Proportion' which is still dependent on Zarlino, and his *Istruzioni diverse* contains an extensive and cumbersome treatise on music. It is idle to speculate on the fact that for Vittone, perhaps the most creative architect Italy had at that period, the great Renaissance tradition was still a living force.

The relation in the academic camp between Perrault and Briseux finds an interesting parallel in the Baroque atmosphere of Turin. For eighty years before Vittone's publication, Guarino Guarini—for whom Vittone had a great veneration and whose treatise on architecture he

[1] Cf. *Opere di Antonio Raffaello Mengs*, Bassano, 1783, I, pp. lxvi, lxxi.
Mengs' belief in the possibility of influencing one art by another through sympathetic magic may be compared with Canova's method of having Homer read to him while working with the chisel.

[2] B. A. Vittone, *Istruzioni elementari*, p. 88 f. See R. Wittkower, *Art and Architecture in Italy* 1600–1750, Pelican History of Art, 1965, p. 282 ff.

[3] *Ibid.*, p. 242.

[4] *Ibid.*, p. 245 ff.

even published posthumously—had broken with the Renaissanc tradition.[1] Guarini's line of argument differs from Perrault's and is in a way, more radical. The eye of the beholder is for him the onl judge of proportion—'per compiacere agli occhi, si dee levare, aggiungere alle Simmetrie, essendo che altro un'oggetto appare sott l'occhio, altro appare in alto, altro in un luogo chiuso, altro in aperto' ('to please the eye one must take away from, or add to, the proportion because one object is placed under eye level, another at great height another in an enclosed space, and yet another in the open air')—and he does not even discuss the possibility of objective truth on which Renaissance æsthetics was founded. In the same vein, a hundred years later, Milizia, the foremost Italian theorist of the late eighteenth century subordinated the rules of proportion to the laws of perspective, since buildings are seen at different distances and in different situations. He goes a decisive step further on the path shown by Temanza twenty years before; his theory of proportion depends on sensation and, like Guarini's, is based on the impression which a building makes on the eye. Logically he refutes the efficacy of the three mean proportionals and even the necessity of commensurable dimensions. Proportion for him is a matter of experiment and experience.[3] The modern approach of the architect to the problem of proportion is taking shape.

* * * * *

It was, however, in England, that the whole structure of classical æsthetics was overthrown from the bottom. Hogarth was only the mouthpiece of the new tendencies when he rejected any congruity between mathematics and beauty.[4] Without an idea of the universality of the classical conception of proportion, he comments on the 'strange notion' that because 'certain uniform and consonant divisions upon one string produce harmony to the ear,' 'similar distances in lines belonging to form, would, in like manner, delight the eye. The very reverse of which has been shown to be true . . . yet these sort of *notions* have so far prevail'd by time, that the words, *harmony of parts*, seem applicable to form, as to music.'

[1] For Guarini, see Wittkower, *op. cit.*, p. 268 ff.

[2] *Architettura Civile*, Turin, 1737, p. 6. Many similar quotations could be given. Guarini died in 1683. The roots of the ideas here elaborated can be traced back to Alberti and Leonardo. Similar ideas had also been advocated by Bernini.

[3] *Memorie degli Arch. ant. e mod.*, 1785, I, p. xli ff. It is exceedingly important to find such views expressed by a dogmatic neo-classicist like Milizia.

[4] *Analysis of Beauty*, 1753, p. 76 f.

The man in whom the new ideas found the most marked expression was Hume. Just as he declared that 'all probable reasoning is nothing but a species of sensation,' so he turned objective æsthetic into subjective sensibility. Already in his earliest work, *A Treatise of Human Nature*, published in 1739,[1] he propounded that the distinguishing character of beauty consisted in giving 'pleasure and satisfaction to the soul.' In his essay *Of the Standard of Taste*, first published in 1757, he continued this trend of thought and broke with unprecedented boldness with the basic axiom of all classical art-theory, according to which beauty is inherent in the object provided the latter is in tune with universal harmony. He now explained that 'beauty and deformity, more than sweet and bitter, are not qualities in objects, but belong entirely to the sentiment . . .' But although he seems to hold the opinion that 'each mind perceives a different beauty . . . To seek the real beauty, or real deformity, is as fruitless an inquiry, as to pretend to ascertain the real sweet or real bitter,' he modifies this radical view by advocating general rules of art derived from experience and 'the common sentiments of human nature.'[2] Like Perrault before him, he is manifestly convinced of æsthetic relativity.

In the same year 1757 appeared Burke's *Enquiry into the Origin of our Ideas of the Sublime and Beautiful*. With his sensual and emotional approach and his exaltation of sublimity he subjected the classical conception of proportion to a detailed analysis and tore it to shreds. He denied that beauty had 'anything to do with calculation and geometry.' Proportion is, according to him, solely 'the measure of relative quantity,' a matter of mathematical inquiry and 'indifferent to the mind.' His further analysis shows again that his generation had lost the faculty of understanding even the most general principles of the classical conception. He does not see that the Beauty of the classical theory has its roots in the idea of an all-pervading harmony, which was regarded as an absolute and mathematical truth, and he is therefore unable to grasp that, for instance, ratios of parts of a body remote from each other may be compared. Nor can he understand the relation between the human body and architecture which was, as will be remembered, at the basis of Renaissance thought on proportion. What he says on this point reveals most clearly the complete break with the past which, also for the perception of proportion, the age of empiricism

[1] Book II, part I, section 8: 'Of Beauty and Deformity.'

[2] David Hume, *Essays Moral, Political, and Literary*, ed. Green and Grose, 1889, I, p. 268 ff., 273. See also T. Brunius, 'D. Hume on Criticism,' in *Figura*, II, 1952.

and emotionalism had brought about. 'I know that it has been said long since, and echoed backward and forward from one writer to another a thousand times, that the proportions of building have been taken from those of the human body. To make this forced analogy complete, they represent a man with his arms raised and extended at full length, and then describe a sort of square, as it is formed by passing lines along the extremities of this strange figure.[1] But it appears very clearly to me, that the human figure never supplied the architect with any of his ideas. For in the first place, men are very rarely seen in this strained posture . . .' Burke winds up with the following remark: 'And certainly nothing could be more unaccountably whimsical, than for an architect to model his performance by the human figure, since no two things can have less resemblance or analogy, than a man, and a house or temple.'[2]

Lord Kames, in his *Elements of Criticism*, 1761, is perhaps 'reactionary' as compared with Burke, and yet he launched a frontal attack against the translation of musical consonances into architecture. He begins his discussion with the words: 'By many writers it is taken for granted, that in buildings there are certain proportions that please the eye, as in sounds there are certain proportions that please the ear; and that in both equally the slightest deviation from the precise proportion is disagreeable.' From this it is evident that he too was unaware of the deeper bond that for a Renaissance mind united ratios in music and visible objects. He argued, in fact, against the doctrinal Blondel-Briseux-Morris-Preti position. It is therefore only logical when he carries on: 'To refute the notion of a resemblance between musical proportions and those of architecture, it might be sufficient to observe in general, that the one is addressed to the ear, the other to the eye; and that objects of different senses have no resemblance, nor indeed any relation to each other.' In support of this he refers to the octave which is the most perfect musical concord; but a proportion of one to two, he asserts, is very disagreeable in any two parts of a building. Here his eighteenth century taste contrasts with that of the Renaissance when, as we have seen, a ratio of 1 : 2 in architecture was regarded as flawless. His main line of attack is not dissimilar to that of the Italian critics. Judgment of proportion rests with the percipient. As we move about in a room the proportions of length to breadth vary continuously,

[1] This refers, of course, to Vitruvius' famous and often illustrated description in bk. III, chap. 1. Cf. above, p. 14 f.

[2] For the passages here quoted cf. the 9th ed., 1782, pp. 175 ff., 181 ff.

and if the eye were an absolute judge of proportion one 'should not be happy but in one precise spot, where the proportion appears agreeable.' Therefore we can congratulate ourselves that the eye is not 'as delicate with respect to proportion as the ear is with respect to concord'; if it were, this 'would not only be an useless quality, but be the source of continual pain and uneasiness.' Thus, apart from the subjective approach to proportion, Lord Kames introduced as a new element the limitations of human sight—an idea utterly foreign to Renaissance theory.[1]

Alison's theory of association, anticipated by Burke, exposes perhaps most clearly the significance of the revolution which had occurred in the course of the eighteenth century. He maintains that any abstract or ideal standard destroys the function of a work of art. It is the 'trains of thought that are produced by objects of taste,' the spontaneous stimulus to the imagination which make a work beautiful and sublime. 'The sublimity or Beauty of Forms arises altogether from the Associations we connect with them, or the Qualities of which they are expressive to us.'[2] In Alison's footsteps Richard Payne Knight in his *Analytical Inquiry into the Principles of Taste*, 1805, declared that proportion 'depends entirely upon the association of ideas, and not at all upon either abstract reason or organic sensation; otherwise, like harmony in sound or colour, it would result equally from the same comparative relations in all objects; which is so far from being the case, that the same relative dimensions, which make one animal beautiful, make another absolutely ugly . . . but the same proportionate combinations of sound, which produce harmony in a fiddle, produce it also in a flute or a harp.'[3] Thus, a pseudo-logical proof was found to show that musical harmony and spatial proportions cannot have anything in common.

* * * * *

Within the terms of a new conception of the world the whole structure of classical æsthetics was systematically broken up, and in this process man's vision underwent a decisive change. Proportion became a matter of individual sensibility and in this respect the architect acquired complete freedom from the bondage of mathematical ratios.[4]

[1] Cf. the 8th ed., 1807, II, pp. 460 f., 463 and *passim*.

[2] Archibald Alison, *Essays on the Nature and Principles of Taste*, Edinburgh, 1790, 5th ed., 1817, I, pp. 13 ff., 317, also II, pp. 20 ff., 33 ff.

[3] p. 169.

[4] However, mathematical ratios survived in a degenerated form as a teaching

This is the attitude to which most architects as well as the public unconsciously subscribed right down to our own days. It is hardly necessary to support this statement with a great many quotations; but brief reference may be made to two authors who interpreted the general feeling on this point. Ruskin declared that possible proportions are as infinite as possible airs in music and it must be left to the inspiration of the artist to invent beautiful proportions.[1] Julien Guadet, in the *Eléments et théorie de l'architecture*, the often re-printed handbook of the students of the 'Ecole des Beaux-Arts' in Paris,[2] explains that in order to establish a dogma of proportions, authors of the past had invoked science. But 'elle n'a rien à voir ici; on a cherché des combinaisons en quelque sorte cabalistiques, je ne sais quelles propriétés mystérieuses des nombres ou, encore, des rapports comme la musique en trouve entre les nombres de vibrations qui déterminent les accords. Pures chimères . . . Laissons là ces chimères ou ces superstitions. . . . Il m'est impossible, vous le concevez bien, de vous donner des regles à cet égard. Les proportions, c'est l'infini.'

'Les proportions, c'est l'infini'—this terse statement is still indicative of our approach. That is the reason why we view researches into the theory of proportion with suspicion and awe. But the subject is again very much alive in the minds of young architects to-day, and they may well evolve new and unexpected solutions to this ancient problem.[3]

expedient for architectural students and without any connection with their original meaning. Cf. our plate 47b which is taken from Joseph Gwilt's *Rudiments of Architecture*, London, 1826. Gwilt's plate is based on J. N. L. Durand, *Précis des leçons d'architecture données à l'Ecole Royale Polytechnique*, 1819-21, a book which contains a large number of similar designs. Durand, in his turn, seems to derive from Vittone's *Istruzioni Elementari*, 1760, who claimed to have invented this method, which for him was still more than a purely didactic device.

[1] *The Seven Lamps of Architecture*, 1849, in 'The Lamp of Beauty.'

[2] Four vols. First ed. 1901-4, 4th ed. 1915, I, p. 138 f. Cf. also F. Hoeber, *Orientierende Vorstudien zur Systematik der Architekturproportionen*, Frankfurt, 1906, who declares that proportion in architecture as the result of an unconscious process should be the object of study of an æsthetic psychology. For a modern view of an English practitioner cf. T. W. Simpson, *Essays and Memorials*, 1923, p. 54 ff., according to whom 'proportion cannot be reduced to any mathematical or geometrical formula.'

[3] I have left the text of the first edition unchanged, although the problem of proportion in art and architecture appears somewhat different to-day from what it did more than two decades ago. In my paper in *Daedalus*, Winter 1960, I have attempted to give an account of the more recent position.

APPENDIX I

Francesco Giorgi's Memorandum for S. Francesco della Vigna

(Translated from Gianantonio Moschini, *Guida per la Città di Venezia*, 1815, I, i, pp. 55-61).

April 1, 1535. In order to build the fabric of the church with those fitting and very harmonious proportions which one can do without altering anything that has been done, I should proceed in the following manner. I should like the width of the nave to be 9 paces (1 pace=ca. 1.8 m.) which is the square of three, the first and divine number. The length of the nave, which will be 27, will have a triple proportion which makes a diapason and a diapente. And this mysterious harmony is such that when Plato in the *Timaeus* wished to describe the wonderful consonance of the parts and fabric of the world, he took this as the first foundation of his description, multiplying as far as necessary these same proportions and figures according to the fitting rules and consonances until he had included the whole world and each of its members and parts. We, being desirous of building the church, have thought it necessary, and most appropriate to follow that order of which God, the greatest architect, is the master and author. When God wished to instruct Moses concerning the form and proportion of the tabernacle which he had to build, He gave him as model the fabric of the world and said (as is written in Exodus 25) 'And look that thou make them after their pattern, which was shewed thee in the mount.' By this pattern was meant, according to all the interpreters, the fabric of the world. And rightly so, because it was necessary that the particular place should resemble His universe, not in size, of which He has no need, nor in delight, but in proportion, which He wills should be not only in the material places, in which He dwells, but particularly in us of whom Paul says, writing to the Corinthians: 'Ye are the Temple of God.' Pondering on this mystery, Solomon the Wise gave the same proportions as those of the Mosaic tabernacle to the famous Temple which he erected. If we, then, follow the same proportions, we shall content ourselves for the length of the nave of the Church with the number 27, which is three times that of the width, and the cube of the ternary number; beyond which [number 27] Plato, in the description of the world, would not go, nor would Aristotle in his first book of 'De Caelo'—