

# GALILEO AS A CRITIC OF THE ARTS

ERWIN PANOFSKY

 Springer

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Stefano della Bella: Aristotle, Ptolemy and Copernicus, the last-named represented in the guise of Galileo. Frontispiece of Galileo, *Dialogo... sopra i due massimi sistemi del mondo*, Florence, 1632

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*To Samuel C. Chew  
in memory of the thirtieth of April, 1954*

# I

THE GREEK PASSION FOR DEBATE, LEGAL OR NOT, PRODUCED, AS EARLY AS the fifth century B.C., a peculiar *genre* of literature, called *σύγκρισις* in Greek and *altercatio*, *concertatio*, *dialogus*, *disputatio* or *conflictus* in Latin<sup>1</sup>; in English, something like "contest" or "debate" would seem to be the most appropriate equivalent. What we witness is, as a rule, not an internecine battle between absolute good and absolute evil (as in the struggle between the Virtues and the Vices, Reason and Lust, Faith and Heresy); rather it is a competition for superiority between two – or, occasionally, more than two – relative values, a competition that may end with a reasonable compromise or even a happy reconciliation.

The contestants may be Virtue and Pleasure but also The Cook and The Pastry Baker, Homer and Hesiod, or Poetry and History but also Lentils Boiled Whole and Lentils Pureed. And in the Hellenistic age, when Plato's theory of ideas was reinterpreted so as to glorify rather than disparage the "imitative arts", the arena was entered by Painting and Sculpture. In Lucian's *Dream*, Sculpture (*Ἐρομολυφικὴ τέχνη*) wages, but loses, a battle against Refined Culture (*Παιδεία*); in Dio Chrysostom's *Olympic*, Phidias, claiming for sculpture the "power of the symbol" (*συμβόλου δύναμις*) and the ability to produce "what cannot be compared to any mortal human being", wins an imaginary argument with Homer; and in the Introduction to Philostratus' *Imagines* we hear the echo of a debate between Sculpture and Painting, the author deciding in favor of the latter.<sup>2</sup>

In the Western Middle Ages, contest literature was passionately cultivated

<sup>1</sup> See H. Walther, *Das Streitgedicht in der lateinischen Literatur des Mittelalters* (Quellen und Untersuchungen zur lateinischen Literatur des Mittelalters, V, 2), Munich, 1920. Cf. also M. Steinschneider, *Rangstreitliteratur*, *Sitzungsberichte der K. K. Akademie der Wissenschaften*, Vienna, Philos.-Histor. Klasse, CLV, 1906, 4.

<sup>2</sup> See E. Panofsky, *Idea, Ein Beitrag zur Begriffsgeschichte der älteren Kunsttheorie* (Studien der Bibliothek Warburg, 5), Leipzig and Berlin, 1924, pp. 8–16 (Ital. transl., Florence, 1952, pp. 9–23); B. Schweitzer, "Der bildende Künstler und der Begriff des Künstlerischen in der Antike", *Neue Heidelberger Jahrbücher*, new ser., II, 1925, p. 102 ff.

in Latin as well as in the vernacular languages, and the number and kind of contestants were varied *ad infinitum*. Wine competes with Water or Beer; Winter with Summer; The Mountain with The Valley; The Swan with The Crow; The Cleric with the Layman, Peasant or Knight; <sup>1</sup> Worldly Glory with Pious Renunciation; Fortune with Philosophy; The Body with The Soul. Even the case of natural love *vs.* what the State Department calls "deviationism" – outlined in Plato's *Phaedrus* and circumstantially developed, from opposite points of view, by Plutarch and Lucian – was kept alive and was amusingly restated in a rhymed debate between Helen of Troy (supported by Nature) and Ganymede (supported by Philology), which ends with the betrothal of the disputants. However, what disappeared from the scene of mediaeval contest literature were the visual arts. Once painting and sculpture had been demoted to the status of *artes mechanicae* (which adjective was held to derive from Latin *moechus*, bastard, rather than from Greek *μηχανικός*), their rivalry with each other was no longer of interest while the possibility of their competing with their aristocratic sisters, the liberal arts, was excluded on principle: the *Bataille des Sept Arts* was a tournament in which mere burghers were not permitted to participate.

It was not until about 1400 – when Brunelleschi and Ghiberti competed for the bronze doors of the Baptistry, when Donatello was an apprentice, and when Masaccio was born – that Cennino Cennini came forward with the contention that painting had a legitimate claim to recognition as a liberal art. His reasoning was rather naive: the painter, he says, is equal to the poet in that he can produce imaginary beings as well as reproduce real ones.<sup>2</sup> But his position, expressing a fundamental change in attitude, came to be generally accepted. The privilege obtained by painting was gradually extended to what was later to be called the "Fine Arts";<sup>3</sup> and for a sixteenth-century thinker

<sup>1</sup> For the connection between this kind of *altercatio* and the strictly legalistic discussion of the question of temporal *vs.* spiritual power, see A. Coville, *Evrart de Trémangon et le Songe du Verger*, Paris, 1933.

<sup>2</sup> Cennino d'Andrea Cennini *da Colle di Val d'Elsa, Il Libro dell'Arte*, D. V. Thompson, Jr., tr., New Haven, 1933, p. 1 f. Cf. J. Schlosser, *Die Kunstliteratur*, Vienna, 1924, p. 77 ff.; *idem, La Letteratura artistica*, Florence, 1935, p. 77 ff.

<sup>3</sup> See P. O. Kristeller, "The Modern System of the Arts," *Journal of the History of Ideas*, XII, 1951, p. 496 ff.; XIII, 1952, p. 17 ff. This otherwise excellent article fails, however, to do justice to the role of the architect in the Middle Ages (cf. N. Pevsner, "The Term 'Architect' in the Middle Ages", *Speculum*, XVII, 1942, p. 549 ff., and E. Panofsky, *Gothic Architecture and Scholasticism*, Latrobe [Pa.], 1951, p. 25 f.); and, more important, the author would seem to underestimate the fact that the arts of painting (plus the "graphic arts"), sculpture and architecture, still commonly understood as the "Fine Arts" in the narrower sense (that is to say, in contradistinction to poetry, music and the dance), were firmly established as a unit by the middle of the sixteenth century. Vasari, the first to



it was, again, more natural to illustrate the meaning of Plato's ideas by "that image of a perfectly beautiful body" which lives in the mind of an artist than by the archetype impressed upon the mind of a philosopher.<sup>1</sup>

No sooner, however, had painting and sculpture been promoted to the rank of Art with a capital "A" than they began to fight each other for superiority. In the North, not as yet inclined to theorize about the arts, a certain rivalry between painting and sculpture may reflect itself in those simulated statues which challenge the genuine productions of sculpture in the altarpieces of the Master of Flémalle, Jan van Eyck and their followers (fig. 1). In Italy, it came into the open about 1430. Leone Battista Alberti, the first art theorist in the full sense of the word, clearly alludes to it when he suggests that sculpture and painting, though different in means and aims, were equal in rank and should keep the peace,<sup>2</sup> and thereafter the competition between the two sister arts remained the favorite topic of contest literature in many lands and for several centuries. A climax was reached in Leonardo da Vinci's "*Paragone*" where painting carries the offensive deep into the territory of the liberal arts, claiming to be superior not only to sculpture but also to music and poetry.<sup>3</sup> And by the middle of the sixteenth century the discussion about the relative merits of painting and sculpture, by now a kind of intellectual pastime, even gave rise to what is perhaps the earliest public opinion poll: in 1546, preparatory to two lectures published three years later, a Florentine humanist, Benedetto Varchi, elicited statements from a great number of important artists, including

define them as the three "*arti del disegno*" because of the fact that "design is their common foundation," consistently treats them *pari passu* both from a biographical and from a systematic point of view. Cf. also p. 5, note 1.

<sup>1</sup> Cf. Panofsky, *Idea*, p. 4 (Ital. transl., p. 6 f.), with reference to Melanchthon and Cicero.

<sup>2</sup> Leone Battista Alberti, *Trattato della pittura* (*Kleinere kunsttheoretische Schriften*, H. Janitschek, ed., Vienna, 1877, p. 94 f.). Alberti prefers painting because its problems are "more difficult" but emphasizes that both arts are "akin to each other and nourished by the same *ingegno*."

<sup>3</sup> See Irma A. Richter, *Paragone, Comparison of the Arts by Leonardo da Vinci*, London, etc., 1949. Cf., apart from the still useful Introduction to Lessing's *Laokoon*, W. G. Howard ed. and ann., New York, 1910: Schlosser, *Die Kunstliteratur*, p. 154 ff.; *idem*, *La Letteratura artistica*, p. 153 ff.; R. W. Lee, "*Ut Pictura Poesis; The Humanistic Theory of Painting*," *Art Bulletin*, XXII, 1940, p. 197 ff.; A. Blunt, *Artistic Theory in Italy 1450-1600*, Oxford, 1940, p. 51 ff.; *idem*, "An Echo of the 'Paragone' in Shakespeare," *Journal of the Warburg Institute*, II, 1939, p. 260 ff.; S. A. Larrabee, *English Bards and Grecian Marbles*, New York, 1943, pp. 40, 48, 242 ff. For Spanish *Paragone* literature, see E. R. Curtius, *Europäische Literatur und lateinisches Mittelalter*, Berne, 1948, p. 543 ff.; *idem*, "Calderón und die Malerei," *Romanische Forschungen*, L, 1936, p. 89 ff. The last fullfledged *Paragone*, involving rhetoric, music, architecture, sculpture and painting, is probably the Introduction to Wilhelm Busch's *Maler Klecksel*.

Michelangelo, Benvenuto Cellini and Pontormo, each of them loyally defending his own profession.<sup>1</sup>

This "*Paragone*" literature has some importance in that it fomented such notions as "sculptural" and "pictorial," "volume" and "space," "one view composition" and "multiview composition," notions which, when the quarrel for superiority had subsided in favor of a calm appraisal of possibilities and limitations, were to become the basic concepts of what we call "stylistic analysis." But on the whole texts of this kind cannot be said to make inspiring reading. Few later writers went beyond the arguments put forward by Leonardo da Vinci, adopting and, very rarely, amplifying them when they were painters or friends of painting, attempting to refute them when they were sculptors or friends of sculpture. There is, however, one glorious exception: a letter of no less illustrious an author than Galileo Galilei.

## II

THIS GREAT PHYSICIST AND ASTRONOMER HAD GROWN UP IN AN ENVIRONMENT humanistic and artistic rather than scientific. The son of a famous musician and theorist of music, he had received an excellent musical and literary education. He knew most Latin classics by heart. He not only wrote poetry himself – serious as well as in the rollicking vein of his great favorite, the satirist Francesco Berni – but also devoted "many months or even years" to the annotation of Ariosto, to whom he felt indebted, as he used to say, for

<sup>1</sup> See Schlosser, *Die Kunstliteratur*, pp. 200 f., 204; *idem*, *La Letteratura artistica*, pp. 198 f., 202 (with further literature). Especially noteworthy among the *Paragoni* dating from the middle of the sixteenth century are those in the *Proemio* of Vasari's *Vite* (ending, quite naturally in view of Vasari's conviction that the "three arts of design" are sisters rather than rivals, on a conciliatory note), and in Cardan's *De subtilitate*, XVII, Basel, 1560, p. 1019 ff. (declaring painting as the more difficult and, therefore, nobler art), to which may be added the amusing exchange of poems between Antonfrancesco Grazzini, called Il Lasca, and Benvenuto Cellini (*Le Rime burlesche edite e inedite di Antonfrancesco Grazzini, detto Il Lasca*, C. Verzzone, ed., Florence, 1882, p. 84 f., kindly brought to my attention by Professor E. E. Lowinsky). In Raffaele Borghini's famous *Il Riposo*, Florence, 1584 (here quoted from the reprint, Florence, 1730, p. 19 ff.) the "disputa, qual sia più nobile, o la pittura o la scultura" is already summarized in almost historical fashion.

whatever clarity and cogency (*chiarezza* and *evidenza*) his own Italian style might possess, and to an elaborate comparison between Ariosto's *Orlando Furioso* and Tasso's *Gerusalemme Liberata*. An excellent draughtsman, he loved and understood "with perfect taste" all the "arts subordinated to design." If we can believe his biographers, he was originally inclined to study painting rather than mathematics,<sup>1</sup> and one of his most intimate and faithful friends was the outstanding painter of their native Florence, Ludovico Cigoli (1559–1613). Galileo's senior by five years, Cigoli remained devoted to him throughout his life and wrote him, when they were separated, numerous letters full of good-natured gossip, praise, encouragement, and if necessary, affectionate criticism. During the critical years after the publication of Galileo's *Sidereus Nuncius* in 1610, Cigoli, then in Rome, made careful independent observations of the sunspots (an invaluable service because these independent observations proved that the sunspots were not optical illusions caused by the vagaries of individual telescopes or some disturbance in the local atmosphere).<sup>2</sup> And in his very last work, the *Assumption of the Virgin* in the dome of the papal chapel in S. M. Maggiore (fig. 2), the painter, as a "good and loyal friend," paid tribute to the great scientist by representing the moon under the Virgin's feet exactly as it had revealed itself to Galileo's telescope (fig. 3) – complete with that "jagged dividing line" and those "little islands" or craters which did so much to prove

<sup>1</sup> See the biographies by N. Gherardini and V. Viviani, reprinted in *Le Opere di Galileo Galileo, Edizione Nazionale*, A. Favaro, ed., Florence, 1890–1909, XIX, especially pp. 601 f., 627 (here also the reference to Galileo's love and understanding of "tutte l'arti subalternati al disegno"), 635. For Galileo's humanistic interests and literary style, see L. Olschki, *Galilei und seine Zeit (Geschichte der neu-sprachlichen wissenschaftlichen Literatur, III)*, Halle, 1927, particularly pp. 131–142, 167–198, and the essays referred to in the Preface of the handy collection of Galileo's literary writings by A. Chiari, *Galileo Galilei, Scritti letterari*, Florence, 1943. For the *Considerazioni al Tasso*, cf. below, p. 20, and note 1.

<sup>2</sup> For Lodovico Cardi da Cigoli, see the biography by his nephew, Giov. Batt. Cigoli, *Vita di Lodovico Cigoli, per cura della Commune della Città di S. Miniato*, 1913, which, on p. 14, informs us that Cigoli in his youth had been instructed in perspective and mathematics by the same Ostilio Ricci (cf. Olschki, *op. cit.*, pp. 141 ff., 144 ff., 150 ff.) who was the early teacher of Galileo; and K. Busse, in Thieme-Becker, *Allgemeines Lexikon der bildenden Künstler*, VI, 1912, p. 588 ff. Cigoli's correspondence with Galileo (*Opere*, X, XI, *passim*) gives the impression, confirmed by the testimony of others, of perfect candor and unflagging devotion. Apart from indefatigably supplying Galileo with sunspot observations, Cigoli warns him of enemies such as the Archbishop of Florence, Alessandro Marzimedici (letter of December 16, 1611, *Opere*, XI, p. 241), revises the illustrations in his *Istoria e dimostrazioni intorno alle macchie solari* (*Opere*, V, p. 102 ff.), and proves himself helpful in every possible way; the letter in which he modestly criticizes the long subtitle of the *Sidereus Nuncius* is of October 1, 1610 (*Opere*, X, p. 441 f.).

that the celestial bodies did not essentially differ, in form and substance, from our earth.<sup>1</sup>

It was during this period, to be exact, on June 26, 1612, that Galileo wrote to Cigoli a letter exclusively devoted to a comparison between sculpture and painting and, naturally, strongly supporting the superiority of the latter.<sup>2</sup> The authenticity of this letter, it is true, has been questioned in the authoritative edition of Galileo's works; and since, to quote a French archaeologist, "l'érudition est moutonnaire," most subsequent writers have either disregarded it or shrugged it off as a forgery.<sup>3</sup> It has been objected that the phraseology of the letter lacks, in part at least, the sparkle and pungency which normally distinguishes Galileo's style and that the rather shopworn subject is never touched upon in any of the other letters that passed between him and Cigoli. But both these objections can be refuted by pointing out the obvious and demonstrable fact that the epistle of June 26 is not a spontaneous communication but what may be called a "put-up job." The penultimate paragraph, directly preceding the very Galilean conclusion "I cordially kiss your hands; and, pray, continue to favor me with your love and also with your observations of the sunspots," begins as follows: "This is what I recall at the moment as a possible reply to

<sup>1</sup> Letter of Federico Cesi to Galileo of December 23, 1612 (*Opere*, XI, p. 449, referred to in E. Wohlwill, *Galilei und sein Kampf für die copernikanische Lehre*, I, Hamburg, and Leipzig, 1909; II, Leipzig, 1926), I, p. 491: "Il S. Cigoli s'è portato divinamente nella cupola della Capella di S. S.tà a S. Maria Maggiore, e come buon amico e leale, ha, sotto l'immagine della Beata Vergine, pinto la luna nel modo che da V. S. è stata scoperta, con la divisione merlata e le sue isolette." In fact, Cigoli's moon looks exactly like one of the illustrations in the *Sidereus Nuncius*, both in the printed edition and in the manuscript reproduced in *Opere*, III, p. 17 ff. Cigoli himself had currently reported to Galileo upon the progress of his last major work (letters of Nov. 11, 1611, *Opere*, XI, p. 228 ff., Feb. 3, 1612, *ibidem*, p. 268 f., April 13, 1612, *ibidem*, p. 290 f.).

<sup>2</sup> Galileo, *Opere*, XI, p. 340 ff. See Appendix I.

<sup>3</sup> While Schlosser, *Die Kunstliteratur*, p. 203 (*La Letteratura artistica*, p. 201), briefly refers to the letter of June 26 without questioning its authenticity, it is omitted from all recent monographs, including Chiari's collection, and branded as a "Fälschung" by Olschki, *op. cit.*, p. 139, note 2. That the letter is transmitted only through a seventeenth-century copy is, of course, no reason to doubt its authenticity; for this applies to a great part of Galileo's correspondence, especially to the only other letter addressed by him to Cigoli which has come down to us (*Opere*, XI, p. 213, dated Oct. 1, 1611). It may be mentioned that the letter of June 26, 1612, was in fact written in the middle of the sunspot campaign: Cigoli reports on his observations on June 8, 1612 (*Opere*, XII, p. 318 f.), June 30, 1612 (*ibidem*, p. 347 ff., with drawings), and July 14, 1612 (*ibidem*, p. 361 f., with an amusing comparison between the reactionary scientists refusing to accept Galileo's discoveries and the reactionary art critics who had claimed that Michelangelo had "ruined architecture by departing from the rules of Vitruvius). See also the additional note, page 32.

the arguments of those champions of sculpture, communicated to me this morning at your request by our Signor Andrea." And this sentence – followed by a good-humored admonition to leave such dialectical exercises to those unable to master either of the two sister arts which are "both truly admirable when practiced with outstanding skill" – makes abundantly clear what had happened. Cigoli, then in Rome, had become involved in one of those tedious discussions about the relative merits of painting and sculpture. Extremely modest and inclined to emphasize that theoretical speculations were "not his dish,"<sup>1</sup> he had asked Galileo for help, transmitting to him the formidable arguments of his opponents through "our Signor Andrea" (apparently none other than Andrea Cioli, then secretary to the mother of the Grand Duke of Tuscany and constantly in touch with Galileo in those years as well as later on)<sup>2</sup> through whom he hoped to reach his friend more speedily than by ordinary mail. And Galileo had obliged on the very same day. Small wonder that his answer is in the nature of a somewhat academic dissertation that could be used by Cigoli at his next meeting with "those champions of sculpture."

The strongest argument in favor of Galileo's authorship, however, is the content of the letter itself. The claims which had to be refuted are, needless to say, entirely conventional; but the manner in which they are refuted constitutes the only original contribution to the subject since Leonardo da Vinci. Moreover, one of these refutations can be shown to have been developed from a brief fragment the authenticity of which cannot, and has never been, questioned.

One of the standard arguments in favor of sculpture was that statues, being three-dimensional objects rather than two-dimensional images, were, so to speak, more "real" than paintings and, therefore, capable of creating a more "deceptive" illusion. To this the letter of June 26 replies that the "relief" which causes the impression of three-dimensionality is of two kinds: "That relief which deceives the sense of vision," it says, "is within reach of painting as well as sculpture or rather more so; for, in painting there are, over and above the light-and-dark which constitutes, as it were, the visible relief of sculpture, the natural colors in which sculpture is lacking. There remains, then, that

<sup>1</sup> On March 23, 1612, having discussed various explanations of the sunspots with excellent good sense, he finally leaves all these speculations to Galileo with the remark: "però non essendo pasto da mia denti, ci lascerò pensare a voi" (*Opere*, XI, p. 286 ff.).

<sup>2</sup> For Andrea Cioli (1573–1641), later First Secretary to Grand Duke Ferdinand II and as such deeply involved in Galileo's struggle with the ecclesiastical authorities, see Wohlwill, *op. cit.*, *passim*, and Galileo, *Opere*, XX, pp. 134 and 420. For his relations with Galileo in the years 1612–1613, see *Opere*, XI, pp. 258 f., 565 f., 583 f.

sculpture is superior to painting in that kind of relief which is perceived by touch. But simple-minded are those who think that sculpture can deceive the sense of touch to a higher degree than painting – provided that we understand by 'to deceive' to operate in such a manner that the sense to be deceived accepts the object not as what it is but as what it is intended to imitate. Who would believe that a man, when touching a statue, would think that it is a living human being?" It cannot be doubted that this argument, so utterly matter of fact as to seem trivial yet never before put forward in a discussion of this kind, grew out of the following *propria manu* fragment: "Sculpture does not deceive at all nor does it make us ever believe what later on turns out not to be so";<sup>1</sup> and it is only when read in the light of the more circumstantial explanation in the letter to Cigoli that this fragment becomes fully intelligible.

The distinction between "visible relief" (*rilevo visibile*) and "that kind of relief which is perceived by touch" (*quella parte di rilievo che è sottoposta al tatto*) is remarkable, not only in that it anticipates the modern distinction between "optical" and "tactile" values, but also from another point of view. Setting out to refute the contention that only sculpture had relief while painting had none, the letter of June 26 argues as follows: "Sculptures will have relief only to the extent that they are shaded, light in one part and dark in another. And that this is true can be demonstrated by experience; for if we were to expose a sculptured figure to the light and then proceed to color it in such a way that we paint it dark wherever it is light until its tone is completely unified, the figure would appear devoid of relief altogether." The optical phenomenon referred to in this argument is substantially the same as that adduced by Leonardo da Vinci when he attempts to show that the plastic effect of a sculpture depends on the lighting conditions under which it happens to be seen whereas a painting contains, as it were, its own illumination. "If nature," says Leonardo, "did not aid the work of the sculptor with shadows more or less deep and lights more or less brilliant, his product would be all of one color, either light or dark, and look like a flat surface"; and, more specifically: "if a sculpture were enveloped by a thick fog of equal density, the beholder would see nothing but the contours of the figure defined by the boundaries of the fog."<sup>2</sup> There

<sup>1</sup> Galileo, *Opere*, VIII, p. 642: "La scultura non inganna punto, nè vi fa creder mai quello che poi non sia tale."

<sup>2</sup> See Richter, *op. cit.*, p. 105 f. (*Trattato della pittura*, 42). At the end, Leonardo somewhat confuses the argument by stating that, if the sculptor were to work in the dark, he would not be able to see anything – a statement which applies with equal force to the painter.

is, however, a fundamental difference between the approach of the Renaissance painter and that of the seventeenth-century physicist. Leonardo, asking the reader to imagine how a statue would look in perfectly diffused light, describes what happens under given natural conditions. Galileo, proposing to "color a statue in such a way that it is painted dark wherever it is light," describes what human interference can cause to happen by changing given natural conditions. Leonardo invokes an experience that may or may not recur; Galileo suggests an experiment which can be repeated *ad libitum*. I have, in fact, repeated it in simplified form: I have photographed two rubber balls, placed perpendicularly above each other, under identical lighting conditions before and after one of them had been treated according Galileo's prescription. The left-hand photograph shows the two balls as three-dimensional spheres; the other makes the upper ball, the lighted area of which had previously been darkened by paint, appear like a flat, black disc (fig. 4).

Thus Galileo reduces the claims of sculpture to one undeniable fact: sculpture is "closer to nature" than painting in that the material substratum manipulated by the sculptor shares with the matter manipulated by nature herself the quality of three-dimensionality. But does this fact redound to the credit of sculpture? On the contrary, says Galileo, it greatly "diminishes its merit": "what will be so wonderful in imitating 'sculptress Nature' by sculpture itself?" And he concludes: "The most artistic imitation is that which represents the three-dimensional in its opposite, which is the plane."

In a defense of painting this conclusion is not surprising; it is in fact foreshadowed, with wistful humor, by Pontormo when he praises the courage of the painter in representing the world in two dimensions while God had needed three to produce it.<sup>1</sup> But Galileo's verdict is arrived at by a chain of reasoning which, so far as I know, has no parallel in either sixteenth or seventeenth-century criticism and is summed up in a truly memorable statement of principle: "The farther removed the means of imitation are from the thing to be imitated, the more worthy of admiration the imitation will be . . .<sup>2</sup> Will we not admire a musician who moves us to sympathy with a lover by representing his sorrows and passions in song much more than if he were to do it by sobs? And this is so because song is a medium not only different from but opposite to the

<sup>1</sup> Pontormo's letter to Benedetto Varchi of February 18, 1546 (G. Bottari and S. Ticozzi, *Raccolta di lettere sulla pittura, scultura ed architettura . . .*, Milan, 1820-1825, I, p. 20 ff.).

<sup>2</sup> Professor A. C. Crombie kindly calls my attention to the basic affinity between the spirit of this sentence and Galileo's unbounded admiration for Aristarchus and Copernicus "because they trusted reason rather than sensory experience" (*Opere*, VII, pp. 355, 362).

[natural] expression of pain while tears and sobs are very similar to it. And we would admire him even more if he were to do it silently, on an instrument only, by means of dissonances and passionate musical accents; for the inanimate strings are [of themselves] less capable of awakening the hidden passions in our soul than is the voice that narrates them."

Once musical theory had turned "humanistic," it was not doubted that music addressed itself to man as well as God and that its purposes were, not only to delight the ear of the listener, but also to influence his soul – emotionally, intellectually and morally.<sup>1</sup> There was, at the time here under consideration, a certain amount of dissension as to the relative importance of these aims. The Italians and a Dutch composer and theorist named John Albert Bannius, who coined the delightful term *musica flexanima*, "soul-bending music," asserted the supremacy of the more-than-hedonistic effects and ultimately looked upon music as "oratory in a different medium" ("its aim," Bannius says with direct reference to Cicero, "is to teach, to please and to move");<sup>2</sup> such Frenchmen as Descartes and Mersenne inclined to emphasize the factor of enjoyment. Both parties, however, agreed in the belief that music lived in an indissoluble union with poetry. Even Mersenne, who held that the essential function of music was "to charm the spirit and the ear, and not to arouse anger and sundry other passions," conceived of it as illustrative of texts to which it lends expression "en donnant aux paroles leur vrai sens."<sup>3</sup> And Galileo's own father went so far as to assert that the text was "la cosa importantissima dell' arte musicale."<sup>4</sup>

<sup>1</sup> See D. P. Walker, "Musical Humanism in the 16th and Early 17th Centuries," *The Music Review*, II, 1941, pp. 1 ff., 111 ff., 220 ff., 288 ff.; III, 1942, p. 55 ff. *Idem*, "Ficino's 'Spiritus' and Music," *Annales Musicologiques*, I, 1953, p. 132 ff. F. A. Yates, *The French Academies of the Sixteenth Century* (Studies of the Warburg Institute, 15), London, 1947, p. 36 ff.

<sup>2</sup> For Bannius (kindly called to my attention by Professor J. G. van Gelder) and his controversies with Mersenne and Descartes, see W. J. A. Jonckbloet and J. P. N. Land, *Musique et musiciens du XVII siècle; correspondance et œuvres musicales de Constantin Huygens*, Leyden, 1882. In a letter to William Boswel (Jonckbloet and Land, p. LXIII f.) he says: "Musicae est docere, delectare et movere. Is musico cum oratore communis est: licet aliis mediis utatur musicus quam orator." The reference is to Cicero, *De optimo genere oratorum*, I, 3, 4: "Optimus est enim orator qui dicendo animas audientium et docet et delectat et permovet. Docere debitum est, delectare honorarium, permovere necessarium."

<sup>3</sup> Mersenne as quoted in Jonckbloet and Land, *op. cit.*, p. LXXX ff. (music is intended "principalement pour charmer l'Esprit et l'oreille" and not "pour exciter la colère, et plusieurs autres passions"), and p. XLV (music must lend expression to the emotion embodied in a text "en donnant aux paroles leur vrai sens").

<sup>4</sup> Vincenzo Galilei as quoted in Walker, *The Music Review*, III, p. 289. Both Vincenzo Galilei and Mersenne take notice of the fact that "pure" music, too, may have emotional and ethical effects and even quote a passage from Aristotle's *Problemata* XIX, 27, according



He must have turned in his grave when his great son anticipated what Jacob Burckhardt was to say some 250 years later: "Music, if we wish to penetrate the essence of its being, must be taken as instrumental music, detached from words and, above all, apart from dramatic representation."<sup>1</sup>

### III

GALILEO'S INSISTENCE UPON A CLEAR AND CLEAN SEPARATION OF VALUES and procedures which at the time were commonly accepted as inseparable bears witness to a critical purism which may be said to be the very signature of his genius. As he preferred pure music – without words – to song, let alone song intermixed with sobs or laughter, so did he insist on a separation of quantity from qualities, of science from religion, magic, mysticism and art. His discovery that the planet Jupiter was encircled by four moons was greeted with cries of horror by those who claimed that God would never have permitted the elements of the planetary system to exceed the sacred number Seven,<sup>2</sup> and

to which *ἀνευ λόγου μέλος ὁμῶς ἔχει ἥθος*; but "the former . . . manages to forget all about it in the rest of the book, and the latter ingeniously, if not very convincingly, claims that these effects are due to instrumental music being reminiscent of, or similar to, some song" (Walker, *ibidem*, p. 227).

<sup>1</sup> Jacob Burckhardt, *Force and Freedom; Reflections on History*, New York, 1943, p. 321 (in a lecture delivered at Basel in 1870).

<sup>2</sup> Francesco Sizi, *Dianoia astronomica, optica, physica . . .*, Venice, 1611, reprinted in Galileo, *Opere*, III, p. 129 ff. Discussing the mystic number Five, Marjorie H. Nicolson, *The Breaking of the Circle*, Evanston, 1950, p. 23, includes Kepler among those who took exception to Galileo's findings on numerological grounds: "Kepler, who accepted with enthusiasm Galileo's discovery of four supposed planets about Jupiter, offered one objection: Galileo must go further with his telescopic observations, since there must be not four planets but five." I have, however, been unable to find this objection in Kepler's writings, and it is possible that Miss Nicolson's statement is one of those tiny errors which, like the *mouches* on the face of an eighteenth-century lady, enhance rather than mar the beauty of a brilliant book. Both in the *Dissertatio cum Nuncio Sidereo (Opera Omnia*, Chr. Frisch, ed., Frankfurt, 1858–1870, II, p. 505; *Gesammelte Werke*, M. Caspar, ed., Munich, 1938 ff., IV, p. 309) and in the *Epitome astronomiae Copernicanae*, IV, 2, 6 (Frisch, VI, p. 361; Caspar, VII, p. 318 f.) Kepler seems quite satisfied with Galileo's foursome because the number of the Jupiter satellites corresponds to that of the "lower planets" (Mars, Venus, Earth, and Mercury) and because the diameters of their orbits (3 : 5 : 8 : 13 or 14) can be expressed by three regular and semi-regular polyhedra (cube, cuboctahedron and icosidodecahedron) just as the diameters of the six planetarian orbits proper can be expressed – according to the *Mysterium cosmographicum* – by the five Platonic solids.

with cries of triumph by those who felt that Galileo's discovery had showed forth, once more, the "supreme wisdom of the Creator," the number of the four new satellites reflecting the fourfold essence of God, the universe and man (Mind, Soul, Nature, and Matter or Body), the four desirable "habits" of the human intellect (wisdom, science, art, and prudence) and many other tetrads.<sup>1</sup> But Galileo himself – perfectly free from any belief in numerology, Biblical or Pythagorean, and thoroughly immune to animism – would have accepted any number without question because he held that "we must not ask nature to accommodate herself to what we may think the best arrangement and disposition, but must adapt our intellect to what she has produced."<sup>2</sup>

He loved the poets and historiographers but refused to accept them as authorities on questions of physics (ironically, even where they happened to be right in principle).<sup>3</sup> And he objected with equal vigor to whatever, in his opinion, amounted to a blurring of borderlines within the realm of art itself. Like his beloved Francesco Berni, he was by no means averse to honest, straightforward indecency, but he resented it when "out of place" ("contro a quello che ricerca l'istoria"), particularly when the *faux pas* was committed

<sup>1</sup> This is the opinion of Monsignor Giovanni Battista Agucchi (or Agucchia) as stated in his unpublished discourse *Del Mezzo*, Florence, Bibl. Nazionale, Mss. Gal., Discepoli, Tom. 136, fols. 95–110, fol. 107 v. "Dunque riconosciamo da questo poco l'altissima sapienza di Dio nel crearle [*scil.*, the Jupiter satellites] e disporle, e senza fine commendiamola. Quanto poi sia la simiglianza trà la figura di questi cerchi con le stelle loro e la nostra imagine, all'uso Platonico fabricata, credo che delle cose dette si scorga assai di leggieri . . . Sono ambedue fatte di quattro cerchi, l'uno nell'altro inchiuso, sicome le quattro parti dell'huomo [*scil.*, *mente*, *anima*, *natura*, and *corpo*, as stated on fol. 108 r.] l'una nell'altra è posta; et hanno ambedue un sol centro . . ." For this discourse, see Appendix II.

<sup>2</sup> Letter to Federico Cesi of June 30, 1612 (*Opere*, XI, p. 344 f.).

<sup>3</sup> See Olschki, *op. cit.*, p. 171 f., with special reference to Galileo's refusal to accept the testimony of poets and historiographers who maintained that heat can be generated by air friction (marginal note in *Opere*, VI, p. 163, and *Saggiatore*, 44, 45, *Opere*, VI, p. 336). Galileo here rejects the theory according to which the incandescence and final disintegration of meteors is caused by the *attrizione dell'aria* and refuses to accept as evidence the wonderful old stories to the effect that fast-moving missiles were seen to melt in midair and that the Babylonians could boil eggs by rapidly rotating them with a sling. It should not be overlooked, however, that in this case the joke is at the expense of Galileo. While he is right in making fun of the examples adduced, the fact remains that meteors do incandesce and disintegrate because of the heat generated by air friction, and that this very heat now threatens – or promises – to put a speed limit on supersonic aircraft (*New York Times*, March 5, 1954, p. 14). The case is instructive in that it illustrates the fact that empirical conclusions *a debiliori* are no less dangerous than the acceptance of *attestazioni d'uomini*: while the boilability of eggs by means of rapid rotation would prove, *a fortiori*, the inflammability of meteoric matter by air friction, the nonboilability of eggs by rapid rotation does not prove, *a debiliori*, the noninflammability of meteoric matter by air friction.

unintentionally;<sup>1</sup> and he squirmed at innuendo.<sup>2</sup> In instinctive agreement with Samuel Butler's immortal phrase, "I don't mind lying but I hate inaccuracy," he had no objection to fairies, dragons, hippogriffs and sorceresses but was annoyed when he was asked to believe in a garden located in the middle of a palace ("one often sees palaces surrounded by gardens," he says, "but not contrariwise") yet containing "hills, valleys, woods, caves, rivers and swamps, and all this junk on top of a high mountain."<sup>3</sup> And he was strongly opposed to allegorical poetry.

In his opinion allegorical poems (such as Tasso's *Gerusalemme Liberata*), forcing the reader to interpret everything as a recondite reference to something else, resemble those perspective trick pictures, known as "anamorphoses," which, to use Galileo's own words, "show a human figure when looked at sideways and from a uniquely determined point of view but, when observed frontally as we naturally and normally do with other pictures, display nothing but a welter of lines and colors from which we can make out, if we try hard, semblances of rivers, bare beaches, clouds, or strange chimerical shapes." In similar manner, he thought, allegorical poetry, unless it succeeds in "avoiding even the slightest trace of constraint," compels the "current narrative, originally plainly visible and viewed directly," to "adapt itself to an allegorical meaning seen obliquely, and implied," and thus "extravagantly obstructs it by chimerical, fantastic and superfluous figments."<sup>4</sup>

<sup>1</sup> See Olschki, *op. cit.*, p. 182, with reference to Galileo's objections to certain verses in Tasso and to certain figures in Michelangelo's *Last Judgment* (*Opere*, IX, p. 94; Chiari, *op. cit.*, p. 138) which Galileo compares to the *St. Michael* in a Pisan church rejected by the authorities although the artist had acted "più per inadvertenza che per elezione."

<sup>2</sup> Olschki, *op. cit.*, p. 181, with reference to Galileo's objections to certain verses even in Ariosto (*Opere*, IX, pp. 157, 171; Chiari, *op. cit.*, pp. 266, 301). It is characteristic of Galileo's sensitivity that he recoils from the phrase "bocca onde esce aura amorosa" (*Gerusalemme Liberata* IV, 30, 7) because "alle quale parole subito l'immaginazione ci può così rappresentare cosa grata, come anche muover nausea, anzi più facilmente questo che quello" (*Opere*, IX, p. 98; Chiari, *op. cit.*, p. 144), and praises Ariosto for having used, in a similar context, the words *parole* and *riso* rather than *aura*.

<sup>3</sup> Galileo, *Opere*, IX, p. 137 f.; Chiari, *op. cit.*, p. 211 f., with reference to *Gerusalemme Liberata*, XVI, 1-9. The phrase translated in the text reads in the original: "E questo giardino, ben che sia quasi nel centro del palazzo, nulla di meno contiene in se colline, valli, selve, spelonche, fiume e stagni, tutte robe costituite su la cima d'un alto monte."

<sup>4</sup> See Olschki, *op. cit.*, p. 171 f. The passage in question is found in Galileo, *Opere*, IX, p. 129; Chiari, *op. cit.*, p. 197 f.: "Ma, Sig. Tasso, vorrei pur che voi sapessi che le favole e le finzioni poetiche devono servire in maniera al senso allegorico, che in esse non apparisca una minima ombra d'obbligo: altrimenti si dara nello stentato, nel sforzato, nello stracchiato e nello spropositato; e farassi una di quelle pitture, le quali, perchè [should read *benchè*], riguardate in scorcio da un luogo determinato, mostrino una figura umana, sono con tal

The best-known example of such "perspectives which, rightly gazed upon, show nothing but confusion, viewed awry, distinguish form" (Shakespeare, *Richard II*, II,2) is found in Holbein's *Ambassadors* in the National Gallery at London (fig. 5). Here the foreground is occupied by an object which certainly deserves to be called "a strange, chimerical shape," and it is only when viewed from the extreme lower left and from a point beneath the bottom of the picture (fig. 6) that this object reveals itself as a death's-head which in this case serves both as a *memento mori* – an idea frequently expressed in portraits of the time – and, probably, a hidden signature: Holbein means, translated literally, a "hollow bone."<sup>1</sup>

## IV

THE SKULL IN HOLBEIN'S *AMBASSADORS*, DATED 1533, IS ONE OF THE EARLIEST examples of perspective "anamorphosis." Reaching the height of their popularity in the second half of the sixteenth century, such distorted images are a playful but characteristic manifestation of a peculiar stylistic phase which separates the High Renaissance of Leonardo, Raphael, the early Michelangelo,

regola di prospettiva delineate, che, vedute in faccie e come naturalmente e comunemente si guardano le altre pitture, altro non rappresentano che una confusa e inordinata mescolanza di linee e di colori, dalla quale anco si potriano malamente raccapazzare immagini di fiumi o sentier tortuosi, ignude spiagge, nugoli o stranissime chimere. Ma quanto [*sic*; the proposed emendation into *quante* is untenable] di questa sorte di pitture, che principalmente son fatte per esser rimirate in scorcio, è sconcia cosa rimirarle in faccia, non rappresentando altro che un mescolgio di stinchi di gru, di rostre di cicogne, e di altre sregolate figure, tanto nella poetica finzione è più degno di biasimo che la favola corrente, scoperta e prima dirittamente veduta, sia, per accomodarsi alla allegoria obliquamente vista e sottointesa, stravagantemente ingombrata di chimere e fantastiche e superflue immaginazioni." For the perspective anamorphoses referred to in this passage, see, e.g., A. H. Barr, Jr., ed. and intr., *Fantastic Art, Surrealism, Dada; Museum of Modern Art*, New York, 1936, nos. 44, 47-49; E. Panofsky, *The Codex Huygens and Leonardo da Vinci's Art Theory* (Studies of the Warburg Institute, 13), London, 1940, p. 93, note 4; F. Clerici, "The Grand Illusion," *Art News Annual*, XXIII, 1953, p. 98 ff., particularly p. 150 f.

<sup>1</sup> To dismiss the suggestion that the skull is a pun on the artist's name as not to be taken seriously (G. H. Villiers, intr., *Hans Holbein the Younger, The Ambassadors in the National Gallery*, London, n.d., p. 9 f.) seems hazardous in view of the fact that the period was no less fond of puns than of *anamorphoses*; see, e.g., J. Porcher's splendid analysis of the numerous puns in two well-known tapestries in the Musée des Arts Décoratifs ("Deux Tapisseries à rébus," *Humanisme et Renaissance*, II, 1935, p. 57 ff.).

and Titian from the High Baroque of Bernini, Pietro da Cortona, Rubens and Rembrandt, and from the "Classicism" of Andrea Sacchi, Poussin and Claude Lorraine – a phase which we are wont to refer to as "Mannerism."

In Heinrich Wölfflin's *Principles of Art History*, an attempt has been made to construe the style of the seventeenth century – the century that ushers in a "modern era" distinct from both the Middle Ages and the Renaissance – as a diametrical contrast to that of the High Renaissance; but this construction was made possible only by the omission of everything that had occurred in between. In reality all seventeenth-century art, both High Baroque and Classicism, resulted from a movement, prevailing from ca. 1590 to ca. 1615, which had arisen, not in opposition to the High Renaissance but, on the contrary, in opposition to the Mannerism of the recent past – a movement that looked upon this recent past much in the spirit of a young man revolting against his father and, consequently, expecting support from his grandfather.<sup>1</sup> On the one hand, there was Caravaggio, famed or decried as a naturalist; on the other, there were the Carracci brothers and their faithful friend, Domenichino, famed or decried as eclectics; but they were all united in a desire to break away from their immediate predecessors, the Mannerists, and by a tendency, differing in degree but not in direction, to recapture the values of the High Renaissance.

When we compare, for example, Raphael's *Madonna di Foligno* of 1511–1512 (fig. 7) with a *Madonna* by Annibale Carracci, produced some 80 or 90 years later (fig. 8), we perceive, all differences in style and temper notwithstanding, a basic community of artistic intention. Carracci's figures, though painted in a looser, more pictorial manner and animated by a more intense emotion, do not appreciably deviate from what Raphael would have considered as "the norm of nature." There is a tendency to harmonize the relationship between surface and depth, plastic volume and ambient space, pattern and intervals. And the subject, the Mother of God appearing to and rapturously venerated by saints, is easily accessible to the beholder's eye and mind.

The Mannerism of Vasari's *Immaculate Conception* in SS. Apostoli at Flor-

<sup>1</sup> The recognition of this process is chiefly due to W. Friedlaender, "Die Entstehung des anticlassischen Stils in der italienischen Malerei um 1520," *Repertorium für Kunstwissenschaft*, XLVI, 1925, p. 49 ff., and "Der antimanneristische Stil um 1590 und sein Verhältnis zum Uebersinnlichen," *Vorträge der Bibliothek Warburg*, 1928–1929, Leipzig and Berlin, 1930, p. 241 ff. Professor Friedlaender has recently given a fine, concise summary of his views in the Preface to *Pontormo to Greco, the Age of Mannerism; A Loan Exhibition . . . February 14–March 28, 1954, The John Herron Art Museum, Indianapolis, 1954*, p. I ff.

ence (fig. 9), executed in 1540, differs from both Raphael's High Renaissance style and Annibale Carracci's Early Baroque in every respect. The arbitrary proportions and contorted movements of the figures reveal inhibitions and tensions incapable of either reconciliation or open conflict. The forms, strongly modeled but confined by tight contours, are crammed into a dense, two-dimensional pattern which prohibits the free deployment of volumes and space in depth. And the subject is an intricate allegory, perplexing, as we learn from his own words, to the artist himself and reduced to visible form only with the help of "many erudite friends."<sup>1</sup>

## V

**G**ALILEO, BORN IN 1564 (ON THE SAME DAY ON WHICH MICHELANGELO died), was an eye witness to the revolt against Mannerism, and it is not difficult to guess where he stood. His *fidus Achates*, Cigoli, played exactly the same role in Florence as did the Carracci and Domenichino in Rome. And he had made friends with Monsignor Giovanni Battista Agucchi, an intimate of these two and, in addition, the very father of an aesthetic and historical theory which, conclusively formulated by Bellori, was to become the creed of the Academies – the theory according to which Annibale Carracci, by having recourse to the great masters of the High Renaissance, had saved the art of painting from both crude naturalism and delusive Mannerism and succeeded in fusing reality and idea into a *beau idéal*.<sup>2</sup> It is, in fact, not only as historians of literature and literary criticism but also as historians of art and art criticism that we must try to evaluate Galileo's unflagging enthusiasm for Ariosto and his mortal aversion to Tasso.

Like sculpture's and painting's "ancient quarrell about Precedency,"<sup>3</sup> as Henry Wotton puts it, the discussion as to whether Tasso or Ariosto was the

<sup>1</sup> *Le Opere di Giorgio Vasari*, G. Milanesi, ed., Florence, 1878–1906, VII, p. 668: "La qualcosa, perchè a me era assai malagevole, avutone messer Bindo ed io il parere di molti comuni amici, uomini letterati . . ."

<sup>2</sup> Cf. Appendix II.

<sup>3</sup> Henry Wotton, *The Elements of Architecture*, 1624; reprinted London, 1903, p. 65.

greater poet was both a serious debate and a kind of parlor game;<sup>1</sup> Annibale Carracci himself is said to have been drawn into a conversation of this kind and, after a long silence, to have left the room with the remark that he thought Raphael the greatest of all painters.<sup>2</sup> When reading Galileo's *Considerazioni al Tasso*, we realize that for him the choice between these poets was not only a matter of vital personal importance but one which transcended the limitations of a purely literary controversy. To him their difference represented, not so much two divergent concepts of poetry as two antithetical attitudes towards life and art in general; and some of his most basic objections to what he considered poor poetry are clothed in images borrowed from the visual arts.

It is not only in comparing Tasso's "allegorical" method to perspective "anamorphosis" that Galileo equates the intent of the *Orlando Furioso* (completed about 1515) with that of classic High Renaissance art, and that of the *Gerusalemme Liberata* (completed about 1575) with that of Mannerism. Right at the beginning of the *Considerazioni*, he describes the contrast between Tasso and Ariosto's styles in terms which, without much verbal change, might be applied to the two paintings by Raphael and Vasari which we have juxtaposed in figs. 7 and 8; or, for that matter, to any work of Giorgione or Titian as compared to any work of Bronzino or Francesco Salviati (who, incidentally, was the favorite painter of Tasso and has been aptly paralleled with him in a recent critical essay):<sup>3</sup> "His [Tasso's] narrative more closely resembles a tarsia picture than an oil painting. For, since a tarsia picture is a composite of little varicolored pieces of wood, which one can never combine and unite so softly that the contours would not remain cutting and sharply distinct from the variety of the colors, it necessarily makes the figures dry, hard, and without roundness and relief. In an oil painting, however, one softly dissolves the contours (*sfumandosi dolcemente i confini*) and passes from one color to the other without abruptness; whence the picture becomes soft, round, forceful and rich

<sup>1</sup> Cf. A. Solerti, *Vita di Torquato Tasso*, I, Turin and Rome, 1895, p. 412 ff.; Olschki, *op. cit.*, p. 182 ff. An aftermath of this contest may be recognized in Goethe's *Torquato Tasso*, I, 3 and 4.

<sup>2</sup> G. B. Bellori, *Le Vite de' pittori, scultori ed architetti moderni*, Rome, 1672, p. 73.

<sup>3</sup> See E. K. Waterhouse, "Tasso and the Visual Arts," *Italian Studies*, III, 1946-1948, p. 146 ff. Waterhouse calls Salviati's frescoes in the Palazzo Farnese (left unfinished at the artist's death in 1563) "the most luminous parallel" to the *Gerusalemme Liberata* in that they "attempt to reconcile the muses with the Counter Reformation." The only other artists mentioned by Tasso are, first, the Venetian sculptor Danese Cattaneo; and, second, the illustrator of the *Gerusalemme Liberata*, Bernardo Castelli, whose work was characterized by a seventeenth-century critic as "cattive figure, non so come il Tasso l'habbia lodate" (quoted in Waterhouse, *op. cit.*).

in relief. Ariosto shades and models in the round . . . Tasso works piecemeal, dryly and sharply . . . and this manner of filling his stanzas, for want of words, with concepts having no cogent connection with what is said or to be said, we will call *intarsiare*.”<sup>1</sup>

In an even more amazing passage, fully appreciable only by art historians, Galileo draws the following parallel: “When setting foot into the *Orlando Furioso* I behold, opening up before me, a treasure room, a festive hall (*tribuna*), a regal gallery adorned with a hundred classical statues by the most renowned masters, with countless complete historical pictures (and the very best ones, by the most excellent painters), with a great number of vases, crystals, agates, lapislazulis and other jewels, in fine, full of everything that is rare, precious, admirable and perfect.” One thinks both of the *School of Athens* and the fantastic gallery pictures by Giovanni Paolo Pannini (fig. 12). When reading the *Gerusalemme Liberata*, however, it seems to Galileo that he enters “the study of some little man with a taste for curios who has taken delight in fitting it out with things that have something strange about them, either because of age or because of rarity or for some other reason, but are, as a matter of fact, nothing but bric-a-brac – a petrified crayfish; a dried-up chameleon; a fly and a spider

<sup>1</sup> Galileo, *Opere*, IX, p. 63; Chiari, *op. cit.*, p. 87: “Uno tra gli altri difetti è molto familiare al Tasso, nato da una grande strettezza di vena e povertà di concetti; ed è, che mancandogli ben spesso la materia, è costretto andar rappezzando insieme concetti spezzati e senza dipendenza e connessione tra loro, onde la sua narrazione ne riesce più presto una pittura intarsiata, che colorita a olio: perché, essendo le tarsie un accozzamento di legnetti di diversi colori, con i quali non possono già mai accoppiarsi e unirsi così dolcemente che non restino i lor confini taglienti e dalla diversità de’ colori crudamente distinti, rendono per necessità le lor figure secche, crude, senza tondezza e rilievo; dove che nel colorito a olio, sfumandosi dolcemente i confini, si passa senza crudezza dall’una all’ altra tinta, onde la pittura riesce morbida, tonda, con forza e con rilievo. Sfuma e tondeggia l’Ariosto, come quelli che è abbondantissimo di parole, frasi, locuzioni e concetti; rottamente, seccamente e crudamente conduce le sue opere il Tasso, per la povertà di tutti i requisiti al ben operare. Andiamo adunque esaminando con qualche riscontro particolare questa verità: e questo andare empiendo, per brevità di parole, le stanze di concetti che non hanno una necessaria continuazione con le cose dette e da dirsi, l’addomanderemo *intarsiare*.” The comparison is reiterated in *Opere*, IX, p. 122; Chiari, p. 187: “Lavorasi orrendamente di tarsie in queste stanze, con i soliti concettuzzi, spezzati e senza connessione appiastrati insieme.” Where the emphasis is on crowding rather than lack of cohesion and “relief,” Galileo uses another simile borrowed from painting: “E pecca il nostro poeta in quella maniera che falleria quel pittore, che, dovendo rappresentare una caccia particolare, accastasse nell’istesso quadro conigli, lepri, volpi, cervi, lupi, orsi, leoni, tigri, cignali, bracchi, levrieri, alcuni pardi, e in somma tutte le sorti di fieri animai di caccia con ogni maniera di cacciagione; e poi questa tal pittura saria più simile ad una rappresentazione dell’entrata nell’ arca di Noè, che ad una caccia naturale” (*Opere*, IX, p. 126 f.; Chiari, p. 194).



embedded in a piece of amber; some of those little clay figures which are said to be found in the ancient tombs of Egypt; and, as far as painting is concerned, some little sketches by Baccio Bandinelli or Parmigianino.”<sup>1</sup> Here Galileo portrays to a nicety, and with evident gusto, one of those jumbled *Kunst- und Wunderkammern* so typical of the Mannerist age (fig. 11); and when he contrasts the “hundred classical statues” and “countless complete history pictures by the most excellent painters” with “some little sketches by Bandinelli and Parmigianino,” he not only disparages the small in favor of the large, and the fragmentary and preliminary in favor of the finished and final, but also points his finger, with unerring accuracy, at two artists – one active up to 1560, the other up to 1540 – whose names are still synonymous with Mannerism *pur sang* (fig. 10).

Tasso has never lost his place among the great poets of the human race, and our own twentieth century has thoroughly revised the wholesale condemnation of Mannerism as an art form. Some of us would rather have a nice *Kunst- und Wunderkammer*, full of Ushebtis, petrified crayfish and Parmigianinos than a formal gallery full of Roman marbles and Raphaels, and many are those in whom a prolonged diet on stainless steel and plate glass has produced an appetite for such less hygienic fare as the Palazzo Spada or the Casino of Pius IV (fig. 13). But if Galileo thought as he did and never changed his opinion up to his dying day,<sup>2</sup> his attitude commands respectful attention. We cannot explain his

<sup>1</sup> Galileo, *Opere*, IX, p. 69; Chiari, *op. cit.*, p. 96: “Mi è sempre parso e pare, che questo poeta sia nelle sue invenzioni oltre tutti i termini gretto, povero e miserabile; e all’opposito, l’Ariosto magnifico, ricco e mirabile: e quando mi volgo a considerare i cavalieri con le loro azioni e avvenimenti, come anche tutte l’altre favolette di questo poema, parmi giusto d’entrare in uno studietto di qualche ometto curioso, che si sia dilettrato di adornarlo di cose che abbiano, o per antichità o per rarità o per altro, del pellegrino, ma che però sieno in effetto coselline, avendovi, come saria a dire, un granchio petrificato, un camaleonte secco, una mosca e un ragno in gelatina in un pezzo d’ambra, alcuni di quei fantoccini di terra che dicono trovarsi ne i sepolcri antichi di Egitto, e così, in materia di pittura, qualche schizzetto di Baccio Bandinelli o del Parmigiano, e simili altre cosette; ma all’incontro, quando entro nel *Furioso*, veggio aprirsi una guardaroba, una tribuna, una galleria regia, ornata di cento statue antiche de’più celebri scultori, con infinite storie intere, e le migliori, di pittori illustri, con un numero grande di vasi, di cristalli, d’agate, di lapislazzari e d’altre gioie, e finalmente ripiene di cose rare, preziose, maravigliose, e di tutta eccellenza.” For the contrast between art gallery and cabinet of curios (the latter type remaining popular in the North, and with such Northern expatriates as P. Athanasius Kircher, when it had gone out of fashion in Italy), see J. von Schlosser, *Die Kunst- und Wunderkammern der Spätrenaissance*, Leipzig, 1908.

<sup>2</sup> See Galileo’s letters to Francesco Rinuccini of November 5, 1639, and May 19, 1640 (*Opere*, XVIII, pp. 120 f., 192 f.; Chiari, *op. cit.*, p. 354 ff.) where he deplors the loss of

*Considerazioni al Tasso* as a product of historical conditions; for many honorable men held opposite views in his own period. Nor can we dismiss it as a "youthful error, inspired by the rampant rationalism of a naively one-sided scientific attitude."<sup>1</sup> In fact, a case may be made, if not for directly reversing this extraordinary pronouncement, at least for recasting it into a statement of complementarity. If Galileo's scientific attitude is held to have influenced his aesthetic judgment, his aesthetic attitude may just as well be held to have influenced his scientific convictions; to be more precise: both as a scientist and as a critic of the arts he may be said to have obeyed the same controlling tendencies.

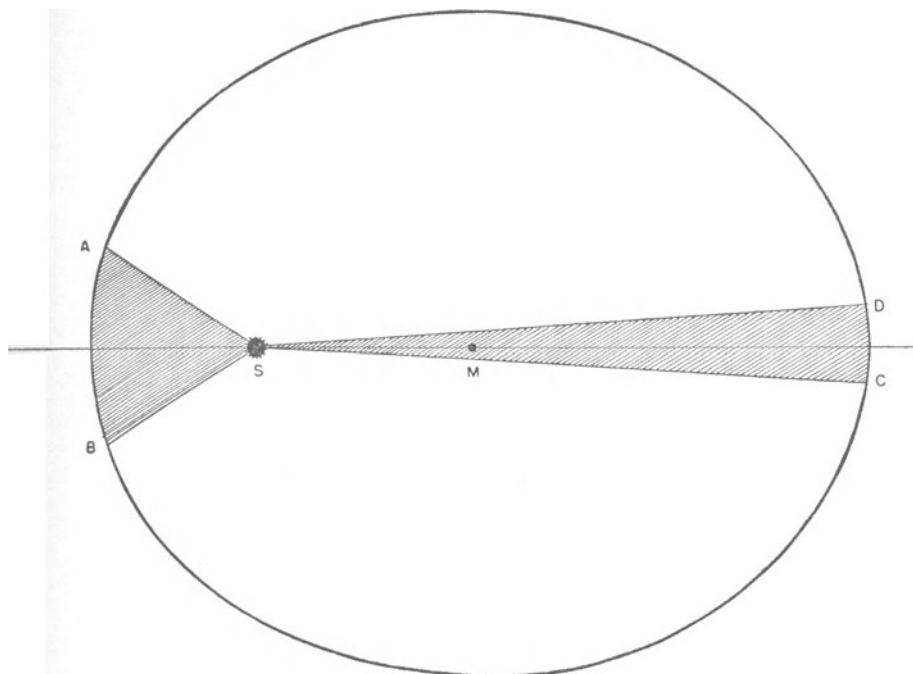
## VI

IT IS A WELL-KNOWN BUT PUZZLING FACT THAT GALILEO, NOT ONLY IN HIS earlier writings but even in the *Dialogue Concerning the Two Chief World Systems* of 1632, the book that made him a victim during his lifetime and a symbol of intellectual freedom ever after, completely ignored the fundamental astronomical achievements of Johannes Kepler – his intrepid comrade-in-arms in the struggle for the recognition of the Copernican system, his fellow member in the Accademia dei Lincei, and a colleague with whom he lived on terms of mutual trust and esteem.

As will be recalled, the original Copernican hypothesis, made public in 1543, his manuscript of the *Considerazioni* (an interfoliated copy of the *Gerusalemme Liberata*), to which he had devoted "molti mesi, a direi anco qualche anno," but restates his objections with undiminished fervor. For the probable date of the *Considerazioni* (before 1609 but hardly before 1595, when Galileo was thirty-one), see *Opere*, IX, p. 10 ff.

<sup>1</sup> U. Leo, *Torquato Tasso, Studien zur Vorgeschichte des Seicentismo*, Bern, 1951, p. 260, note 61. The phrase is too beautiful not to be quoted in German: "Der grosse Galilei, in einer Jugendsünde, jenem von blühendem Rationalismus harmlos einseitiger Naturwissenschaftlichkeit beschwingten, kommentarförmigen Pasquill gegen die *Gerusalemme Liberata* . . ." For the fact that Galileo maintained the view set forth in his *Jugendsünde* (and the latter's date), see the preceding note; for the authenticity of the *Considerazioni*, see Solerti, *op. cit.*, p. 499 ff., and Galileo, *Opere*, p. 10 ff. While the biographers of Tasso tend to be critical of Galileo because of his failure to do justice to Tasso, the biographers of Galileo tend to be critical of Tasso because of his failure to meet the standards of Galileo; see, e.g., Olschki, *op. cit.*, pp. 183 ("... Ariosts konstruktives Genie und Tassos dekorative Talente..."), 185 ("... die ungleichartigen und nicht immer glücklich verschmolzenen Elemente des Gedichtes...").

was based on the assumption that the planets, including the earth, revolve not so much around the sun itself as around a "Nodus Mundi," that is to say, an ideal point located in the center of their orbits and in the sun's vicinity; that these orbits are perfect circles; and that, therefore, the speed of the planets, appearances notwithstanding, is in reality constant. Kepler corrected and amplified this theory by his famous planetary laws which were to form the basis of Newton's final solution (text fig. 1). He showed, first, that the center of the



Text fig. 1. Schematic illustration of Kepler's First and Second Laws

planetary revolutions is not an abstract geometrical point in the vicinity of the sun but the center of the sun's very body, and that the orbits of the planets are not circles but ellipses, the sun being located in one of their foci (first Keplerian law); second, that the planets move faster as they approach the perihelion than while approaching the aphelion, their acceleration and deceleration being determined by the fact that the *radius vector* covers equal areas in equal times (second Keplerian law: if the shaded areas are equal, AB evidently  $>$  CD); third, that a definite though rather complex ratio exists

between the planets' periods of revolution and the sizes of their orbits (third Keplerian law: the squares of the periods are proportional to the cubes of the "mean distances," viz., of half the major axes of the respective ellipses).

The first two of these laws were published, in 1609, in Kepler's *Astronomia Nova*; the third, in 1618 and 1619, respectively, in his *Epitome Astronomiae Copernicanae* and *Harmonice Mundi*.<sup>1</sup> But nowhere does Galileo make use of them. He teaches the Copernican system in its primitive, uncorrected form, and where he himself attempts to establish a ratio between the periods of revolution and the sizes of the orbits, he is patently at variance with the astronomical facts.<sup>2</sup> How can we explain this "most bewildering of omissions,"<sup>3</sup> as one of Galileo's biographers puts it?

To assume that he had "no knowledge of Kepler's laws throughout his life"<sup>4</sup> or at least "was not apprised of them in time" (*rechtzeitig*, meaning, before 1632)<sup>5</sup> is demonstrably impossible. Not only do we know that in this very year Kepler's discoveries were known and accepted in Galileo's circle;<sup>6</sup> we also have a letter of July 21, 1612, addressed to the Master himself by one of his closest friends (Federico Cesi, the founder of the Accademia dei Lincei); and in this letter – apparently not mentioned in previous discussions of the problem – Kepler's ellipses are referred to as a matter of common knowledge and as a

<sup>1</sup> Kepler's first law is stated in *Astronomia Nova*, IV, Chapter 58 (Frisch, III, p. 399 ff.; Caspar, III, p. 364 ff.), the second, *ibidem*, Chapter 40 ff. (Frisch, III, p. 320 ff.; Caspar, III, p. 263 ff.). As for the third law, it appears in its perfected form (with the "mean distance" defined as half the major axis) in the *Harmonice Mundi* of 1519, V, 3 (Frisch, V, p. 274 ff.); without this specification, it is stated in the first part of the *Epitome* (published in 1518), IV, 2, 1 and 4 (Frisch, VI, pp. 337, 350 ff.; Caspar, VII, pp. 291, 306 ff.).

<sup>2</sup> See E. Strauss, *Dialog über die beiden hauptsächlichsten Weltsysteme . . . von Galileo Galilei*, Leipzig, 1901, p. 501.

<sup>3</sup> Olschki, *op. cit.*, p. 329, quoted below, note 5.

<sup>4</sup> Strauss, *loc. cit.* Cf., however, the same author as quoted below, p. 24, note 2.

<sup>5</sup> Olschki, *op. cit.*, p. 329: "Wenn man bedenkt, dass Galilei von Kepler's Gesetzen keine Kenntnis nahm, so ist es anzunehmen, dass diese seltsamste aller Unterlassungen nicht allein auf den unüberwindlichen Widerwillen gegen Keplers Ausdrucksweise zurückzuführen ist, sondern auch auf die Tatsache, dass niemand Galileo auf die grosse Entdeckung rechtzeitig aufmerksam gemacht hatte." Cf., however, the same author as quoted below, p. 24, note 1.

<sup>6</sup> Olschki, *op. cit.*, p. 356, note 2, calls attention to a passage in Buonaventura Cavalieri's *Lo Specchio ustorio ovvero trattato delle settioni coniche*, Bologna, 1632, where Cavalieri says that Kepler had "immeasurably ennobled the conic sections by clearly demonstrating that the orbits of the planets were not circles but ellipses." In addition, Galileo himself seems to allude to Kepler's *Astronomia Nova* (subtitled "*Physica Coelestis tradita commentariis de motibus stellae Martis*") in his own *Dialogue*, (*Opere*, VII, p. 480) when he speaks of "Marte che tanto travaglia i moderni astronomi" (see E. Strauss as quoted p. 24, note 2).

convenient answer to questions left unsolved by the original Copernican theory: "I believe with Kepler that to confine the planets to the rigorous precision of circles would mean to tie them to a treadmill against their will . . . I know, as you do, that many motions are not concentric in relation to either the earth or the sun . . . And that this is true of all of them if their orbit is elliptical as Kepler claims it to be." <sup>1</sup>

From at least 1612, then – only three years after the publication of Kepler's *Astronomia Nova* and twenty years before the publication of his own *Dialogue* – Galileo was familiar with Kepler's first and second laws. He was not ignorant of them; he ignored them. And we must ask ourselves why.

Some hold that Galileo, writing in Italian and addressing himself to the educated layman rather than the uneducable professional, chose to pass over the problems and enigmas resolved by Kepler in order to impress the superiority of the Copernican system upon the mind of "every thinking person" <sup>2</sup> and

<sup>1</sup> Galileo, *Opere*, XI, p. 365 f.: "Ho in qualche parte considerato, credendo con Keplero che l'obligar l'erranti alla giustezza de' circoli sia un attaccarlo contra lor voglia al pistrino et chiuderli onde spesso scappino; et perciò conobbi con V. S. molti motioni non concentriche nè al sole nè alla terra, alcune alla terra, alcune al sole, et forse tutte se la via de' pianeti è elliptica come vol Keplero." For the *pistrino* simile, one may think of Kepler's letter to David Fabricius of December 8/18, 1602: "Tu Martem Soli *nimis arcto vinculo obligas*" (Frisch, III, p. 71; Caspar, III, p. 448) or of his letter to S. Hasenreffer of November 16, 1606: "neque circulis *revincti* sunt planetae quibus circumagantur" (Frisch II, p. 836; Caspar, XV, p. 359 f.).

<sup>2</sup> Wohlwill, *op. cit.*, II, p. 88: "Von einer Fortbildung der [copernicanischen] Lehre in ähnlichem Sinne [wie bei Kepler] kann bei den Dialogen nicht die Rede sein. Nur in wenigen, untergeordneten Beziehungen geht Galilei über die copernicanischen Grundlagen hinaus, ja, jene grossen Entdeckungen, die durch Tycho Brahes Beobachtungen ermöglicht und von Keplers Genius ausgeführt waren, sind *für ihn noch nicht vorhanden*; während Kepler die Geschwindigkeit der Planeten nach bestimmter Regel mit ihrem Abstand von der Sonne sich ändern sah, kennt Galilei eine Veränderung weder der Abstände noch der Geschwindigkeiten; die Grundanschauung des Copernicus, nach der die Sonne im Mittelpunkt der kreisförmigen Planetenbahnen steht, ist in den Dialogen unbedenklich festgehalten; und doch hatte Kepler die Unmöglichkeit dargetan, bei kreisförmigen Bahnen die beobachteten Ungleichheiten der Planeten zu erklären. Die Dialoge schweigen selbst von den Problemen und den Rätseln, die in Keplers Forschung ihre Lösung gefunden hatten. Die Beseitigung dieser Schwierigkeiten war unerlässlich, wenn es sich darum handelte, die copernicanische Lehre zur wahren Astronomie des Sonnensystems zu erheben; sie war von untergeordneter Bedeutung, wo es darauf ankam, der überlieferten Weltanschauung gegenüber die unermessliche Ueberlegenheit der Vorstellung, die von der zweifachen Bewegung der Erde ausging, *für jeden Denkenden zur Klarheit zu bringen*. Dies und nichts anderes wollen die Dialoge, um dieser Aufgabe willen begreift man, was sie ausführen, wie was sie übergehen; sie reden nicht von unerledigten Schwierigkeiten; *es ist mehr als wahrscheinlich, dass Galilei Keplers Lösung nicht als Erledigung anerkannte* – aber um der mangelnden Vollendung willen dem Copernicus widersprechen, das hiess ihm das Haus niederreißen, weil der Ofen raucht." (Italics mine.)

therefore presented it in "its simplest form – a form which he certainly knew to be false." <sup>1</sup> Others believe that Galileo "failed to appreciate fully the incomparable accomplishment of a contemporary with whom he was on friendly terms," <sup>2</sup> and it is this view which, with more profound psychological insight, has recently been restated by Einstein: "That Kepler's decisive step has not left any traces in Galileo's life work is a grotesque illustration of the fact that creative individuals are often not receptive." <sup>3</sup>

It would indeed seem probable that Galileo, who in his *Dialogue* discusses many problems no less "difficult" than Kepler's laws, was unresponsive rather than uncommunicative. He appears to have dismissed them from his mind, by what may be called a process of automatic elimination, as something incompatible with the very principles which dominated his thoughts as well as his imagination.

At the very beginning of the *Dialogue*, Galileo unequivocally endorses the belief, common to Platonism and Aristotelianism, in the perfection – as we would say, the privileged status – of the circle not only from a mathematical

<sup>1</sup> A. Koyré, *Etudes Galiléennes*, III; *Galilée et la loi de l'inertie*, Paris, 1939, p. 52, note 2: Galileo – addressing himself to the *lecteur* "honnête homme" whom he did not wish to tire or to overwhelm – "ne tient aucun compte non seulement des découvertes de Kepler, mais même du contenu concret de l'œuvre de Copernic. L'héliocentrisme se présente chez lui sous sa forme la plus simple – le soleil au centre, les planètes se mouvant autour du soleil sur des cercles – forme qu'il savait pertinemment être fausse." A somewhat similar view is expressed, somewhat in contradiction with the statement quoted p. 22, note 5, by Olschki, *op. cit.*, p. 354 (referring to Galileo's incorrect analysis of the absolute motion of falling bodies in the *Dialogue*, *Opere*, VII, p. 190 ff.): "Die parabolische Fallbewegung [*scil.*, instead of a purely circular one] hätte dieses geschlossene Bild ebenso gestört wie die Keplersche Entdeckung der elliptischen Planetenbahnen, die Galilei *geflissentlich ignorierte*. Ausserdem war er sich der erheblichen Schwierigkeiten bewusst, die eine solche Kurve sowohl geometrisch wie physikalisch dem *Laienverstand* entgegengesetzt hätte." (Italics mine).

<sup>2</sup> Strauss, *op. cit.*, p. 572 (with reference to Galileo's allusion to Mars, mentioned above, p. 22, note 5: "... wohl ein Hinweis auf Keplers berühmtes Hauptwerk *Astronomia nova*... (1609), in welchem auf Grund der Marsbeobachtungen die beiden ersten der drei sogenannten Keplerschen Gesetze aufgestellt werden. Die Art, wie Galilei von diesen unvergleichlichen Leistungen eines ihm befreundeten Zeitgenossen spricht oder vielmehr nicht spricht, beweist, dass er sie nicht in vollem Umfang würdigte."

<sup>3</sup> Galileo Galilei, *Dialogue Concerning the Two Chief World Systems*, S. Drake, tr.; A. Einstein, pref., Berkeley (Cal.), 1953, p. XVI: "Eine Stützung des kopernikanischen Systems, die über das Qualitative hinausging, war nur möglich, wenn die 'wahren Bahnen' der Planeten ermittelt waren – ein fast unlösbar scheinendes Problem, das aber von Kepler zu Galileos Zeiten in wahrhaft genialer Weise gelöst wurde. Dass in Galileos Lebenswerk dieser entscheidende Fortschritt keine Spuren hinterlassen hat, ist ein groteskes Beispiel dafür, dass schöpferische Menschen oft nicht rezeptiv orientiert sind."

or aesthetic but also from a mechanical point of view. According to him the qualities of uniformity and perpetuity, reserved to rectilinear motion in post-Galilean dynamics, exclusively belong to the circular movement which Huygens and his successors have taught us to consider as vectorially accelerated.<sup>1</sup>

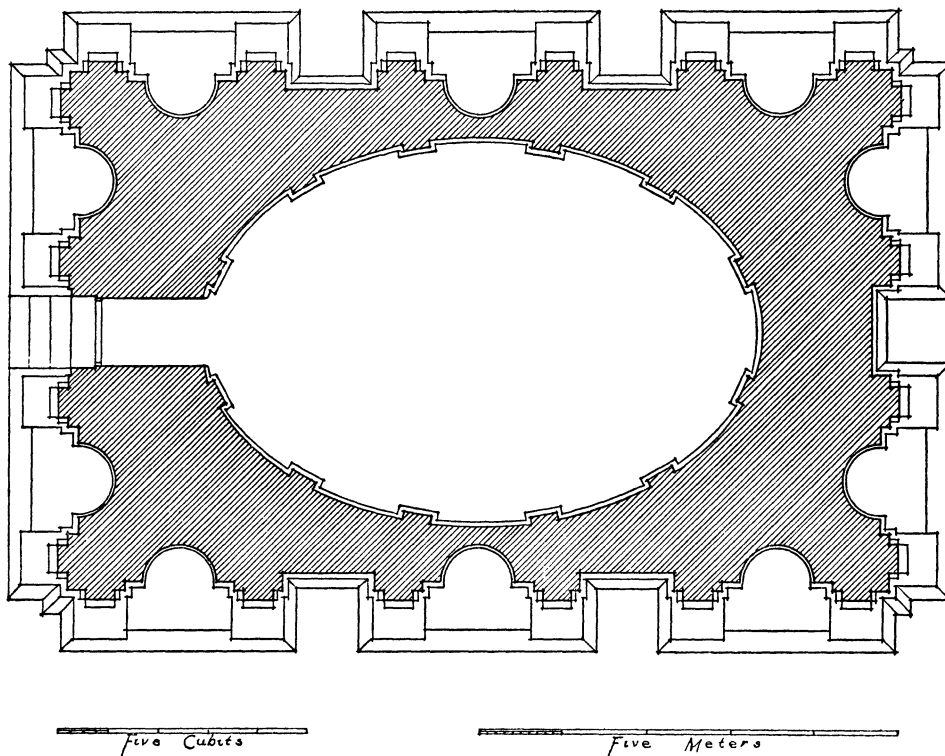
Rectilinear motion, Galileo says, may have had some use before the world was created; but thereafter "only circular motion is naturally [*scil.*, without external interference] appropriate to the bodies constituting the universe and disposed in the best order; rectilinear motion has been assigned by nature to the bodies and their parts whenever they are disposed in bad order, outside their proper places."<sup>2</sup> It is this *hantise de la circularité*, this "haunting spell of circularity," which prevented him from reaching the goal in man's long quest for the law of inertia;<sup>3</sup> and it is, I believe, the same *hantise* which made it impossible for him to visualize the solar system as a combination of ellipses. Where we would consider the circle as a special case of the ellipse, Galileo could not but feel that the ellipse is a distorted circle: a form in which "perfect order" has been disturbed by the intrusion of rectilinearity; which, therefore, cannot result from what he conceived as uniform motion; and which, we may add, was as emphatically rejected by High Renaissance art as it was cherished in Mannerism. In painting it does not occur until Correggio (fig. 14); in sculpture, not until Pierino da Vinci and Guglielmo della Porta; in architecture – apart from Michelangelo's first project for the Tomb of Julius II (text fig. 2) where it crept in, as it were, as an interior feature, invisible from without – not until Baldassare Peruzzi.<sup>4</sup>

<sup>1</sup> Galileo, *Opere*, VII, p. 56: "E perchè nel moto circolare il mobile sempre si parte da termine naturale, e sempre muove verso il medesimo; adunque in lui la repugnanza e l'inclinazione son sempre di eguali forze: dalla quale egualità ne risulta una non ritardata, nè accelerata velocità cioè l'uniformità del moto. Da questa uniformità, e dall'esser terminato, ne può seguire la continuazion perpetua col reiterar sempre le circolazioni, la quale, in una linea interminata, e in un moto continuamente ritardato o accelerato, non si può naturalmente ritrovare."

<sup>2</sup> Galileo, *Opere*, VII, p. 43 f.: "Possiamo dunque dire, il moto retto servire a condur la materia per fabbricar l'opera, ma fabbricata che ell' è, o restare immobile, o, se mobile, muoversi circolarmente." Thus (*ibidem*, p. 56): "Concludo per tanto, il solo movimento circolare poter naturalmente convenire ai corpi naturali integranti l'universo e costituiti nell'ottima disposizione; e il retto, al più che si possa dire, essere assegnato dalla natura ai suoi corpi, e parti di essi, qualunque volta si ritrovassero fuori de' luoghi loro costituite in prava disposizione." For all this, see Koyré, *op. cit.*, *passim*, particularly pp. 3, 49 f.

<sup>3</sup> See Koyré (from whom I borrow the phrase *hantise de la circularité*), *op. cit.*, pp. 27, 113, and *passim*.

<sup>4</sup> See H. Wölfflin, *Renaissance und Barock*, 3rd ed., Munich, 1908, p. 45 f.; H. W. Janson, "The Hildburgh Relief; Original or Copy?," *Art Bulletin*, XXX, 1948, p. 143 ff.



Text fig. 2. Michelangelo, First Project of the Tomb of Julius II, groundplan (reconstruction)

Kepler, on the other hand, did break the “spell of circularity,” not only in establishing the elliptical shape of the planetary orbits, but in a much more general way. In contrast to Galileo, and in anticipation of post-Galilean physics, he considered the rectilinear, and not the circular, movement as privileged as far as the physical world is concerned: “I deny,” he says, “that God has instituted any perpetual non-rectilinear motion unguided by mental control.”<sup>1</sup> This diametrical contrast between the Galilean and the Keplerian interpretation of motion is conspicuously evident when both attempt – with equal justification – to support their celestial mechanics by comparing the movements of the stars to those of the human body. “All muscles,” says Kepler, “operate according to the principle of rectilinear movement . . . There is no limb that can rotate in uniform and comfortable manner. The bending of the head, the feet and the

<sup>1</sup> Kepler, *Astronomia Nova*, I, Chapter 2 (Frisch, III, p. 177 f.; Caspar, III, p. 69 f.): “Nego enim, ullum motum perennem non rectum a Deo conditum esse praesidio mentali destitutum.”



tongue are brought about, through some mechanical artifice, by many straight muscles shifted and stretched from here to there.”<sup>1</sup> Galileo, thinking in terms of bone structure rather than muscular action, comes to exactly the opposite conclusion: “As to the kind and differences of [animal] movements, I maintain that they are all of one kind, that is to say, they are all circular; and this is why all the ends of the movable bones are either convex or concave. Some of these ends are spherical, namely those which must move in all directions as do . . . the joint of the shoulder and the arm . . . or the joint of the elbow. Others are only circular or, so to speak, cylindrical, serving such members as bend only in one way as do the joints of the fingers . . .” And to the objection that man can run, jump, walk up and down, etc., he replies: “Yes; but these are only secondary movements depending on the primary ones which are the movements at the joints. It is from the bending of the leg at the knee, and of the thigh at the hip, which are circular movements, that the jump or the run results.”<sup>2</sup>

Galileo, then, reduces all human movements to a system of circles and epicycles; and this is, curiously enough, precisely what Leonardo da Vinci had suggested in his *Trattato della Pittura* and systematically elaborated (or at least planned to elaborate systematically) in a “Book on Human Movement” (*Libro del Moto Actionale*) which can be reconstructed from a treatise composed by

<sup>1</sup> *Ibidem*: “. . . omnes musculi principiis moventur rectilinearum motuum . . . Nullum adeo membrum est, quod aequabiliter et expedite gyretur. Flexus vero capitis, pedum, brachiorum, et linguae quibusdam artificiis mechanicis per multos rectos musculos huc illuc transpositos vel attensos expressi sunt. Qua ratione efficitur, ut facultas motrix natura sua in rectum tendens membrum illud contorqueat in gyrum.”

<sup>2</sup> Galileo, *Opere*, VII, p. 283 ff.: “Voi primieramente ammettete per vero che la natura abbia fatti gli articoli, le flessure e snodature agli animali acciocchè si possano muover di molti e diversi movimenti; e io vi nego questa proposizione; e dico che le flessioni son fatte acciocchè l’animale possa muovere una o più delle sue parti, restando immobile il resto; e dico che, quanto alle spezie e differenze de’ movimenti, quelli sono di una sola, cioè tutti circolari; e per questo vedete tutti i capi degli ossi mobili esser colmi o cavi; e di questo altri sono sferici, che son quelli che hanno a muoversi per tutti i versi, come fa nella snodatura della spalla il braccio dell’alfiere nel maneggiar l’insegna, e dello strozziere nel richiamar col logoro il falcone, e tal è la flessura del gomito, sopra la quale si gira la mano nel forar col succhiello. Altri sono circolari per un sol verso e quasi cilindrici, che servono per le membra che si piegano in un sol modo, come le parti della dita l’una sopra l’altra, ec . . . *Simplicio*: Io non l’intendo per questo verso; anzi veggo io l’animale muoversi di cento moti non circolari e diversissimi tra loro, e correre, e saltare, e salire, e scendere, e notare, e molti altri. *Salviati*: Sta bene; ma cotesti son moti secondarii dipendenti dai primi, che sono degli articoli e delle flessure: al piegar delle gambe alle ginocchia e delle cosce ai fianchi, che sono moti circolari delle parti, ne viene in conseguenza il salto o il corso, che son movimenti di tutto il corpo, e questi posson esser non circolari.”

one of his followers<sup>1</sup> (fig. 15). To say that Galileo was acquainted with this theory (he does, in fact, refer to "Leonardo's teachings," even though not a line of them was published until 1651)<sup>2</sup> would be incautious; but it is noteworthy that his view of human movement agrees with that of a High Renaissance painter rather than with that of a contemporary astronomer.

## VII

**S**HALL WE CONCLUDE FROM ALL THIS THAT KEPLER WAS MORE "MODERN" than Galileo? Nothing could be farther from the truth. If we accept as "modern" the elimination of the soul from matter, including the celestial bodies, Kepler was still closer to the classical animism, so vigorously revived in the Renaissance, than Galileo;<sup>3</sup> if he was more nearly right in several respects, even extremely important ones, it is not so much because he had fewer prejudices as because his prejudices were of a different kind.

Kepler and his friends were no less deeply committed to the belief in the ideal supremacy of the circle and the sphere than Galileo. Like Galileo's, Kepler's universe always retained the form of a finite and centered sphere – for him an image of the Deity – and he felt a "mysterious horror" at the "mere thought" of Bruno's "limitless and centerless infinitude."<sup>4</sup> He never denied,

<sup>1</sup> See Panofsky, *Codex Huygens*, pp. 23 ff., 122 ff., figs. 7–13.

<sup>2</sup> Galileo, *Opere*, VII, p. 60; Chiari, *op. cit.*, p. 364: "... altri posseggono tutti i precetti del Vinci, e non saprebber poi dipignere uno sgabello."

<sup>3</sup> For Kepler's position in the history of science, see the illuminating essay by W. Pauli, "Der Einfluss archetypischer Vorstellungen auf die Bildung naturwissenschaftlicher Theorien bei Kepler," *Naturerklärung und Psyche* (Studien aus dem C. G. Jung-Institut, Zürich, 4), Zürich, 1952, p. 108 ff.

<sup>4</sup> Kepler, *De Stella Nova Serpentarii* (Frisch, III, p. 688; Caspar, I, p. 253): "Sed Brunus ita infinitum facit mundum, ut quot sunt stellae fixae, tot mundos, et hanc nostram regionem mobilium unum ex innumerabilibus mundis faciat... Quae sola cogitatio nescio quid horroris occulti prae se fert; dum errare sese quis deprehendat in hoc immenso, cuius termini, cuius medium ideoque et certa loca negantur." Cf. *Dissertatio cum Nuncio Sidereo* (Frisch, III, p. 501; Caspar, p. 304): "Si circa unam fixarum discursitantes invenisses planetam, iam erant mihi apud Bruni innumerabiles parata vincula et carcer, imo potius exilium in illo infinito... Ingens sane Wackherium [Matthew Wacker von Wackenfels, Councillor to Rudolph II] philosophiae illae horridae de novo ceperat admiratio..." For Galileo's belief in a finite and spherical universe, see Koyré, *op. cit.*, p. 98.

nay, insisted that only the perfect circle could claim "mental beauty and perfection,"<sup>1</sup> and it is characteristic that one of his most helpful friends, David Fabricius, having objected, on incontrovertible observational grounds, to a preliminary and faulty hypothesis according to which the orbits of the planets were ovals, no less emphatically rejected the final and correct solution for no other reason than that ellipses are not circles: "You have deprived the [celestial] movements of their circularity which, upon careful consideration, seems absurd to me . . . There can be no doubt that all movements of all celestial bodies take place in perfect circles, and not in ellipses."<sup>2</sup>

However – and this is one of the more amazing paradoxes in history – where Galileo's "progressive" empiricism prevented him from differentiating between ideal form and mechanical action, and thereby served to keep his theory of motion under the "spell of circularity," Kepler's "conservative" idealism permitted him to make such a differentiation and thereby served to free his theory of motion from this spell.

One of Galileo's most important innovations is his denial of the idealistic axiom, accepted by Platonists and Aristotelians alike, that there exists an ontological difference between geometrical figures and physical bodies: for him, the ideas of *the* sphere and *the* circle are adequately realized in every material sphere or circle.<sup>3</sup> But just this "geometrization of nature" – or, put it the other way, this materialization of geometry – made it difficult for him to deny the privileged status of circularity in physics and astronomy while accepting it as an axiom of mathematics and aesthetics. Kepler, in this respect the stricter Platonist, maintained the ontological difference between, and I quote, "the intelligible idea of the circle in which there is no distinction between large and small" and "the actual path of the planet, which path, in addition to

1 Kepler, *Epitome*, IV, 2, 2 (Frisch, VI, p. 340 f.; Caspar, VII, p. 295): "Planetae orbita non est perfectus circulus; at si Mens hanc efficeret, ordinaret utique eam in perfectum circulum, cuius est mentalis pulchritudo et perfectio."

2 Fabricius' objections to Kepler's preliminary hypothesis are stated in a letter of October 27, 1604 (Frisch, III, p. 94 f.; Caspar, XV, p. 58 ff.). With characteristic generosity, Kepler thanked his friend in the *Astronomia Nova* IV, Chapter 55 (Frisch, III, p. 384; Caspar, III, p. 345) for having put him on the right track. But upon being informed of Kepler's correct and final solution, Fabricius himself replied, on January 20, 1607 (1608, new style): "Per ovalitatem vel ellipsin tuam, tollis circularitatem et aequalitatem motuum, quod mihi imprimis penitus consideranti absurdum videtur. Coelum enim rotundum est, ita circulares et maxime circa suum centrum regulares et aequales motus habet . . . Ergo non dubium est omnes omnium motus per circulum perfectum, non ellipsin aut excessum etiam fieri . . . Quodsi igitur retento circulo perfecto ellipsin per alium circellum excusare posses, commodius esset" (Frisch, II, p. 108; Caspar, III, p. 475, XV, p. 376 f.).

3 See Koyré, *op. cit.*, p. 122 ff.

its ideal form, also possesses a certain quantity.”<sup>1</sup> But just this rigid separation enabled him to affirm that even the celestial bodies, *qua* bodies, were bound to deviate from a perfectly circular course, however desirable from a metaphysical point of view, when such a deviation was required by what he had established as the laws of nature.

Yet Kepler himself still interpreted these laws of nature, which Newton was to reformulate some 60 years later, as quantitative expressions of qualitative, even animistic, forces. His sun – for him a vast father image, even a symbol of God the Father Himself<sup>2</sup> – has a soul by virtue of which it rotates “like a most rapid whirlpool”; and a magnetic or quasimagnetic *species motrix* or *virtus motoria*,<sup>3</sup> inherent in this huge, rotating body, “takes hold of” (*prensat*) the planets and flings them around, their speed increasing and decreasing as they approach or move away from the sun.<sup>4</sup>

Thus Kepler’s final answer to those who held that only the beauty and perfection of the exact circle was worthy of the celestial movements is this: “If the celestial movements were the work of the mind it could be validly concluded that the orbits of the planets are perfectly circular . . . But the celestial movements are not the work of the mind but the work of nature, that is to say, of the natural faculty of bodies or of a soul that acts in full accord with these corporeal faculties . . . ; even assuming that we were to endow the planets with intelligences, these intelligences would still be unable to achieve what they want, that is to say, the absolute perfection of the circle; for, if it were a question of only the beauty of the circle, the circle would not only be correctly perceived by the mind but also adorn all bodies, and above all the celestial ones; the most beautiful quantity [would adorn] that which has quantity. But since, in order to produce movement, there would also be necessary, in addition to the mind, the natural and animal faculties, these would follow their own inclinations (*ingenium*); they would not do everything according to the

<sup>1</sup> Kepler, *Epitome* IV, 2, 2 (Frisch, VI, p. 341; Caspar, VII, p. 296): “Nam de Idea circuli intellectuali hic non est sermo, in quo non est magni et parvi distinctio, sed de reali itinere planetae, quod praeter Ideam habet etiam certam quantitatem.”

<sup>2</sup> See particularly Pauli, *op. cit.*, pp. 117 ff., 129 f.

<sup>3</sup> These expressions occur, e.g., in *Astronomia Nova* III, 34 (Frisch, III, p. 306 f.; Caspar, III, p. 245 f.). Kepler was never quite clear as to whether the attractive force inherent in the sun was actual magnetism or only something akin to magnetism; cf. the remarks in Caspar, III, p. 468.

<sup>4</sup> For this whole theory, see especially *Epitome* IV, 2, 3, IV, 3, 3, IV, 3, 5 (Frisch, VI, pp. 343, 376, 392 f.; Caspar, VII, pp. 299, 336, 354). At an earlier stage, Kepler had envisaged an active rather than passive response on the part of the planets (which he holds to be endowed, like the sun, with “souls” though not with “minds”); cf. Caspar, VII, p. 593.

dictates of the mind – which they would not apprehend – but would do much according to natural necessity.”<sup>1</sup>

Here Kepler explicitly rejects a mathematical and aesthetic prejudice which Galileo implicitly accepts; but he rejects it in the name of a still animistic interpretation of nature, inherited from neo-Platonic and neo-Pythagorean sources, which in Galileo’s mind had never existed. It is, perhaps, precisely because Kepler started out with an essentially mystical cosmology but had the power of reducing it to quantitative statements that he was able to become as “modern” an astronomer as Galileo was a physicist. Free from all mysticism but subject to the bias of the purist and the classicist, Galileo, the father of modern mechanics, was an explorer rather than a demiurge in the field of astronomy; and he represented a curious blend of prophetic insight and academicism in his attitude towards the arts.

<sup>1</sup> Kepler, *Epitome* IV, 3, 1 (Frisch, VI, p. 372; Caspar, VII, p. 330 f.): “Sic philosophati sunt: ex omnibus motibus in se redeuntibus, simplicissimum esse circularem et perfectissimum, caeteris omnibus, ut ovali et similibus, rectitudinis aliquid admixtum esse; hunc igitur circularem naturae corporum simplicissimae, hunc divinis mentibus motricibus (ut cuius pulchritudo et perfectio sit quippiam mentale), hunc denique coelo, quod sphaericam habet figuram, esse familiarissimum. *Quomodo diluendum hoc est?* Ad haec ego sic respondo, primo si motus coelestes essent mentis opus, ut crediderunt illi veteres, admodum speciose concluderetur itinera planetarum esse perfecte circularia . . . At motus coelestes non sunt opus mentis, sed naturae, hoc est, naturalis corporum potentiae, aut Animae secundum illas corporales potentias uniformiter agentis . . .

Deinde, ut largiamus illis intelligentias, nondum tamen obtinent, quod volunt, omnimodam scilicet perfectionem circuli. Si namque de sola pulchritudine circuli ageretur, circulus et mente certissime cerneretur, et corpora ipsa qualiacunque, maxime coelestia, decoraret, quippe quantitatis participia, quantitas pulcherrima. Sed quia praeter mentem tunc opus esset etiam facultatibus naturalibus et animalibus ad movendum, illae suum etiam sequerentur ingenium, nec omnia ex mentis dictamine, quod non perciperent, sed multa ex materiali necessitate agerent . . . Concedunt ipsi veteres itinera planetis eccentrica, quae multo major videtur deformitas, quam via elliptica. Et tamen mentium suarum providentia hanc deformitatem cavere non potuerunt.”

At the end of this exposition, however, Kepler cautions the reader that, when he speaks of *mens*, he never means the Mind of God. To the *mens creatrix*, he feels, *everything* is appropriate, “sive circularia sive elliptica, sive per mentes administranda et representanda, sive per materialem necessitatem coacta ex principiis semel positis.” And it is with this reservation in mind that we should read Marjorie Nicolson’s beautiful paraphrase of Kepler’s views in *The Breaking of the Circle*, p. 133 f.

## APPENDIX I

GALILEO'S LETTER TO LODOVICO CIGOLI OF JUNE 26, 1612<sup>1</sup>

(*Opere*, XI, pp. 340-343):

"È tanto falso che la scultura sia più mirabile della pittura, per la ragione che quella abbia il rilievo e questa no, che per questa medesima ragione viene la pittura a superar di maraviglia la scultura: imperciocchè quel rilievo che si scorge nella scultura, non lo mostra come scultura, ma come pittura. Mi dichiaro. Intendesi per pittura quella facoltà che col chiaro e con lo scuro imita la natura. Ora le sculture tanto avranno rilievo, quanto saranno in una parte colorate di chiaro et in un' altra di scuro. E che ciò sia il vero, l'esperienza stessa ce lo dimostra; perchè se esporremo ad un lume una figura di rilievo, et anderemola in modo colorendo, col dar di scuro dove sia chiaro, sinchè il colore sia tutto unito, questa rimarrà in tutto priva di rilievo. Anzi quanto è da stimarsi più mirabile la pittura, se, non avendo ella rilievo alcuno, ci mostra rilevare quanto la scultura! Ma che dico io quanto la scultura? Mille volte più; atteso che non le sarà impossibile rappresentare nel medesimo piano non solo il rilievo d' una figura, che importa un braccio o due, ma ci rappresenterà la lontananza d'un paese, et una distesa di mare di molte e molte miglia. E quelli che rispondono che il tatto poi ne dimostrerebbe l' inganno, certo che e' par ch'e' parlino da persone debili; quasi che le sculture e pitture sieno fatte per toccarsi non meno che per vedersi. In oltre, que' che stimano rilievo delle statue, credo certo che ciò facciano credendo che con questo mezzo possano esse più facilmente ingannarci e parerci naturali. Or notisi questo argomento. Di quel rilievo che inganna la vista, ne è così partecipe la pittura come la scultura, anzi più; poichè nella pittura, oltre al chiaro et allo scuro, che sono, per così dirlo, il rilievo visibile della scultura, vi ha ella i colori naturalissimi, de' quali la scultura manca. Resta dunque che la scultura superi la pittura in quella parte di rilievo che è sottoposta

<sup>1</sup> Through the kindness of Professor P. O. Kristeller I learn, too late, that the authenticity of Galileo's letter to Cigoli has already been vindicated, a fact apparently overlooked by Olschki as well as Chiari, as early as 1922: Margherita Mârgani, "Sull'autenticità di una lettera attribuita a G. Galilei," *Atti della Reale Accademia delle Scienze di Torino*, LVII, 1921-1922, p. 556 ff. (also referred to in E. Rosen, "The Authenticity of Galileo's Letter to Landucci," *Modern Language Quarterly*, XII, p. 473). While I am naturally regretful of my oversight, I am glad to see that the authenticity of the letter to Cigoli can be supported even by purely stylistic reasons (Sig. Mârgani does not discuss the problem of the "Signor Andrea" nor adduce the fragment propria manu published in *Opere*, VIII, p. 642).

al tatto. Ma semplici quelli che pensano che la scultura abbia ad ingannare il tatto più che la pittura, intendendo noi per ingannare l'operar sì che il senso da ingannarsi reputi quella cosa non quale ell'è, ma quella che imitar si volle! Ora chi crederà che uno, toccando una statua, si creda che quella sia un uomo vivo? Certo nessuno: et è ben ridotto a cattivo partito quello scultore, che non avendo saputo ingannar la vista, ricorre a voler mostrare l'eccellenza sua col voler ingannare il tatto, non si accorgendo che non solamente è sottoposto a tal sentimento il rilevato e il depresso (che sono il rilievo della statua), ma ancora il molle e il duro, il caldo e'l freddo, il delicato e l'aspro, il grave e'l leggiere, tutt'indizi dell'inganno della statua.

Non ha la statua il rilievo per esser larga, lunga e profonda, ma per esser dove chiara e dove scura. Et avvertasi, per prova di ciò, che delle tre dimensioni, due sole sono sottoposte all'occhio, cioè lunghezza e larghezza (che è la superficie, la quale da' Greci fu detta *epifania*, cioè periferia o circonferenza), perchè delle cose che appariscono e si veggono, altro non si vede che la superficie, e la profondità non può dall'occhio esser compresa, perchè la vista nostra non penetra dentro a' corpi opachi. Vede dunque l'occhio solamente il lungo e 'l largo, ma non già il profondo, cioè la grossezza non mai. Non essendo dunque la profondità esposta alla vista, non potremo d'una statua comprender altro che la lunghezza e la larghezza; donde è manifesto che noi non ne vegghiamo se non la superficie, la qual altro non è che larghezza e lunghezza, senza profondità. Conosciamo dunque la profondità, non come oggetto della vista per sè et assolutamente, ma per accidente e rispetto al chiaro et allo scuro. E tutto questo è nella pittura non meno che nella scultura, dico il chiaro, lo scuro, la lunghezza e la larghezza: ma alla scultura il chiaro e lo scuro lo dà da per sè la natura, ed alla pittura lo dà l'arte: adunque anche per questa ragione si rende più ammirabile un'eccellente pittura di una eccellente scultura.

A quello poi che dicono gli scultori, che la natura fa gli uomini di scultura e non di pittura, rispondo che ella gli fa non meno dipinti che scolpiti, perchè ella gli scolpe e gli colora, ma che questo è a loro imperfezione, e cosa che scema grandissimamente il pregio alla scultura: perciocchè quanto più i mezzi, co' quali si imita, son lontani dalle cose da imitarsi, tanto più l'imitazione è maravigliosa. Era anticamente molto più stimata quella sorta d'istrioni che co' movimenti soli e co' cenni sapevano recitare una intera storia o favola, che quelli che con la viva voce l'esprimevano in tragedia o in commedia, per usar quelli un mezzo diversissimo et un modo di rappresentare in tutto differente dalle azioni rappresentate. Non ammireremmo noi un musico, il quale cantando e rappresentandoci le querele e le passioni d'un amante ci muovesse a compassionarlo,

molto più che se piangendo ciò facesse? e questo, per essere il canto un mezzo non solo diverso, ma contrario ad esprimere i dolori, e le lagrime et il pianto similissimo. E molto più l'ammireremmo, se tacendo, col solo strumento, con crudezze et accenti patetici musicali, ciò facesse, per esser le inanimate corde meno atte a risvegliare gli affetti occulti dell'anima nostra, che la voce raccontandole. Per questa ragione dunque, di qual meraviglia sarà l'imitare la natura scultrice coll'istessa scultura, e rappresentare il rilevato coll'istesso rilievo? Di niuna certo, o di poca; et artificiosissima imitazione sarà quella che rappresenta il rilievo nel suo contrario, che è il piano. Maravigliosa dunque, per tal rispetto, si rende più la pittura che la scultura.

L'argomento poi dell'eternità non val niente, perchè non è la scultura che faccia eterni i marmi, ma i marmi fanno eterne le sculture; ma questo privilegio non è più suo, che d'un ruvido sasso: benchè e le sculture e le pitture sieno forse egualmente soggette a perire.

Soggiungo che la scultura imita più il naturale tangibile, e la pittura più il visibile; perocchè, oltre alla figura, che è comune con la scultura, la pittura aggiugne i colori, proprio oggetto della vista.

Finalmente, gli scultori copiano sempre, et i pittori no; e quelli imitano le cose com' elle sono, e questi com' elle appariscono: ma perchè le cose sono in un modo solo, et appariscono in infiniti, e' vien perciò sommamente accresciuta la difficoltà per giugnere all'eccellenza della sua arte. Di qui è che sommamente più ammirabile è l'eccellenza nella pittura, che nella scultura.

Tanto per ora mi sovviene poter ella rispondere alle ragioni di cotesti fautori della scultura, partecipatemi questa mattina di ordine di V. S. dal S.<sup>re</sup> Andrea nostro. Ma io però la consiglierai a non s' inoltrar più con essi in questa contesa, parendomi ch' ella stia meglio per esercizio di spirito e d'ingegno fra quei che non professino nè l' una nè l'altra di queste due veramente ammirabili arti, quando in eccellenza sono praticate; poichè oramai V. S. nella propria s' è resa così degna di gloria con le sue tele, quanto il nostro divino Michelagnolo co' suoi marmi.

E qui cordialissimamente le b. l. m., e la prego a continuarmi il suo amore, e l'osservazioni ancora delle macchie."

TRANSLATION OF GALILEO'S LETTER TO LODOVICO CIGOLI OF JUNE 26, 1612

(*Opere*, XI, pp. 340-343):

"The contention that sculpture is more admirable than painting because the



former has relief while the latter has not is so wrong that, by virtue of this very argument, painting turns out to surpass sculpture in excellence; for that relief which one perceives in sculpture is exhibited by it not insofar as it is sculpture but insofar as it is painting. Let me explain. By 'painting' one understands the faculty of imitating nature by means of light and dark. Now, sculptures will have relief only to the extent that they are colored [shaded] light in one part, and dark in another. And that this is true is demonstrated by experience; for, if we were to expose a sculptured figure to the light and were then to proceed to color it in such a way that we paint it dark wherever it is light until its color [tone] is completely unified, the figure would appear devoid of relief altogether. How much more highly must we think of painting if it, not having any [real] relief, yet shows us just as much relief as does sculpture. But why do I say: just as much as sculpture? A thousand times more, since it is not beyond the power of painting to represent, in one and the same plane, not only the relief of one figure which amounts to one or two cubits, but the development in depth of a countryside or an expanse of sea which amounts to many, many miles. And those who reply that the sense of touch would disclose the fraudulence of these [prospects] surely would seem to speak like weak-minded people, as though both sculptures and paintings were made in order to be touched in addition to being seen. Furthermore, those who praise the relief of statues do this, in my opinion, in the belief that this means [viz., relief] enables them [viz., the statues] more easily to deceive us and to appear natural to us. Now look at this argument! That relief which does deceive the sense of vision is within reach of painting as well as of sculpture, or rather more so; for, in painting there are – over and above the light-and-dark which is, so to speak, the visible relief of sculpture – the natural colors in which sculpture is lacking. There remains, then, that sculpture is superior to painting in that kind of relief which is perceived by *touch*. But simple-minded are those who think that sculpture can deceive the sense of touch to a higher degree than painting – provided that we understand by 'to deceive' to operate in such a manner that the sense to be deceived accepts the object not as what it is but as what it is intended to imitate. Who would believe that a man, when touching a statue, would think that it is a living human being? Certainly nobody; and a sculptor who, being unable to deceive the sense of sight, would want to show his prowess by trying to deceive the sense of touch would place himself in a most awkward position, since he would ignore the fact that not only projections and depressions (which constitute the relief in a statue) come within the province of this sense but also softness and hardness, warmth and coolness, smoothness

and roughness, heaviness and lightness, all of which [would be] criteria of the statue's power to deceive.<sup>1</sup>

The statue does not have its relief by virtue of being wide, long and deep but by virtue of being light in some places and dark in others. And one should note, as a proof of this, that only two of its three dimensions are actually exposed to the eye: length and width (which is the superficies, called *epifania* in Greek, that is to say, periphery or circumference).<sup>2</sup> For, of the objects appearing and seen we see nothing but their superficies; their depth cannot be perceived by the eye because our vision does not penetrate opaque bodies. The eye, then, sees only length and width but never depth, and never thickness. Thus, since thickness is never exposed to view, nothing but length and width can be perceived by us in a statue, whence it is clear that we see of it only the superficies which is nothing but width and length without any depth. We know of depth, not as a visual experience *per se* and absolutely but only by accident and in relation to light and darkness. And all this is present in painting no less than in sculpture, that is to say lightness, darkness, length and width. But sculpture receives lightness and darkness from Nature herself whereas painting receives it from Art; and for this reason, too, an excellent picture is more admirable than an excellent sculpture.

To the sculptors' contention that Nature herself makes the human being by means of sculpture and not by means of painting, I answer that she makes them painted as well as sculpted inasmuch as she both sculpts and colors them; and that this redounds to their [the sculptors'] imperfection and is a thing which greatly diminishes the merit of sculpture. For, the farther removed the means by which one imitates are from the thing to be imitated, the more worthy of wonder the imitation will be. In ancient times those actors who could tell a whole story exclusively by means of movements and gestures were more highly appreciated than those who expressed it *viva voce* in tragedy or comedy, because the former used a means very different and a mode of representation quite divergent from the actions represented. Will we not admire a musician who moves us to sympathy with a lover by representing his sorrows and passions in song much more than if he were to do it by sobs? And this we do because song is a medium not only different from but opposite to the [natural] expression of pain while tears and sobs are very similar to it. And we would

<sup>1</sup> This is the passage developed from the perfectly genuine but thus far uninterpreted fragment *Opere*, VIII, page 642 (quoted p. 8, in note 1).

<sup>2</sup> *Ἐπιφάνεια* in this sense occurs in Democritus, Aristotle, Euclid (*Elementa* I, deff.), Philo Mechanicus (*Belopoeica*, LXX, 27), and Damianus (*Optics*, XI).

admire him even much more if he were to do it silently, with an instrument only, by means of dissonances and passionate musical accents; for the inanimate strings are [of themselves] less capable of awakening the hidden passions of our soul than is the voice that narrates them. For this reason, then, what will be so wonderful in imitating "sculptress Nature" by sculpture itself, in representing that which is relieved by the relief itself? Certainly nothing or very little, and the most artistic imitation will be that which represents relief on its opposite, which is the plane. In this respect, therefore, painting is more wonderful than sculpture.

The argument of eternity [indestructibility] counts nothing because it is not sculpture that eternalizes the marble blocks; rather the marble blocks eternalize the sculptures. This prerogative belongs, not to sculpture, but to coarse rock – although perhaps sculptures and paintings are [in fact] equally subject to annihilation.

Let me add that sculpture imitates more that which is tangible in nature and painting more that which is visible; for to form, which it has in common with sculpture, painting adds colors, the peculiar object of sight.

Finally, the sculptors always copy and the painters do not. The former imitate things as they are, the latter as they appear; but since things are only in one way and appear in infinite ways, it is enormously more difficult [for the painter] to attain to excellence in his art. And from this it follows that excellence is enormously more admirable in painting than it is in sculpture.

This is what I recall at the moment as a possible reply to the arguments of those champions of sculpture communicated to me this morning at your behest by our Signor Andrea. However, I would advise you not to go on with them any further in this controversy; it is more suitable, it seems to me, for an exercise of wit and acumen among those who are not active in either the one or the other of these two arts, both truly admirable when practiced with outstanding skill. In your own you have now made yourself as worthy of fame with your canvases as our divine Michelangelo with his marbles.

I cordially kiss your hands; and, pray, continue to favor me with your love and also with your observations of the sunspots."

## APPENDIX II

### MONSIGNORE GIOVANNI BATTISTA AGUCCHI AND HIS DISCOURSE DEL MEZZO. 1

Giovanni Battista Agucchi was born at Bologna in 1570 and settled in Rome in 1607; he was Maggiordomo to Cardinal Aldobrandini from 1615 to 1621, Secretary of State to Gregory XV from 1621 to 1623, and Archbishop of Amasia and Papal Nunzio to the Republic of Venice from 1623 up to his death at Motta di Livenza in 1632 (see Galileo, *Opere*, XX, p. 364, and the sources quoted in Solerti, *op. cit.*, p. 735). To art historians he is known only as a *littérateur* "enamored of painting and poetry": an intimate of Annibale Carracci, said to have helped him in devising the program for the Farnese Gallery, to have assisted him in his dying hour and to have written his epitaph (Bellori, *op. cit.*, pp. 32, 73 f., 77 f.); a generous friend of Domenichino (*ibidem*, pp. 293 f., 297, 305); and an art theorist noteworthy as the contemporary spokesman of a group of painters and *dilettanti* whose views were to be codified, some fifty years later, in Bellori's *Idea del Pittore, dello Scultore e dell' Architetto*, the Magna Charta of academicism (*ibidem*, pp. 3-13, Panofsky, *Idea*, p. 130 ff. [Ital. transl., p. 183 ff.]). See H. Bodmer, *Lodovico Carracci*, Burg, 1939, p. 107; and, above all, D. Mahon, *Studies in Seicento Art and Theory* (Studies of the Warburg Institute, 16), London, 1947, *passim*.

Historians of science, on the other hand, know Agucchi as an amateur astronomer and an enthusiastic though understandably somewhat apprehensive admirer of Galileo (cf. particularly Wohlwill, *op. cit.*, p. 491 f.). Galileo and Agucchi had become acquainted during the former's stay at Rome in the spring of 1611 (cf. *Opere*, V, p. 82, and XIX, p. 612); Cigoli, too, refers to the "molto virtuoso Monsignore" from Bologna in a letter of August 23, 1611 (*Opere*, XI, p. 175) and transmits his greetings on June 3, 1612 (*ibidem*, p. 424). They conducted a lively correspondence from 1611 to 1613 (*Opere*, XI, pp. 205, 214, 219, 225, 249, 255, 264, 328, 346, 389, 440, 520), and as late as October 23, 1621, Giovanni Ciampoli gives Galileo the affectionate regards of several friends, among them Agucchi and Cardinal Maffeo Barberini, the future Urban VIII (*Opere*, XIII, p. 78). The direct correspondence between Agucchi and Galileo, as far as it has come down to us, ends with the former's memorable letter of June 13, 1613 (*Opere*, XI, p. 520 ff.), where the good Monsignore congratulates

1 I wish to express my gratitude to the Director of the Biblioteca Nazionale at Florence for having placed at my disposal a microfilm of the manuscript preserved in Mss. Gal., Discepoli, Tom. 136, fols. 95-110 (mentioned in Galileo, *Opere*, XI, p. 249, note).

Galileo on his latest triumphs and once more endorses his findings in every factual respect yet warns him, with well-meaning solicitude and a shrewd insight into what was brewing, not to waste time on further controversy and, above all, not to come out in favor of the Copernican system: he, Agucchi, has carefully studied it on Galileo's advice but finds it unacceptable for a variety of reasons, notably the very good one that it would ultimately lead to the Brunian concept of a world of "infinite magnitude" within which "qualunque stella della quarta o quinta magnitudine, le quali a pena si discernono, fossero di esso [*scil.*, the sun] maggiori o ad esso eguali"; for, once it is admitted that the sun is a fixed star, there is no valid argument against the assumption that the fixed stars are suns. Agucchi therefore prefers the system of Tycho Brahe (according to which the earth remains unmoved in the center of the universe while the moon, the sun and the fixed stars revolve around it and the five other planets revolve around the sun).

It is in the *Del Mezzo, Discorso Accademico* – prepared with Galileo's help and sent to him on December 23, 1611 (*Opere*, XI, pp. 225, 249) – that, as it were, the two Agucchis meet: an academic philosophy of life and art, half Aristotelian and half neo-Platonic (for the same mixture in Bellori's theories, cf. Panofsky, *Idea*, p. 59 ff.; Ital. transl., p. 79 ff.), is fused with a half Galilean, half Tychonian astronomy. Beginning with Dante's "Nel mezzo del cammin di nostra vita" and quoting nearly every Greek and Roman writer within reach, Agucchi sets out to prove that goodness and beauty are dominated by one principle: that of *mezzanità* which for him comprises the ideas of "mean" as well as "center." As Odysseus was saved by avoiding both Scylla and Charybdis, so do truth, beauty and virtue lie in the middle between two opposite falsehoods or vices: "The beautiful proportion in architecture, whereon is it based if not on the mean? And the best way of imitation in poetry, painting or sculpture, on what else?" (fol. 98 r.). The capital is in the middle of a country, the most important church or palace in the middle of a city, the most beautiful monument in the middle of a square, substance in the middle of its accidents; "God Himself may reasonably be designated and recognized as a middle because the created things are outside of Him yet always return to Him as do the rivers to the sea." (fol. 99 v.).

Then Agucchi proceeds to show that both the macrocosm and the microcosm, "centered" in God yet mirroring Him as His images, are governed by the sacred number Four: "From God, as the First Cause, there proceed all things by way of Ideas, Reasons, Seeds, and Shades" (fol. 100 v.), which tetrad corresponds to Mind, Soul, Nature and Matter (or, in the human being, Body) both in a

cosmological and in an anthropological sense (fol. 102 r.); and the hierarchy of these – neo-Platonic – spheres of being can be expressed by “a circular figure consisting of four circles that have the same center,” circles and center being connected in such a manner that innumerable radii, emanating *del mezzo*, transmit to the peripheries – and thereby diversify – the unified goodness of God (fol. 101 v.f.). By subdividing nature into four forms of “essence” and four forms of “operation,” and by subdividing man into four intellectual and four moral “habits,” Agucchi finally proclaims God as the center of creation in four times four, or sixteen, different “modes”; while another subdivision of nature and human habits leads to a total of twenty-four “figures” (fol. 104 v.).

Having reached this point, Agucchi confesses the principal purpose of his discourse: he wishes to develop a device or *impresa* for himself. This *impresa*, he feels, should proclaim his enthusiasm for *mezzanità* both in the sense of “mediocrity” (“frail of mind and body,” he says, “my natural talent has always inclined me towards mediocrity so that I have avoided, as best I could, the danger of going to extremes”) and “centricity”; at the same time, it should express the four intellectual “habits” which he was most anxious to cultivate as an individual, viz., scientific knowledge, the arts, prudence and the moral virtues (fol. 105 r.), as well as the four parts of man in general, viz., Mind, Soul, Nature and Body (fols. 107 v./108 r.).

Agucchi’s *impresa*, therefore, must feature four circles revolving around one center; but – and this is a rather nice idea – the center itself, while fixed in relation to the four *giri* surrounding it, must be mobile in relation to another, absolute center that represents, as it were, eternal truth as opposed to its variable manifestations. “So variable is the material substratum of the moral virtues that their center is now in one place and now in another”; and the same applies to the arts, prudence and scientific knowledge. In all these spheres, he says, standards continually “shift, according to human fantasy’s being altered by the universal movements of the heavens, from age to age, from province to province, from group to group, from sect to sect.” In short, the four *giri* of Agucchi’s *impresa* must be epicycles rather than circles, their center moving on a deferent.

But where in nature, Agucchi asks, can we find an actual model of such a figure? The Tychonian system, in which he believed,<sup>1</sup> might have provided an approximation in that it assumes the planets to revolve around the sun, the sun in turn revolving around the earth; but the number of those planets

<sup>1</sup> See fol. 160 r. “Mercurio e Venere . . . si girano intorno al sole”; cf. also the letter of June 13, 1613, just quoted.

is, unfortunately, five, not four. However, only a year or so ago, Galileo Galilei, "gentleman from Florence," had discovered the perfect model for Agucchi's *impresa*, "most beautiful and most similar but, after having been elaborated with divine art by the Eternal Workman and created in an instant, hidden from mankind up to the present": the satellites of Jupiter. Thus Agucchi's treatise, departing from its highly metaphysical course, trails off into a long discussion of Galileo's telescope (the magnifying power of which is correctly stated as *ca.* 1200, or *ca.* 34.4 linear) and the astronomical and astrological characteristics of the Jupiter system (fols. 105 v.–107 v.). And it concludes, first, with a praise of God for having assigned the four satellites to Jupiter, the most felicitous of planets, the star of Justice (the supreme form of human activity) and, last but not least, the dominant influence in Agucchi's own horoscope (fol. 108 r.); second, with the selection of a motto (fol. 108 v.–end). Deliberately reversing the view of Lucretius, who had denied that the components of the world were held in balance by a "desire for the middle" (*De rerum natura*, I, 1081 f.: "Haud igitur possunt tali ratione teneri/ Res in concilio, medii cuppedine victae"), Agucchi's *impresa* (separately despatched to Galileo on January 6, 1612, *Opere* XI, pp. 255, 264) shows the planet Jupiter in the center of its four satellites, surrounded by an oval border inscribed with the motto MEDII CUPPEDINE VICTAE – SWAYED BY THE DESIRE FOR THE MIDDLE (fig. 16). And with this maxim, directed against Giordano Bruno as well as against Lucretius, both Galileo and Kepler would have wholeheartedly agreed (see p. 28, note 4).

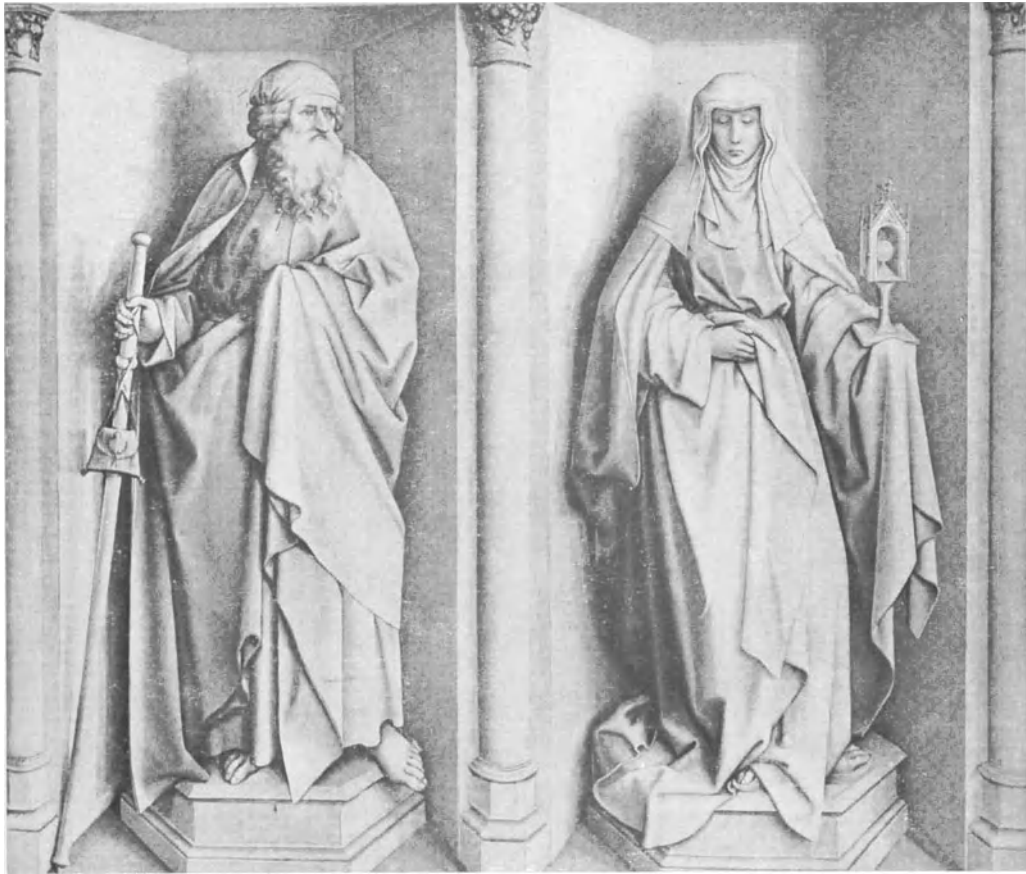


Fig. 1. The Master of Flémalle: St. James the Great and St. Clare. Madrid, Prado





Fig. 2. Ludovico Cigoli: *The Assunta* (fresco). Rome, S. M. del Popolo

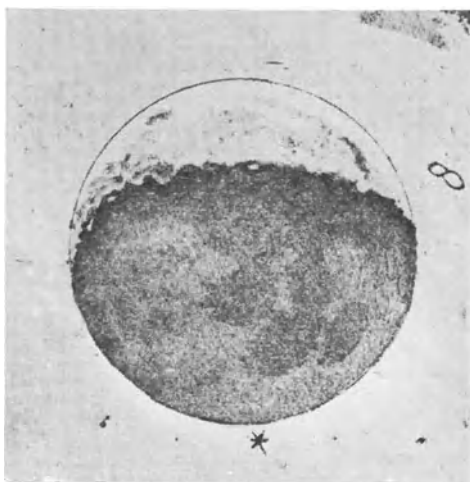


Fig. 3. Crescent Moon. Drawing in the draft of Galileo's *Sidereus Nuncius*, Florence, Biblioteca Nazionale, mss. Gal., Par. III, T. III, fols. 8 ff. (turned by 90 degrees)

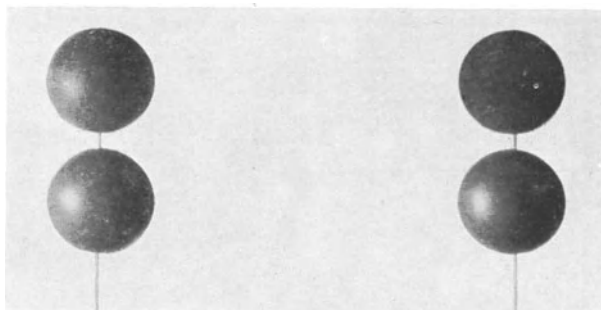


Fig. 4. Illustration of Galileo's discussion of "visible" and "tangible" relief



Fig. 5. Hans Holbein the Younger:  
The Ambassadors. London,  
National Gallery



Fig. 6. Detail of Fig. 5. Rectification  
of the "anamorphosized" skull  
in the foreground



Fig. 7. Raphael: Madonna di Foligno. Rome, Pinacoteca Vaticana



Fig. 8. Annibale Carracci: Madonna and Saints. Bologna, Pinacoteca



Fig. 9. Giorgio Vasari: Immaculate Conception. Florence, SS. Apostoli



Fig. 10. Parmigianino: Nymphs Bathing (drawing). Florence, Uffizi

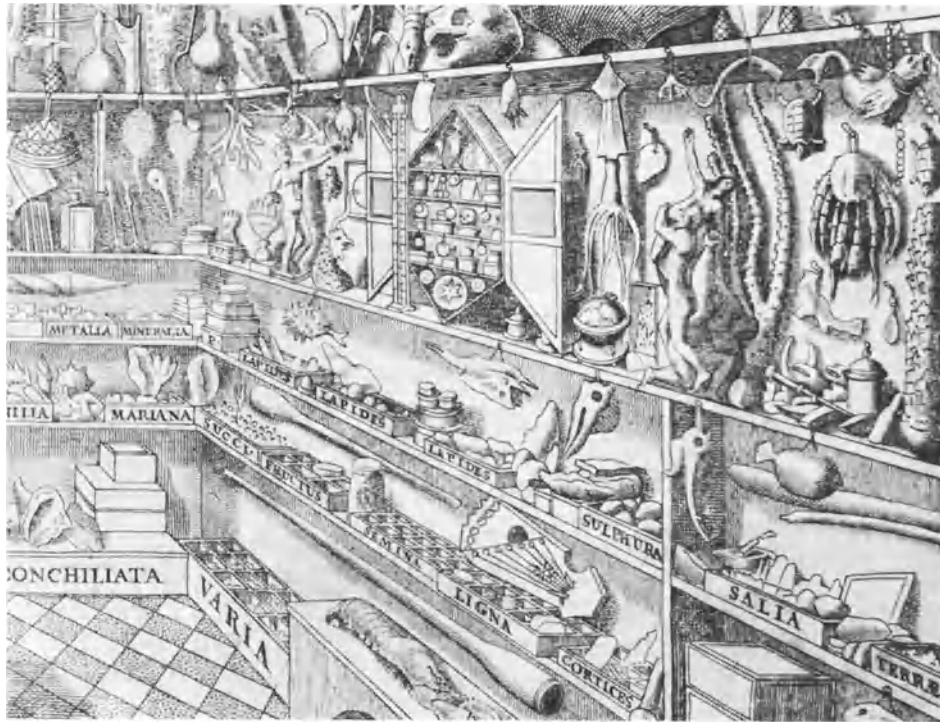


Fig. 11. G. Wingendorp: Frontispiece of *Museum Wormianum, seu Historia Rariorum, tam naturalium, quam Artificialium, tam Domesticorum quam Exoticorum, quae Hafnia Danorum in aedibus Authoris servantur*, Leiden, 1655 (detail including a small replica of Giovanni da Bologna's *Rape of the Sabine Women*)



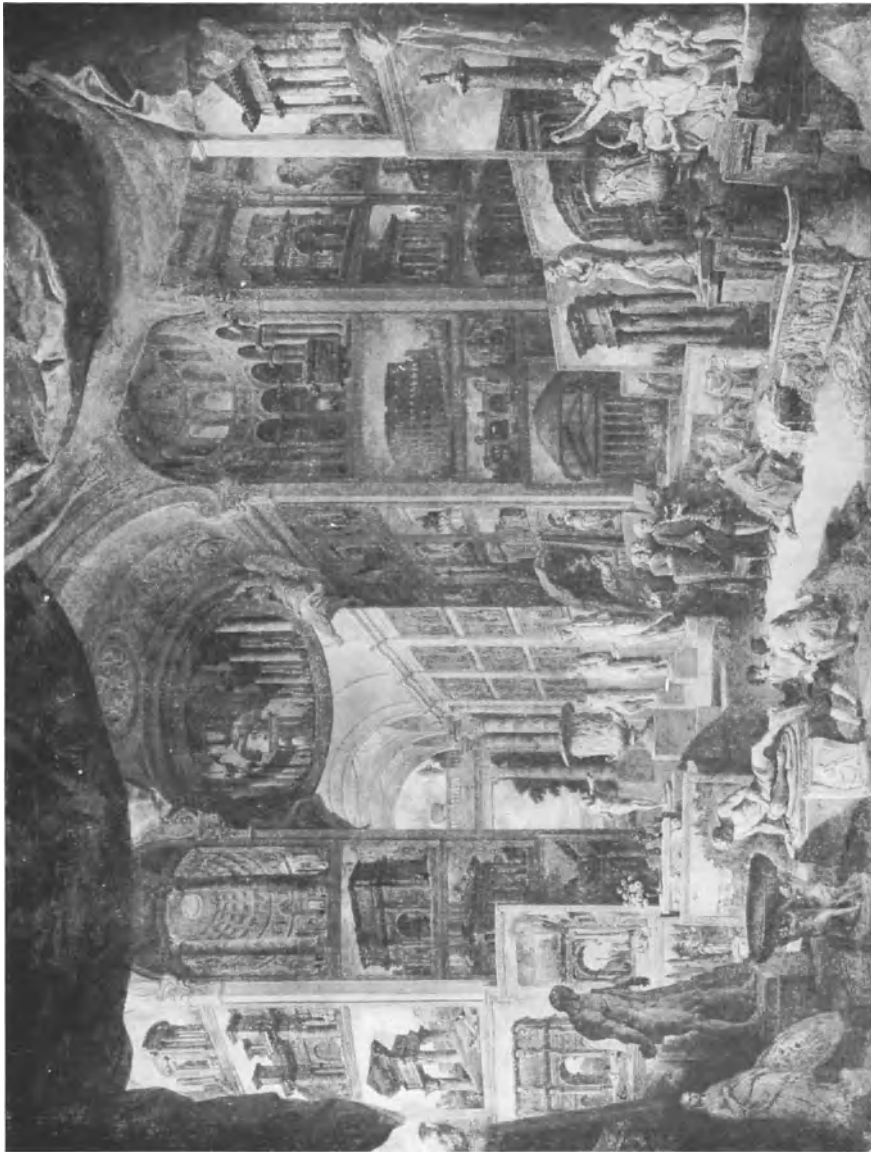


Fig. 12. Giovanni Paolo Pannini: "Classical Rome". New York, Metropolitan Museum

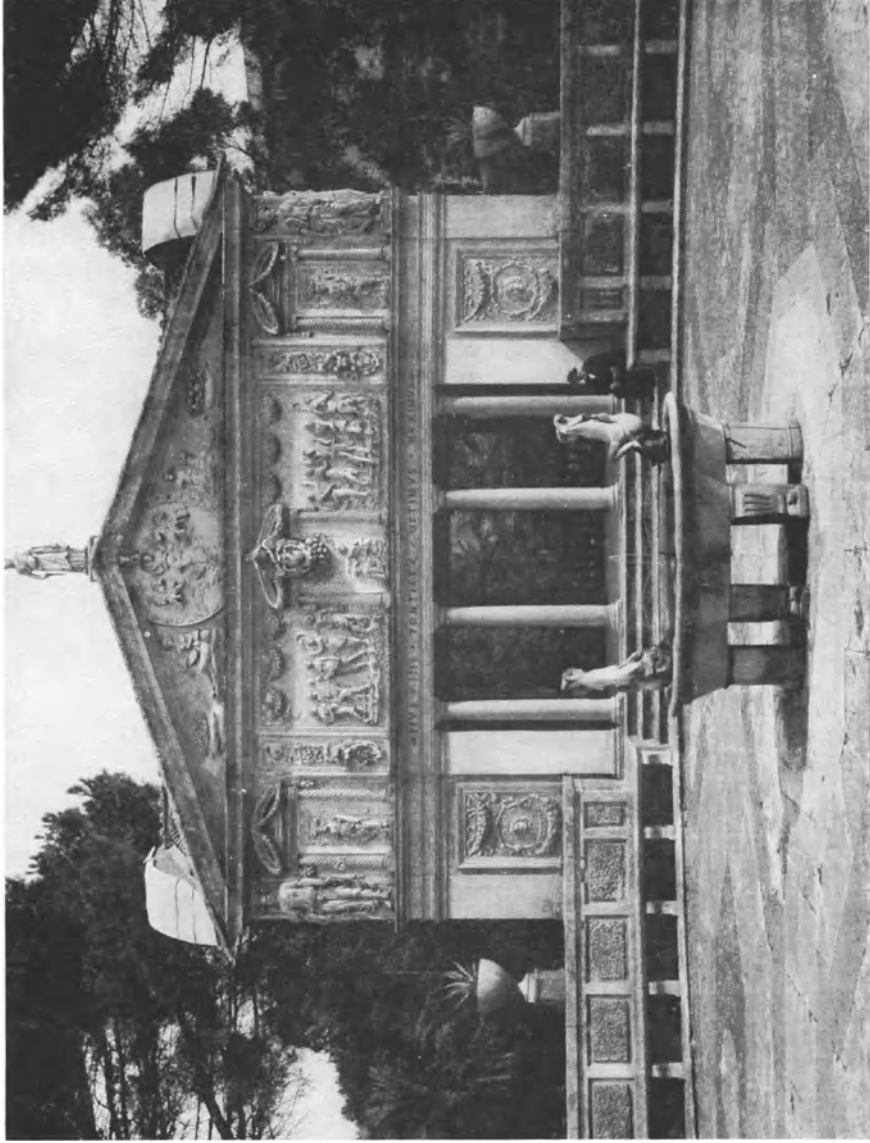


Fig. 13. Rome, Casino of Pius IV



Fig. 14. Correggio: Madonna of St. Francis. Dresden, Gemäldegalerie (detail)

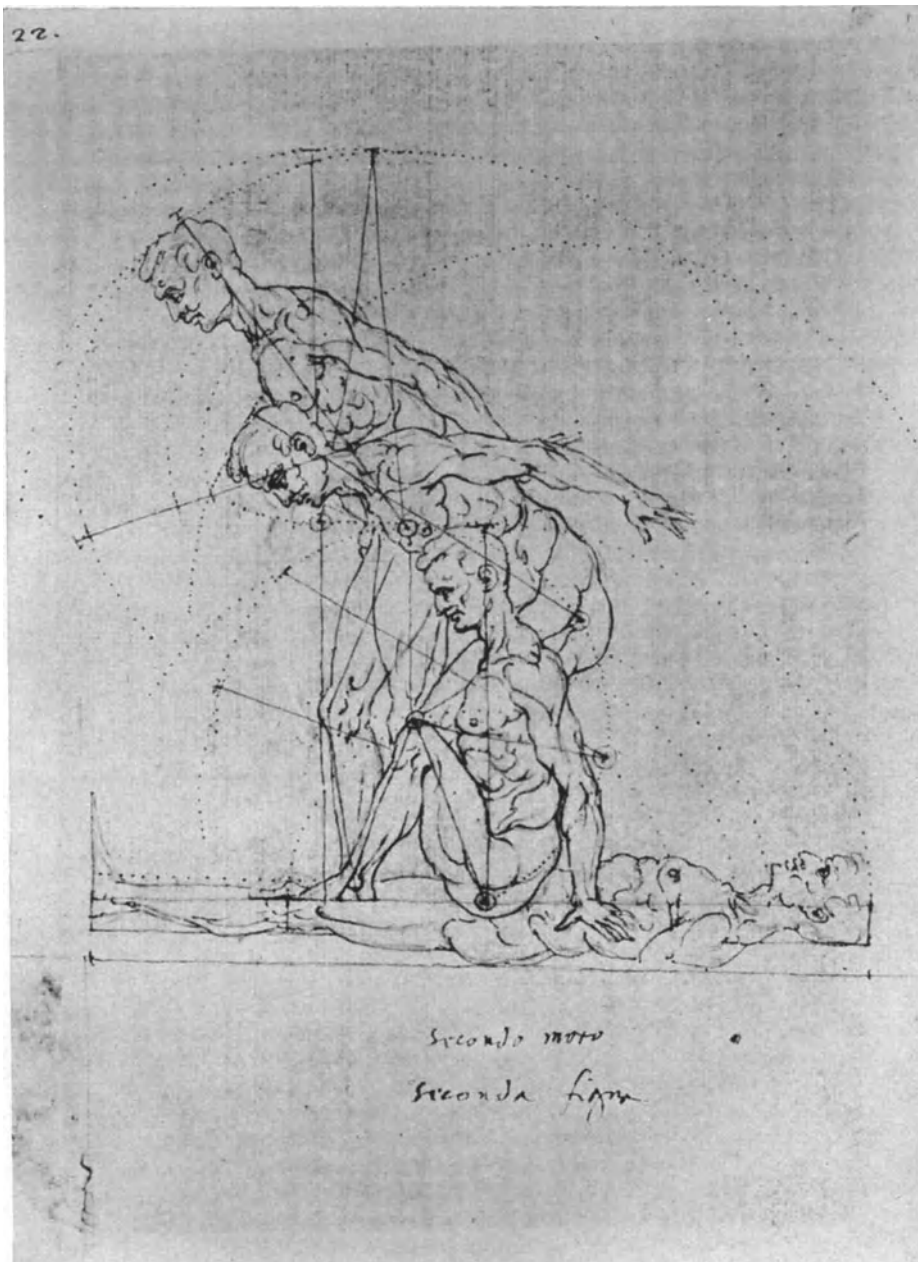


Fig. 15. New York, Pierpont Morgan Library, ms. M.A. 1139 ("Codex Huygens"), fol. 22.  
Analysis of human movement in terms of circles and epicycles

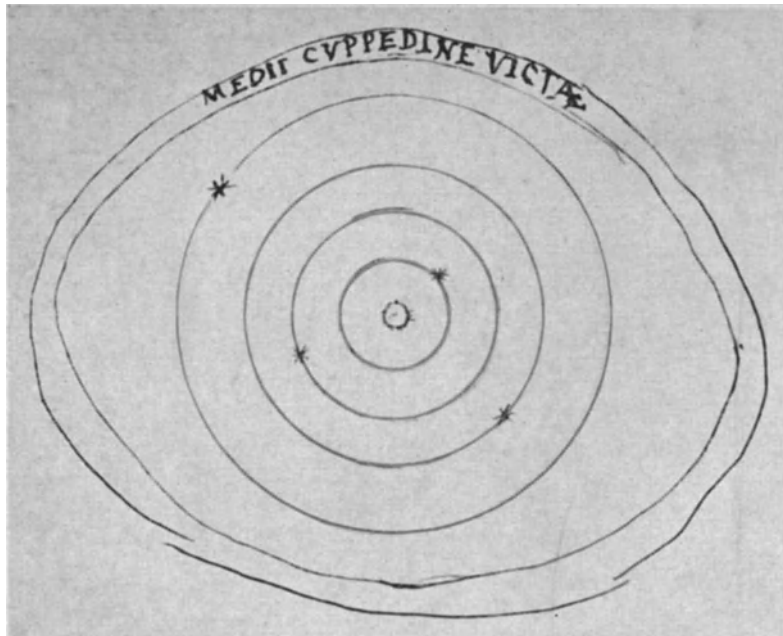


Fig. 16. Impresa of Mons. Giovanni Battista Agucchi. Florence, Biblioteca Nazionale, mss. Gal., Discepoli, Tom. 136, fol. 110