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Academic Principles

Today many art teachers interpret the adjective 'academic' as eclectic, pedantic, or passé. This is understandable, for the original purpose of the academies of Classical and Renaissance times, a search through discussion for the fundamentals of philosophy, mathematics, science, and art, was replaced from the seventeenth to the nineteenth century, as far as art was concerned, by preoccupation with the Ancients.

There are two fairly direct ways to deduce the principles upon which academic art education was based. First, one can read the works of Vitruvius and Alberti, the chief heralds of the Renaissance art academy; second, one can study the lists of professorships in various art academies to learn what teaching was thought necessary. From these it can be deduced that students were directed towards certain principles of symmetry, proportion, anatomy, and perspective. They were also instructed in ancient history since, as Vasari pointed out, 'the invention of history' was essential for a painter. I do not deal with this, as it is hardly a principle, and Professor Quentin Bell has dealt with it very well in his *Schools of Design*.[1]

SYMMETRY AND PROPORTION

The earliest analytical approach to art stemmed from Babylonian and Egyptian investigations into number and geometry, essential to calculations for huge buildings and colossi. 'Exact calculation: the gateway leading to all things,' wrote Ahmes on papyrus (circa 1700–1550 B.C.). Measure preoccupied Egyptian scholars, and since their empirical geometry was mainly a geometry of area and volume, it is not surprising to find its application to their art, which had previously been sensual, instinctive, or imitative. The bases of academic concepts – geometry, measured proportion, and idealized form – pervade Egyptian art, giving it that formal, refined, and balanced appearance, which distinguishes it from the cruder art of Assyria. Scholars of Classical times were aware of these qualities in Egyptian work.

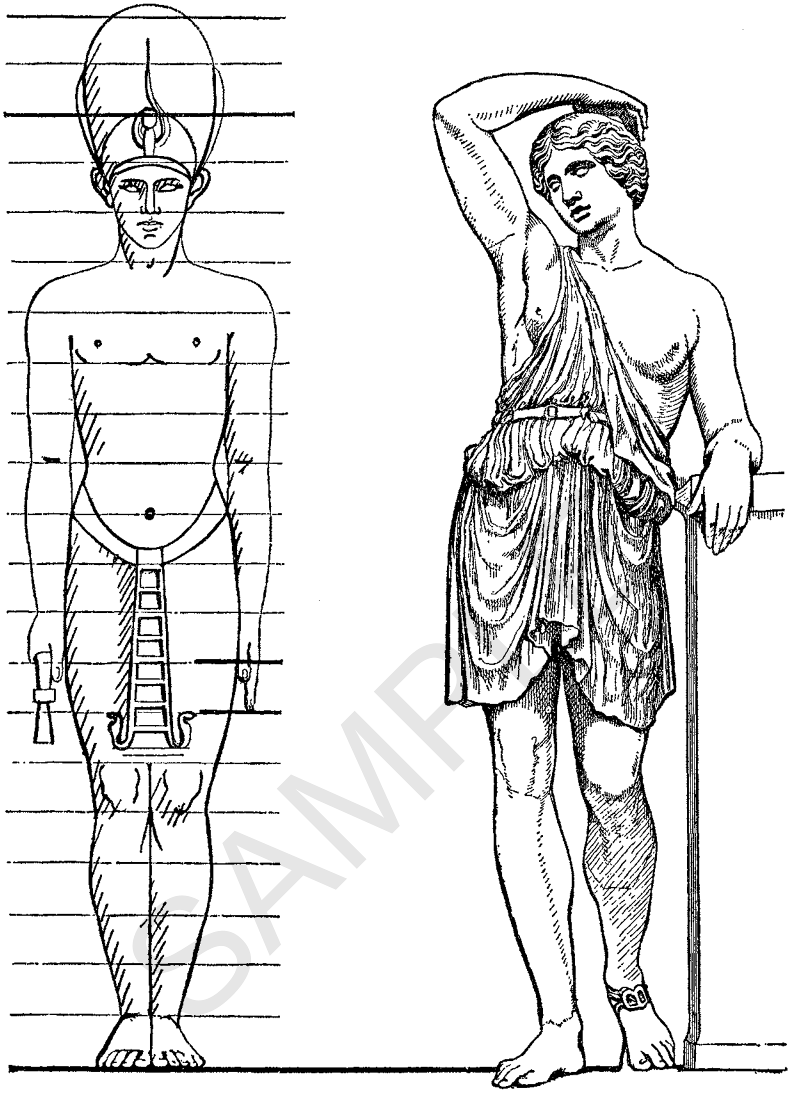
Diodorus Siculus, the Greek historian, travelling in Egypt circa 60–57 B.C., was intrigued enough to calculate the proportions of the ancient sculpture, and concluded that the total height of the sculptures of standing humans could be divided into $21\frac{1}{4}$ parts of equal measure.

The grids which the Egyptians used to square up their paintings and sculpture, and the various points marked upon them, have assisted theoreticians. Karl Lepsius (1810–84), the German Egyptologist, noted that the feet of the figures drawn in an unfinished tomb at Sakkara were measured between points marked in red ochre, and concluded that the foot was the module or basic unit of proportion. Others have given the length of the medius (middle finger) as the module. It is interesting to note that an Egyptian figure engraved in Lepsius' *Choix de Monuments funeraires* is divided into exactly $21\frac{1}{4}$ parts, confirming Diodorus; and that both the height of the foot and the length of the medius are one module.[2] The total height of the figure up to the top of the head-dress was the measure divided, and the proportion of the body often varies slightly because of this, sometimes being 19 modules to the head-band, and sometimes 19 to the top of the head.

The statuary of Egypt conforms to the 'Law of Frontality' rediscovered by K. Lange, who affirmed that 'whatever the pose assumed by the figure, it was subjected to the following rule: The median plane, which may be considered as passing through the top of the head, the nose, the spinal column, the breast bone, the navel, and the genital organs, dividing the body into two symmetrical parts, remains invariable and may not be bent or curved in either direction.'[3] This architectonic canon for statuary applies equally to temples if we take a centre line through the front elevation, or a line running from front to back through the plan; thus both the statuary and architecture demonstrate the Egyptian adherence to the principle of frontal symmetry for over two thousand years. Else Christie Kielland has made a very exhaustive study of the mathematical principles of Egyptian art in *Geometry in Egyptian Art* (1955), and one fact emerges very clearly indeed from the author's researches,[4] that the Egyptians were familiar with the Golden Section.

VITRUVIUS

Fine art in the Ancient World was architectonic, and the only comprehensive authority still extant upon the principles which governed Greek art is Marcus Vitruvius Pollio, a Roman architect of the time of Augustus Caesar. In his *Ten Books on Architecture* Vitruvius gave the 'fundamental principles', which he derived from Greek authors mentioned in his books, as Order, Arrangement, Eurythmy, Symmetry, Propriety and Economy. As Albert Howard noted in his introduction to Professor Morgan's translation, Vitruvius becomes rather involved and is ambiguous at times. His definitions of the first four principles overlap so much as to be practically synonymous, and the fifth, Propriety, is not really a principle but 'that perfection of style which comes when a work is



1 Egyptian Figure, and Amazon of Polykleitos

The Egyptian figure, taken from Lepsius's *Choix de Monuments funeraires*, is divided from the top of the head into nineteen equal parts, the module being the longest finger. The Amazon (Berlin Museum), copied from a bronze by Polykleitos, demonstrates the simple dignity he achieved by balance and proportion.

authoritatively constructed on approved principles'. From the attention given to Symmetry throughout his work, Vitruvius obviously regarded this as the most important principle of the Greek artists. He gives the following definition:

'Symmetry is a proper agreement between the members of the work itself, and relation between the different parts and the whole general scheme, in accordance with a certain part selected as standard'[5] [the module].

In Book III he gives the same definition for Proportion, and then goes on to say that Symmetry is the result of Proportion. It would appear that the simplest logical interpretation of his views is that Symmetry and Propriety, or balance and correct style, which he gives as results, are the product of the application of the principle of proportion.

The advance of Greek art was due to technical rationalization arising from an analytical outlook. 'Man is the measure of all things,' Protagoras had declared, 'of those that are, that they are, and of those that are not, that they are not', and man was considered, not only the chief arbiter and centre of the universe, but its model. The microcosm was the model and measure for the macrocosm. Even the gods were in man's image, so it is not surprising that, when the Greeks sought a system of proportion for both art and architecture, the human body was their basis, and the use of a module resulted. It has long been held that it was Polykleitos of Argos, the Greek sculptor of the fifth century B.C., who solved the problem of relating the natural harmonic proportions of the human figure to arithmetical proportions within a simple geometric framework.

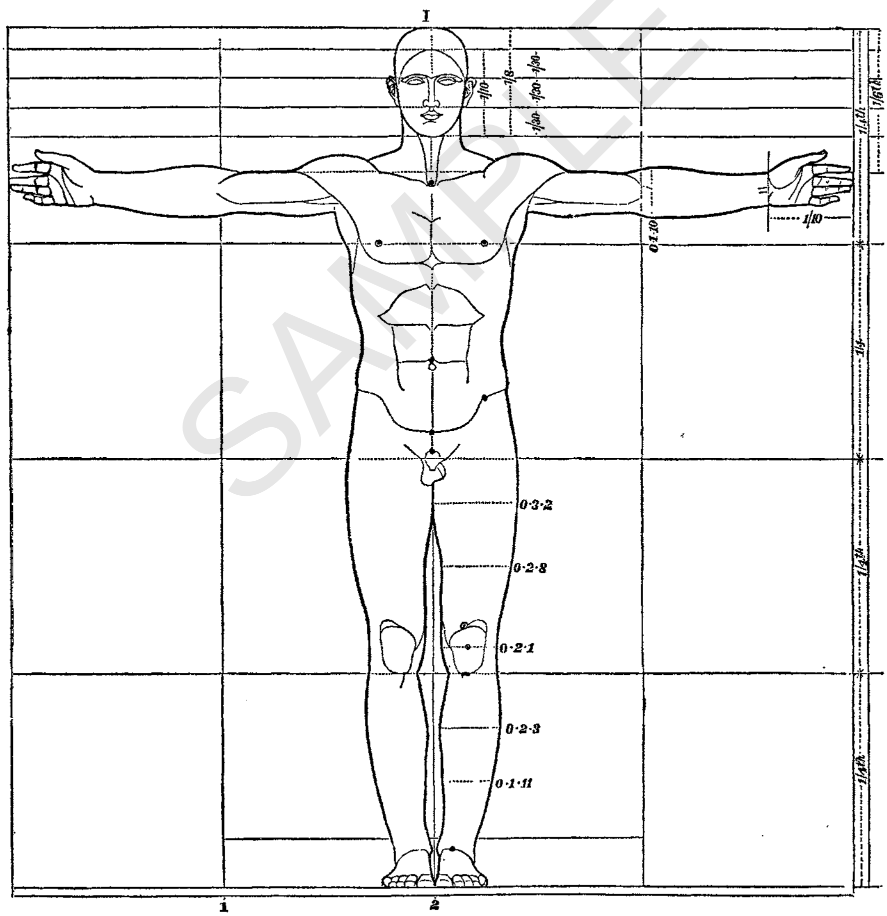
THE CANON OF POLYKLEITOS

> 'The beautiful is not in the elements, but in the harmony of the parts of the body, of finger with finger, and all these with the metacarpus and the carpus [the bones of the hand], and of all these with the cubitus [fore-arm including hand], and of the cubitus with the arms, and of all with all, according as it is written in the Canon of Polykleitos.'

So wrote Galen, the famous Greek physician and anatomist of the second century. Mere fragments of the teachings of Polykleitos have survived, the only authentic sources for the Canon being passages from Vitruvius and Galen, and some extant Roman copies of his statues, especially those of his 'Doryphoros'. This idealized version of an athletic spear-bearer, of which there is a fair copy in the National Museum at Naples, is recognized as an outstanding example of the sculptor's concept of proportion; indeed, it has been dubbed 'the Canon'. Pliny stated that Polykleitos 'also made what the artists have called the Model statue and from which, as from a sort of standard, they study the lineaments'.[6] Aelian related that on one occasion the sculptor produced two statues from the same model, one made according to popular suggestion, the other governed by principles. Polykleitos then displayed both statues. The one based upon his Canon excited great admiration, the other mockery.

The details of human proportion which Vitruvius derived from Greek authors have usually been accepted as constituents of the Canon. Vitruvius gave it piecemeal, the face and the open hand each as one-tenth, the head as one-eighth, head plus neck as one-sixth, head and breast to nipples as one-quarter, and so on; also that the centre point of the circle made by the tips of the extended limbs is the navel. The clearest demonstration of the Canon is to divide a square into sixteen equal squares, as Joseph (Giuseppe) Bonomi did in his *Proportions of the Human Figure* (1872). The cubitus then equals one-quarter of the width or height of the body, and is therefore the basic measure. This scheme shows the arm as a basic measure of the grid (rather than the head as is accepted today), and it conforms to the above statement by Galen, who knew the ancient Canon; thus there seems little doubt that Vitruvius was describing the same scheme.

The diagram from George Redford's *Ancient Sculpture* (1882) is



2 Bonomi's version of the Canon, derived from Vitruvius, as published in George Redford's *Ancient Sculpture* (1882)

Bonomi's version of the Canon, derived from Vitruvius. Vitruvius gave the head as one-eighth and the face as one-tenth of the height, and later theoreticians tended to divide the height by eight or ten. Some Greeks preferred ten divisions, agreeing with Plato that it was the 'perfect number', but others, especially mathematicians, preferred eight divisions, because they considered the 'perfect number' as six, and eight divisions could be arrived at by using six, adding one third of it to give eight. The Greek concept of proportion of the figure was of course applied to architecture, as Vitruvius affirms; the diameter of the column was the basic module, sometimes being one-eighth of its height, sometimes more, according to principles of symmetry established by Hermogenes. It should be realized that the principle of proportion based upon a module was only used as a guide by the Greeks to give a total symmetry, and there were many slight deviations, as in real human bodies; indeed, it is thought that there were two parts to the Canon of Polykleitos, the first part dealing with the principle of proportional relationship as described by Galen and Vitruvius, and the second part dealing with the subtleties of form, which improve symmetry, but cannot be grasped by simple measurement.

The discovery of the Vitruvius manuscripts at St Gall in the fifteenth century provided Renaissance artists and architects with a foundation for research into proportion, a main preoccupation of the first Italian academies. Bramante, Leonardo, Michelangelo and Palladio all owed much to Vitruvius. Giorgio Vasari wrote in 1568:

> 'Seeing that design, the parent of our three arts . . . having its origin in the intellect, draws out from many single things a general judgment, it is like a form or idea of all the objects in nature, most marvellous in what it compasses, for not only in the bodies of men and of animals, but also in plants, in buildings, in sculpture, and in painting, design is cognizant of the proportions of the whole to the parts, and of the parts to each other and to the whole.'[7]

The idea of using parts of the body as a module became a little absurd when the practice grew over-complicated and led to eclecticism in the eighteenth century. Measurements of ancient statuary and live models were made between numerous points, and students were asked to apply a host of calculations. Alberti must bear some responsibility for this because of the complicated system he advocated in *De Statua*. For a more interesting and purely mathematical concept of proportion, we must return to ancient Greece.

PYTHAGORAS

'All things consist of number . . . the elements of numbers are the elements of everything . . . God works everywhere by means of geometry.' These fragments from the teaching of Pythagoras, the great mathematician of the sixth century B.C., demonstrate the Greek desire to order the universe at its most extreme. Three types of proportion were formulated by Pythagoras in accordance with the above principles: the *arithmetic*, the *geometric*, and the *harmonic*. To demonstrate these proportions it is usual to give three quantities, the first and third quantities being considered as *extremes*, to be compared with the central quantity or *mean*. The clearest definitions of the Pythagorean systems are given by Rudolf Wittkower in his *Architectural Principles in the Age of Humanism.*[8]

Arithmetic proportion exists when the first quantity is lesser than the second by the same amount as the third is greater than the second, e.g. 2 : 3 : 4. Geometric proportion exists when the first quantity is to the second as the second is to the third, e.g. 1 : 2 = 2 : 4. Harmonic proportion exists when the difference between each extreme quantity and the mean is the same fraction of each extreme, e.g. 3 : 4 : 6. In this case, the fraction is one-third, since 4 is greater than 3 by one-third of 3, and 6 is greater than 4 by one-third of six. Plato defines harmonic proportion in the *Timaeus*.

Pythagoras discovered that musical intervals are based upon ratios between lengths of string held at the same tension: 2:1 for the octave, 3 : 2 for the fifth, and 4 : 3 for the fourth. This astonishing discovery contributed to the Pythagorean belief that all things consist of number; moreover, it convinced Greek and, later, Renaissance scholars that artistic and musical harmony were analogous. Alberti wrote that 'the numbers by which the agreement of sounds delight our ears, are the very same which please our eyes . . .', and his fellow Italian, Giampolo Lomazzo, asserted that the human body was 'composed of musical harmony'.[9]

Besides basing his concept of the ideal life upon harmony, Plato adopted the twin Pythagorean belief that all things are structured by means of geometry. Pythagoras was credited by Proclus with the discovery of the five regular geometric solids, namely the cube, tetrahedron, octahedron, dodecahedron, and icosahedron; and it was these solids with equal faces, equal sides, and equal angles, which Plato gave in the *Timaeus* as the corpuscles or atoms of the elements.

The quantities in the Pythagorean types of proportion are commensurable using simple arithmetic, but the Greek also discovered incommensurable proportions in geometric figures that could not be expressed in the form of simple additions, fractions, or ratios, such as the relationship between the hypotenuse and the other two sides of an isosceles right-angled triangle. The most pregnant and intriguing proportion is a development of Pythagoras's geometric proportion, namely that created by the Golden Section.