

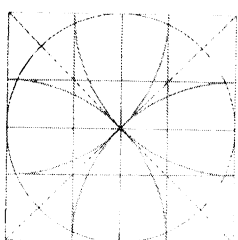
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TONS BRUNES

THE SECRETS OF Ancient Geometry

- AND ITS USE



VOLUME I

RHODOS

INTERNATIONAL SCIENCE PUBLISHERS, COPENHAGEN

1879

Ch 10

Pythagoras ~ and a geometric
analysis of Plato's Timaeus

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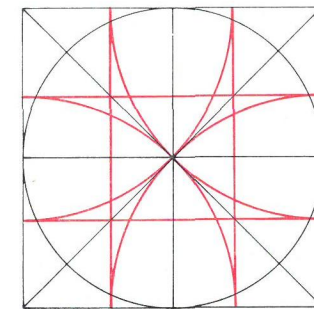
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of 12. The object is to calculate the triangle's height.

We are familiar with all the figures from the previous problem and indeed saw the calculation of a similar exercise in No. 58. We need not therefore go through the motions of working out this problem. It is included merely to illustrate that our suspicions regarding the height/base were well founded.

★

After this lengthy study of a number of well-known ancient Egyptian mathematical problems we can, I think, establish that this diverse material forms a logical unity only when seen from the standpoint of ancient geometry. The certainty with which we have elucidated the mathematical working of these problems is so evident that there can be no doubt concerning the procedure's accuracy.

It would have been impossible with a

doubtful or unfounded system to work out all the examples shown in the preceding pages, to follow closely the intermediate working, and to achieve a correct result.

And of course the system was not something specially invented for Egyptian mathematics. We have seen how the theory behind the Nile mathematics was part (and only part) of a wider subject, i.e. the vast knowledge of geometry that existed in numerous other spheres, too.

The problems are the first known attempts to convert geometry into figures and sums. Hence the initial problems are uncomplicated—as long as we are familiar with the basis on which they are founded.

It must consequently be the case that mathematics sprang from geometry and its many aspects, rather than the reverse.

I regard the problems in *Rhind Mathematical Papyrus* to be proof that this assumption is correct.

CHAPTER TEN

Pythagoras - and a Geometric Analysis of Plato's Timaeus

MOSES' ESCAPE from Egypt at the head of the Jews was discussed in an earlier chapter where we saw how he passed on the geometric aspect of his wisdom through the medium of the building instructions for the Tabernacle. In this way he handed over his knowledge to those among the Israelites whom he found worthy of initiation. It is to be expected that this knowledge spread to a certain extent to countries bordering the land of Midian, finally to reach the temples of Jerusalem where the traditions were adapted to surroundings and incorporated in holy teaching in that city. But we can trace the dissemination of Egyptian tradition as far as our own civilisation through other sources than Moses. For although the Book of Exodus today occupies a place on the book-shelves of many homes as a part of the Book of Life, the key is missing. And the text has retained its hidden significance constantly throughout time.

Egypt for thousands of years remained the inspirational centre for the whole of Africa and Europe, and travellers came from every compass point to soak in the knowledge and wisdom of the Egyptian Temple.

When the time came for these students after years of education to leave the Temple they were obliged to pledge never to enlighten an outsider on the knowledge

they had obtained; and these pledges were impeachable: woe to the foolhardy soul who ventured to profane the sacred knowledge which had over a period of uncountable centuries been hidden from the public eye by veiled frontages and symbolism of the Temple, knowledge which had never before leaked through the shield of concealment. Even an initiate of the lower degrees was banned from obtaining the genuine article too early in his training. It was released little by little as he progressed in his Temple instruction.

Greece is generally looked upon as the birth-place of mathematics and the nation responsible for handing this sphere over to modern civilisations. This is based upon the fact that most surviving written material on the subject of mathematics and geometry is of Greek origin. The tendency—admittedly an inviting one—is therefore to assume that the knowledge passed on by the Greeks in fact sprang into being in that country. Little consideration is given to the material that Grecian mathematicians and philosophers themselves received from yet earlier civilisations.

Greece was perhaps the country that first broke with the age-old esoteric tradition, and partially burst the bonds of secrecy. It was Pythagoras of Samos, after living 34 years in Egypt and Babylon, who returned to Greece and opened the

world's first school (as we today recognise the term) with education in elementary subjects and the philosophy of life.

This school, in the pattern of the Temple, operated a process of admission by which the pupil's courage and ability were put on trial. But as was perhaps only natural admission to the Pythagorean school was not nearly such a strict procedure as a full-blooded temple initiation.

The school had the same tradition of secrecy as the temples, holding all learning within a tight circle of students, but as with the process of admission this essential secrecy too was loosely observed.

Pupils were educated in geometry and counting from the earliest classes, Pythagoras's opinion being that practice in these spheres was the finest training in independent thought, but of course *all* the secrets of ancient geometry were not released to students.

Numerous other aspects of geometry and numbers could be taught and practised, without directly profaning the real Temple learning.

The position is likely to have been that pupils who attended the school for a suitable period of time and who were regarded by Pythagoras as worthy men were at some stage initiated in the genuine arts with ancient geometry (the principle of divinity) as the major subject. But this only for the few who had demonstrated their reliability and had kept lesser secrets to themselves. Moreover the ancient knowledge had been released on exchange for an unbreakable vow of silence.

There was no obligation on the part of pupils to remain at the Pythagorean school for a predetermined length of time, and the large group of students who frequented the lower classes of the school began—once they had gone as far as they could without being accepted for further training by the old Master—to philosophise on their own about the material

now in their possession. And they developed their own theories. In this way a considerable corps of thinkers arose, men with a certain insight into numbers and their handling, men who at the same time realised the significance something called geometric proportion, proportions which the philosopher could develop. This was a completely fresh concept in the cultural development of people devoid of a Temple initiation.

This was how the philosophy of geometric thinking leaked out of the Temple and to a limited degree became public property. Naturally the first flush of secret knowledge sparked off both accurate and erroneous thoughts and theories.

But this independent stream of theorists held the undoubted advantage over the occult that they were free to write about their results. And these written thoughts were hailed by a culture-hungry populace and quickly became widespread, compared with the knowledge of the Temple which was reserved for initiates.

Thus over a certain period two groups developed in Greece, each with its own distinct though related views on geometry. One group was made up of the temples and their brethren, the other of the free thinkers who worked with geometry for its own sake on a numerical basis.

But in fact both groups sprang from the same source: the material handed down to the Greeks by the Egyptians.

This was a period of conflict for mathematics in Greece. It shines through the following piece of dialogue from Plato's *Timaeus* in which Timaeus has launched into his account of the World's creation. As shown earlier, he engages in secret geometry to illustrate his tale:

"The creator's ... purpose ... was, firstly, that it should be as complete a living being as possible, a whole of complete parts, and further, that it should be single and there should be nothing left over out of

which another such whole could come into being, and finally that it should be ageless and free from disease. For he knew that heat and cold and other things that have powerful effects attack a composite body from without, so causing untimely dissolution, and make it decay by bringing disease and old age upon it."

We have here Timaeus's excellent defence of the geometric directions used in the rest of his account.

He states that the world's geometric likeness must be a complete being, consisting of complete parts, namely squares, rectangles and triangles. It should be the only one of its kind since from an esoteric standpoint there could not and must not exist any geometric truth other than the ancient accepted form.

The system was not rendered defective by the faults alleged by outsiders, such as old age (which in this context meant old-fashioned influence) or disease (which here meant inaccuracy).

His final remark indicates the will of the creator in respect of the powerful opposition which will face the ancient system, and it is a point of corroboration that the passage concludes by stating that the system is attacked from the outside, i.e. by the group outwith the Temple. This same outside group would bring, he says, disease and old age to the secret system.

By the word "disease" we normally infer sickness in a human being or animal. The application of the term to an inanimate object or system must infer faults or errors.

The term "old age" on the other hand cannot be applied to something which is brought upon a thing, a system or a human being. Old age is something that time alone can produce.

Reference here to disease and old age obviously indicates that the words are used to disguise other concepts, namely inaccuracy and obsolete systems. The whole of

the last sentence—in my opinion—builds up and supports this theory.

This defence by Timaeus of his geometric views was due probably to the fact that external opposition had become so great that one could no longer tell whether some of his listeners—all of whom were initiated brethren—had in fact lent an ear to the new theories that had begun to penetrate from every direction with increasing force. In some instances the new thoughts attracted initiates and lured them from the ancient system since many had—blindly—acknowledged geometry to be a birthright from the past, based on faith, without becoming familiar with its defence or proof; whereas the emergent group—with no tradition to build upon—were so much more able to illustrate the proof of their theories.

In fact we are in a rather similar situation today with mathematical education. The maths student is loaded with a pile of books full of formulae he is obliged to accept at face value. Only in one or two instances is it possible to test the veracity of the propositions. It is quite another matter that the formulae have been at one time the result of practical tests. The pupil who is told by authority, i.e. his teacher, that such-and-such a formula is the case must accept this and cannot doubt its accuracy. This is the parallel drawn with the secrets of ancient geometry.

The ancient student was also told certain things as fact and was obliged to take them at face value.

The other group, i.e. the group outside the Temple, attacked these statements and propositions fiercely and in their turn were sternly resisted by the brethren of the Temple. This resistance in fact was one of the main factors that brought about the collapse of Pythagoras's school of learning, which was finally abolished from Greece; the Temple eventually

could not tolerate a development which threatened its very foundation.

But the path from a critical murmuring to a victorious overturning of accepted facts is a long one. It is today and it was in ancient days. The Temple had the tremendous advantage of tradition, and encompassed brethren with a splendid gift of speech who lent their able tongues to the defence of established theory. We shall see later how the temples fought continuously and stubbornly to maintain their own points of view in the face of outside developments. We shall also be able to trace the ancient traditions up to the Middle Ages, when the system of ancient geometry eventually dies out.

Possibly the greatest sage of them all and the man who conveyed Egyptian wisdom to Greece was Pythagoras of Samos. His renown is partly due to his immense personality the effects of which are felt even in modern times, and his Pythagorean style of school spread after his death all over Europe, promoted by his pupils and his pupils' pupils.

Pythagoras

THE PYTHAGORAS story makes interesting reading. The precise date of his birth is cloudy but generally reckoned to be somewhere between 600 and 570 B.C. His place of birth, Samos, was one of the most flourishing islands in the Ionian group, just off the coast of present-day Turkey. His father was a rich merchant according to some accounts, and a maker of seals according to other sources.

A handsome lad even from early boyhood, Pythagoras proved to have an extra-

But part of Pythagoras's fame is also accountable to the fact that he was in the vanguard of Grecian mathematical philosophers.

The following list illustrates how the great majority of these philosophers came after the Pythagorean era. The dates are as accurate as history permits.

Pythagoras of Samos	600	B.C.
Theodorus of Cyrene	570	B.C.
Protagoras of Abdera	485-411	B.C.
Hippocrates of Cos	470-400	B.C.
Socrates of Athens	469-399	B.C.
Archytas of Tarentum	430-365	B.C.
Plato of Athens	428-347	B.C.
Eudoxus of Cnidus	409-356	B.C.
Aristotle of Stagira	384-322	B.C.
Euclid of Alexandria	323-285	B.C.
Archimedes of Syracuse ...	287-212	B.C.

We see from this chronological list that Pythagoras had been dead for well over 200 years by the time Euclid wrote *The Elements of Geometry*, regarded today as one of the foundation works of Greek mathematics.

ordinary intelligence and to possess a sense of justice and power of judgment far in advance of his years.

During his youth he frequented the schools of learning run by the Ionian temples and his mentors included, among the finest brains of his era, Pherecydes of Syros and Thales of Miletus (one of the Seven Sages).

But his urgent passion for knowledge was insatiable, and as a scholar of 20 he sought the assistance of the Ionian tyrant

king, Polycrates, whose friend and martial ally at that time was the Egyptian king, Amasis. It was through the Egyptian ruler that Pythagoras made contact with the Temple of Memphis and after considerable difficulty the young Samian was admitted to the Temple as a junior brother.

Many years were to pass and innumerable tests and stiff trials to be undergone before he achieved the knowledge dispensed to higher degrees of the Order, but behind his seemingly gentle exterior Pythagoras hid a stubborn and invincible will-power. It saw him through. After the customary 22 years of learning he began turning his thoughts once more in the direction of Samos and Greece.

But war was to delay his return. Cambyses III, warrior son of Cyrus the Great (who had conquered and mastered Media, Persia and Babylonia and founded the Persian Empire), in the battling tradition of his father fell upon the giant kingdom of Egypt. In 527 B.C. this commercial and intellectual giant of the Ancient World, whose influence stretched to all the Mediterranean countries from Phoenicia over Greece to Etruria, submitted to the conqueror.

Pythagoras witnessed the invasion and the terrible aftermath. He saw the temples of Memphis and Thebes burn to the ground. He saw the Pharaoh and his family as well as a horde of young courtiers dragged to the scaffold and executed. He saw the same treatment meted out to some of his fellow students and temple teachers. His education was complete. He had seen Man at the pinnacle of culture—now he watched him at the depths of barbarity.

Pythagoras himself was one of the lucky ones. He was clamped in irons and taken to Babylon as a prisoner of the Persian master.

Cambyses, despite his bestiality, recognised the source of power and strength of his fallen foe: a vigorous army of

priests, steeped in tradition and knowledge. This was an excellent opportunity to take a collection of these Egyptian priests back with him to Babylon to inspire his own religious leaders and perhaps to give them the benefit of Egyptian teaching.

The modern equivalent would be to seize machinery, drawings, plans, patents. But in ancient days there was only one course: to carry away the actual people responsible for teaching or planning. For the sacred symbols of the Egyptians were worthless to an outsider without the advice of a handful of men who knew their meaning.

To a certain extent we have an even closer parallel today. In working with new sciences such as atomic power it is essential for major countries to obtain for themselves a human source of inspiration by one means or the other since the mathematical symbols applied in this science retain their secrets unless someone can provide the key.

Pythagoras was well received by the Babylonian priesthood, who harboured a deep respect for their Egyptian brethren, and his life changed from that of a prisoner to that of a relatively free man. He was free to wander within the confines of the Temple and, while teaching and revealing as much or as little as he thought necessary, he soaked up knowledge from the sources around him.

Babylonia presented a mixed appearance to the world. It had been governed by a succession of tyrants and had held victorious campaigns against Chaldea, Assyria, Persia, Judea, Syria and Asia Minor. Captured priests and temple brethren had been transferred from these countries to Babylon.

Excavations at ancient Babylon indicate that the city occupied an area roughly four times the size of present-day London. This monster-city, inhabited by a myriad

of nationalities, housed just about every religious system in existence.

Pythagoras seized the opportunity to study all of these religious orders and to delve as deeply as permitted into their mysteries. His superior intellect ensured that he drained every available benefit from his experience.

For twelve years he lived in Babylon, years of partial imprisonment and semi-freedom. Finally help came from an unexpected and welcome quarter. Democedes of Crotona, himself captured by the Babylonians in 522 B.C. during one of their conquests in the North and now Royal Physician at Babylon, put in a word for Pythagoras whom he had befriended. His release was granted. And after an absence of 34 years Pythagoras returned to his native Samos.

To his dismay he found all the island temples closed and their inmates fled. The Babylonians had here, too, been on the warpath and now controlled the Aegean.

But his grief was coloured with pleasure when he found Phartenis, his mother, had survived the years of tyranny and welcomed him back to Samos as the island's intellectual saviour. Her son, she had been certain all along, would lift the burden of oppression from the weary Samians.

But not wishing to entangle himself once more with the Babylonian conquerors, Pythagoras himself fled to Greece, bringing his mother with him. And it was in Greece that he was to further his knowledge of mathematics and apply it to philosophy.

Pythagoras's presence in Greece and his immensely rich knowledge derived from his years of foreign travel gave the Mystery Temples of that country a tremendous stimulus. Within a short time of his arrival he had set up a school and begun the teaching of knowledge originated in Egypt, Babylon and other areas he had visited. Alas, no document of any kind

has survived or been heard of in Pythagoras's own hand. Everything we know of him and his teaching was recorded by his disciples and students. This fact fits in well with the picture we form of Pythagoras: an astute man of honour, bound to silence by initiation and an unbreakable vow.

He in his turn demanded a pledge of silence from his pupils and followers but as the selective process of pupils was not as strict and enduring as his own temple initiation, and since to a certain extent the ritual background was lacking at his school, and furthermore since he had no qualified assistants who had faced the same temple training as he himself had, the vows of his pupils were not absolute. A large part of his practical teaching became public property and the subject of discussion with all and sundry.

On his death his school was carried on and spread throughout Europe, branches were set up by his pupils. And at these offshoot centres of learning the vow of secrecy was perhaps maintained to an even lesser degree than previously. The secrecy depended more and more on moral responsibility than the fear of punishment. But we frequently see instances where secrecy was upheld despite the outbursts of individual students, and how the information released by the latter was not always accepted on face value by outsiders.

There is a modern parallel in the lodges of secret societies, whether Knights Templars, Freemasons or other orders, or in guilds and corporations of tradesmen and craftsmen.

Although many books are available to outside parties on these societies, it is not possible to appreciate fully the ritualistic aspect for the vital key is invariably missing and without it the ritual proceedings remain incomprehensible and mysterious.

We have established by research and excavation that the great majority of sources

of written mathematics originate after the Pythagoras era in Greek mathematical speculation, but this is insufficient reason to assume that mathematics did not exist in Greece before Pythagoras.

It has been quite firmly established that prior to this period mathematical or geometric knowledge was the province of a select few within the mystery temples of Greece, but not until Pythagoras opened his school did this geometric system and thought burst upon larger sections of the public—who for many years were bound by their vows to a form of secrecy. But the Pythagoras school was not, after all, a despotic mystery temple. It attracted mainly the young and, of course, one of Pythagoras's grand ideals was to spread wisdom and knowledge (on a basis of responsibility) to the people at large. In this way, he reasoned, Greece would be preserved from the fate of sinking into a morass of ignorance and total eclipse. It was with this in mind that he called his mystery society a school and not a temple of Isis or Osiris dedicated to a central god.

Many of the finest, questing brains in Greece assembled at Pythagoras's school and although it was not a large institution it carried tremendous influence and indeed had the support of the State. But gradually, as the school grew in proportion and authority and Pythagorean pupils occupied an increasing number of influential posts in society, a fear grew in administrative circles that this upstart and his young followers would seize the very power of the executive. Consequently an active resistance to Pythagoras and his teachings arose, urged on by the envy and bitterness of orthodox temple society.

Pythagoras was not in effect a mathematician. He was certainly a brilliant geometrician but this subject formed only a minor part of his teaching and knowledge.

He also educated his disciples in the natural sciences, astronomy and the philosophy of life.

A youth or man had to possess special abilities before being admitted to his school. It was hopeless to try without these.

Anyone could apply for membership and be admitted for a trial period during which they had to undergo and pass a series of tests. They were kept under strict observation and at the end of this period were either given assent or turned away as unsuitable.

This procedure was maintained strictly. A youth's social or financial background played no part in Pythagoras's decision. And it was particularly among the sons and parents of the upper classes that the philosopher made his enemies when, after the trial period, a rich young candidate was rejected.

Pythagoras in his legacy left the world several clear mathematical formulae which even in our time find regular expression. For example, the best-known Pythagorean theorem $a^2 + b^2 = c^2$ in which he proved that in any right-angled triangle the square on the hypotenuse is equal to the sum of the squares on the other two sides.

Another geometric factor, less well-known, which is thought attributable to Pythagoreans is a type of recognition sign, a characteristic of their society, namely the five-pointed star or pentacle, drawn as a signature and indeed used generally as a



Fig. 165.

form of symbol in the same manner, for example, as Freemasons use the square and compasses. The five-pointed star was drawn as a flowing figure in Fig. 165.

The star can be drawn as a shape without the pen having to leave the paper. Naturally a star drawn free hand in this way cannot be uniform, but later theorists have assumed that the original symbol was the five-pointed star or pentacle which could be drawn inside a uniform five-sided or pentagon shape.

Euclid, for example, who lived two or three hundred years after Pythagoras spent considerable time and thought on this geometric shape. He wrote often of the relation of a given circle to an equilateral, equiangular pentagon.

He describes this problem on no less than six occasions in his writings:

Book IV, Propositions 11, 12, 13, 14 and 16.

Book IX, a recapitulation of the foregoing.

This phenomenon, that Euclid speculated and gave instructions on how to construct a pentagon both outside and inside a circle, is no proof whatever that the Pythagorean pentacle was uniform in shape. Since, as far as I can establish, no information has ever been forthcoming to confirm that it was indeed uniform, it is equally logical to assume the contrary—especially if an irregular star may have contained a symbolic significance for the Pythagorean group.

In reality the five-pointed star has no characteristics outstandingly superior to, for example, the six or eight-pointed version. And the fact that its construction has presented more difficulty to geometers than its more or less sided associates is no real reason for its being recorded as something special. Euclid's attention to the pentagon/pentacle and his philosophising upon this problem must on the other hand indicate that the five-pointed star reigned as a symbol in geometric circles. But Euclid himself was no Pythagorean, and scarcely familiar in fact with the run-of-the-mill schools of mystery—

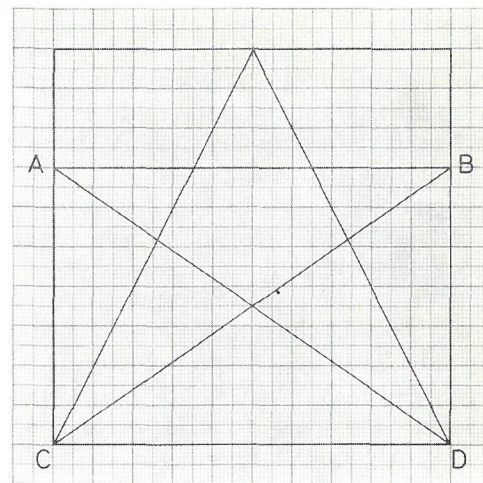


Fig. 166.

but we shall touch on this later. Suffice at this stage to say that he had no knowledge of esoteric mathematics, and spent much time therefore in trying to ascertain why the pentagon or five-sided plane figure was so special and why it was significant to mathematics. These speculations produced a number of constructions of the pentagon, without Euclid discovering the meaning of the five-pointed star as a symbol.

Fig. 166 suggests why indeed it was the pentacle and not the pentagon that was important.

The Pythagorean pentacle was not an equiangular, uniform figure. Symbolically it demonstrated the shape (significant to ancient geometry) of the division of the square by the acute-angled triangle and the placing of the sacred cut, and thus the halving of the square.

Line AB indicates the sacred cut in the main square which, as we see, is divided up by the acute-angled triangle.

The diagonal cross AD-BC has no geometric significance apart from the fact that these two lines connect the remaining lines in the diagram and thus create the symbolic five-pointed, irregular star.

This particular construction places the pentacle in the richly symbolic world of the initiate since it illustrates factors so familiar to him in the sphere of ancient geometry. Non-initiates on the other hand see nothing of this. Euclid's fruitless search for the importance of the pentagon, in my opinion, shows this to the full; similarly I believe that it proves that Euclid was not an initiate in the secrets of ancient geometry. For although mathematics had become a subject for public discussion, this applied only to certain aspects. The once mystic subject of numbers and counting

had progressed so rapidly in open talk that any nimble mind could juggle with figures and sizes independent of any form of training, but the genuine wisdom of ancient mathematics remained within the Temple and within the mystery societies. It was never released to the public gaze. Not even by Pythagoras.

Pythagoras was undoubtedly a major source of inspiration, an intellectual master, who founded his school with the planning of a genius, giving it through his massive personality strength to survive the difficult times that followed his death.

Plato

ONE OF Pythagoras's supporters was later to be Plato, the most prolific of Greek philosophic writers. Plato was the son of a wealthy aristocratic Athenian and was born about 80 years after the death of Pythagoras. He spent his youth among the upper classes of Athens and received an excellent contemporary education. As a youth he had already begun writing poetry and tragedies, and by the age of 21 had submitted several works to the state theatre of Athens.

At about this point he heard several speeches by Socrates. The fearless utterances of this great philosopher so profoundly impressed the young Plato that he deserted his career as a writer to follow Socrates. During the last three years of the latter's life Plato was one of his most faithful disciples, and even as Socrates awaited execution for heresy and sedition Plato listened to the words of the doomed man in his cell.

Depressed by this unjust treatment of

his friend and teacher, Plato later sought out and joined the various Pythagorean societies which maintained an occult existence in the face of public disapproval. He journeyed out to similar Pythagorean groups in Asia Minor, India and elsewhere. He, too, included Egypt in his travels and was initiated in the lower degrees of learning in Egyptian temples—which were slowly regaining the ground lost by their almost total disbandment by the Babylonian-Persian conquerors more than a hundred years earlier.

On his return to Athens, Plato established his own school of learning, naming it the Academy in full recognition of Pythagoras's place as the supreme initiate and the greatest personality Greece had ever seen. Still very much a rich man, Plato spent huge sums buying up as many of the documents and writings directly connected with Pythagoras as he could lay his hands upon.

His initiation forbade Plato from writ-

ing in direct language of many things, but since from an early age he had been well practised in the art of writing (and considerably better than most) he was particularly adept at flirting publicly with a subject—without, however, actually revealing anything of consequence. In Chapter Four we saw how part of a Plato dialogue indicates how to construct the sacred cut, without revealing it to other than initiates.

That text has since been read by millions without apparently anyone previously having tumbled to its genuine significance. Yet another proof of his genius as a writer.

He was not as highly initiated as his ideal, Pythagoras, nor was his knowledge—naturally—as extensive, but much of his colossal importance to later scholars lies in the fact that he wrote more than any other of his contemporaries, and has presented us with a rich intellectual feast. But to gain most benefit from that fruit we need some kind of secret code or key to unlock the orchard door. Without the Open Sesame his screed of print remains just that, pages and pages of profound, well-written nonsense! Attributable more to Plato the writer than Plato the philosopher.

In Chapter Four we analysed an extract from Plato's *Timaeus* and saw how, illustrated by the symbols of esoteric geometry, this passage emerges clearly from obscurity and alters character so radically that what previously was considered illogical style and rather incomprehensible verbiage now assumes definite shape. In fact the text never entertains the possibility of mathematical speculation; this belongs to a later period of time and was thus missing from the text right from the start.

I intend now to spotlight yet another passage from the same book, or more correctly a continuation of the same passage.

In its entirety this section of *Timaeus* reads:

"The construction of the world used up the whole of each of these four elements. For the creator constructed it of all the fire and water and air and earth available, leaving over no part or property of any of them, his purpose being, firstly, that it should be as complete a living being as possible, a whole of complete parts, and further, that it should be single and there should be nothing left over out of which another such whole could come into being, and finally that it should be ageless and free from disease. For he knew that heat and cold and other things that have powerful effects attack a composite body from without, so causing untimely dissolution, and make it decay by bringing disease and old age upon it. On this account and for this reason he made this world a single complete whole, consisting of parts that are wholes, and subject neither to age nor to disease. The shape he gave it was suitable to its nature. A suitable shape for a living being that was to contain within itself all living beings would be a figure that contains all possible figures within itself. Therefore he turned it into a rounded spherical shape, with the extremes equidistant in all directions from the centre, a figure that has the greatest degree of completeness and uniformity, as he judged uniformity to be incalculably superior to its opposite. And he gave it a perfectly smooth external finish all round, for many reasons. For it had no need of eyes, as there remained nothing visible outside it, nor of hearing, as there remained nothing audible; there was no surrounding air which it needed to breathe in, nor was it in need of any organ by which to take food into itself and discharge it later after digestion. Nothing was taken from it or added to it, for there was nothing that could be; for it was designed to supply its own nourishment from

its own decay and to comprise and cause all processes, as its creator thought that it was better for it to be self-sufficient than dependent on anything else. He did not think there was any purpose in providing it with hands as it had no need to grasp anything or defend itself, nor with feet or any other means of support. For of the seven physical motions he allotted to it the one which most properly belongs to intelligence and reason, and made it move with a uniform circular motion on the same spot; any deviation into movement of the other six kinds he entirely precluded. And because for its revolution it needed no feet he created it without feet or legs.

"This was the plan of the external god when he gave to the god about to come into existence a smooth and unbroken surface, equidistant in every direction from the centre, and made it a physical body whole and complete, whose components were also complete physical bodies. And he put soul in the centre and diffused it through the whole and enclosed the body in it. So he established a single spherical universe in circular motion, alone but because of its excellence needing no company other than itself, and satisfied to be its own acquaintance and friend. His creation, then, for all these reasons, was a blessed god.

"God did not of course contrive the soul later than the body, as it has appeared in the narrative we are giving; for when he put them together he would never have allowed the older to be controlled by the younger. Our narrative is bound to reflect much of our own contingent and accidental state. But god created the soul before the body and gave it precedence both in time and value, and made it the dominating and controlling partner. And he composed it in the following way and out of the following constituents. From the indivisible, eternally unchanging Existence

and the divisible, changing Existence of the physical world he mixed a third kind of Existence intermediate between them: again with the Same and the Different he made, in the same way, compounds intermediate between their indivisible element and their physical and divisible element: and taking these three components he mixed them into single unity, forcing the Different, which was by nature allergic to mixture, into union with the Same, and mixing both with Existence. Having thus made a single whole of these three, he went on to make appropriate subdivisions, each containing a mixture of Same and Different and Existence. He began the division as follows. He first marked off a section of the whole, and then another twice the size of the first; next a third, half as much again as the second and three times the first, a fourth twice the size of the second, a fifth three times the third, a sixth eight times the first, a seventh twenty-seven times the first. Next he filled in the double and treble intervals by cutting off further sections and inserting them in the gaps, so that there were two mean terms in each interval, one exceeding one extreme and being exceeded by the other by the same fraction of the extremes, the other exceeding and being exceeded by the same numerical amount. These links produced intervals of $\frac{3}{2}$ and $\frac{4}{3}$ and $\frac{9}{8}$ within the previous intervals, and he went on to fill all intervals of $\frac{4}{3}$ with the interval $\frac{9}{8}$; this left, as a remainder in each, an interval whose terms bore the numerical ratio of 256 to 243. And at that stage the mixture from which these sections were being cut was all used up.

"He then took the whole fabric and cut it down the middle into two strips, which he placed crosswise at their middle points to form a shape like the letter X; he then bent the ends round in a circle and fastened them to each other opposite the point

at which the strips crossed, to make two circles, one inner and one outer. And he endowed them with uniform motion in the same place, and named the movement of the outer circle after the nature of the Same, of the inner after the nature of the Different. The circle of the Same he caused to revolve from left to right, and the circle of the Different from right to left on an axis inclined to it as the side of a rectangle to its diagonal; and made the master revolution that of the Same. For he left the circle of the Same whole and undivided, but slit the inner circle six times to make seven unequal circles, whose intervals were double or triple, three of each; and he made these circles revolve in contrary senses relative to each other, three of them at a similar speed, and four at speeds different from each other and from that of the first three but related proportionately."

The passage continues with philosophic reflections on the coming into being of the universe, but we have taken a sufficiently large section of the quotation to provide us with the information we require from the standpoint of ancient geometry.

At first sight the text is rather confused and incoherent, with apparently little hope of fusion. Much has at various times been written about this particular quotation, the critics in their turn selecting one or two pieces for discussion—and regarding such excerpts as complete in themselves.

One of the more typical reviews has been written by the Dane, Professor Carsten Høegh. In a footnote to his book Høegh puts forward the theory that since one or two of the figures mentioned by Plato in his text fit the modern musical scale, and since the word "interval" is used, the indication is that this passage deals with training in harmony.

But he completes his comment on this chapter:

"To conclude I should like to emphasise that this has merely been an elementary introduction to this remarkable text and its structure, and that a number of the explanations and translations must be regarded as purely hypothetical. It should be borne in mind that it is quite impossible to translate this text or to review its underlying theme without continually having to choose between several feasible solutions, and many of the more puzzling aspects must at present be left unanswered. On certain points one is inclined to believe that Plato in this text has set out side by side explanations which cannot and must not be conjoined, and there are details, too, in the illustrative language to which ought not to be attributed any genuine philosophic meaning.

"It is, however, worth noting that in recent years researchers have been successful in uncovering a profound significance in details of the structure which were earlier regarded as strictly "mystical" and irrelevant to philosophy. But of one thing let there be no doubt: even the most penetrating and comprehending interpretation will never succeed in plumbing the full depth and clarity of thought mulled by Plato as he reflected on problems the understanding of which he has illustrated or hinted at in this peculiar piece of dialogue."

We see then that there is fairly general agreement on the incomprehensibility of this passage. No writing, no literature has ever come to light to explain it in its entirety.

We cannot on the other hand ignore the fact that Plato was an intelligent and inspired philosopher, teacher and writer. It would therefore be quite incompatible with the man's make-up that he would jot down—in a work such as *Timaeus*—thoughts which could not find expression in a subsequent readership, especially since the material was written down for others

to read. If one considers for a moment that others (albeit an intimate circle of readers) are meant to understand the subject matter, it must be agreed that at least a small number of those readers found the subject intelligible. And if Plato's followers and associates, with less intelligence than he himself for he was an undoubted leader, could understand his writings then it is perhaps logical to assume that men of lesser intellectual stature than Plato might be able to interpret the meaning correctly.

This again would mean that the material under discussion is not the sole property and was not originated by an individual no matter how intelligent; otherwise its significance would be lost to others. I believe therefore success with this text depends on the viewpoint from which the reader regards it.

We saw from the previous quotation how Plato, in preparing for the dialogue, employed a figurative language to illustrate his picture of the world, the picture so formed being his symbol of the world's image and geometric appreciation being essential to an understanding of the picture and thus of the story.

We for our part must realise that Plato is in the position of describing a picture of the world or a story of creation which is both exoteric and esoteric: the former because the story is in itself no secret, the latter because the theories regarding the manner applied by god in his work were secret.

In order to explain to his initiate brethren how god had performed his task of creation, Plato was obliged to resort to geometry and numbers since the story of creation was from ancient times built upon this sacred teaching, the teaching that everything divine resulted from geometry and its associate, numbers.

Had he been an ordinary Greek-in-the-street who knew the story of creation, a

simple man boasting no connections with mystery societies, devoid of a Pythagorean initiation, Plato could have come straight to the point and talked openly of geometric proportion. He need not have shrouded his theories in intricate verbal disguise. But he was not an ordinary person. Plato was bound by his pledge of silence, a vow given at his admittance to the circle of brethren and reaffirmed, renewed and strengthened with each successive degree of initiation received. As a man of honour Plato could not and would not breach his pledge. Plato thus found himself in the tricky situation of wishing to write of geometric shapes without mentioning them by name or directly mentioning any of their features.

This was a tremendously demanding task. It required a description of the *symbols' symbols*. As an indication of the intricacy involved, the reader should try to describe, for example, a square—without mentioning the word "square" or "quadrangle" or referring to a four-sided plane figure. When these words and phrases are banned the problem immediately becomes acute, and how much more difficult would it have been for Plato in like fashion to describe a complete diagram such as that for the circle's rectangle. One might well imagine it impossible. And yet I believe that Plato has succeeded with this dialogue. I shall demonstrate in the following pages how the text can be read and interpreted to produce—quite clearly—a comprehensible unity. We quoted the complete piece of dialogue in order to show the relevant portions in their proper context, but many of the details naturally concern only the story and will be ignored in the following analysis.

I shall be content with selecting only those portions I consider to harbour direct reference to the geometric analysis. The various sentences have been taken in consecutive order from the quotation.

We begin:

"The construction of the world used up the whole of each of these four elements. For the creator constructed it of all the fire and water and air and earth available, leaving over no part or property of any of them."

We see here that Plato states the construction of the world to have required four things. We read in Chapter Four in our analysis of the first part of this quotation how Plato used air, fire, water and earth to represent certain pre-determined geometric figures. Here again he refers to the same shapes and his listeners or readers know without further prompting to which shapes he relates.

I shall not at this stage recapitulate the shapes intended since Plato goes into this in more detail later. Suffice to say that to his listeners mention either of the shapes or of the equivalent elements would be synonymous.

"Therefore he turned it into a round-ed spherical shape, with the extremes equidistant in all directions from the centre."

This is clear indication of a sphere, and we may subsequently be surprised to find Plato deserting the sphere as such and describing the circle and its features. This must have been due to the fact that either he and his contemporaries were unable to calculate with a sphere, or the subject proved to be outwith the range of his listeners. He was thus obliged to lower his dialogue to a level that could be understood. In his earlier text, too, Plato writes of cubes and squares and analogises between them, cubes merely being mentioned while the actual geometric analysis is completed with plane figures.

"For of the seven physical motions he allotted to it the one which most properly belongs to intelligence and reason, and made it move with a uniform circular motion on the same spot; any de-

viation into movement of the other six kinds he entirely precluded."

This reveals seven main motions, six of which are rejected, leaving the circular motion. The other six motions were up and down, forwards and backwards, right and left.

It is typical that the motions should be numbered seven. If one considers every kind of movement, of course, there is an infinite number of variations of the circular, from horizontal rotation to vertical rotation with numerous angles through the 90°. And there are right and left rotation on the same spot.

There is also an endless variety of movements on the vertical and horizontal planes (i.e. up-down-right and left-forward-backward) but in spite of this only seven are detailed. Obviously Plato and other philosophers were aware of the fact that other motions existed but in their choice between an infinite number and very few they selected—true to ancient tradition—the sacred figure seven.

After another piece of text in which he describes how the sphere was given a smooth and unbroken surface, Plato turns to the real point in his story, namely the geometric explanation, stating:

"And he composed it in the following way and out of the following constituents. From the indivisible, eternally unchanging Existence and the divisible, changing Existence of the physical world he mixed a third kind of Existence intermediate between them."

He says here that—for the time being—three components were required, the indivisible, the divisible and a third type formed from a mixture of the two.

We may be a little confused about Plato's use of the word "existence". It is possible that the original Greek has a somewhat more closely defined significance, but reflection shows that it is difficult to find another word to express bet-

ter Plato's intention. If we draw a square, then it *exists* in reality. This is the existence to which is referred here.

Plato begins with the indivisible and eternally unchanging, and if we were to choose from among the familiar geometric shapes one to fit this description, it would have to be the circle.

In mentioning the circle first, Plato is merely following ancient ritual since the entire geometric system had built upon the circle.

Reference to the circle as the indivisible is related to the contrary features between this shape and others of straight lines.

Plato actually mentions at a later stage that "all rectilinear surfaces are composed of triangles".

This illustrates the recognition of triangulation as late as the period of Greek speculation and shows that it was still a major subject for theory.

The circle cannot be split accurately into triangles, squares or other units. If a square is divided laterally we obtain two rectangles, but a circle divided similarly produces merely two part-circles. Any other division of the circle produces the same result.

A square divided from corner to corner is composed of two triangles, but the "same" line through a circle produces two half circles.

These factors are obvious and natural when one thinks of them, but must be emphasised in order to illustrate why the circle is termed the indivisible.

The other shape to which he refers is the divisible Existence "of the physical world".

This is a reference to the circle's opposite number, the square.

The definition of the square as the physically divisible is due to the division, so familiar to geometric brethren, of the square into its half size, the rectangle, the acute-angled triangle, etc. And of course

the square can be split into a myriad of small triangles or squares.

When Plato had combined these two shapes, the Indivisible Circle and the Divisible Square, he formed another type of Existence, a mixture of the two. In other words, a new geometric area or shape in which both shared. We see this in *Fig. 167* in which we have the circle and, outside it, the square.

The third version of Existence was the acute-angled triangle, seen as ABC. And we have here the symbol in ancient geometry which we have called "O".

We can see how the lines of this triangle intersect the circumference of the circle at D and E, thus providing a triangle which in area is a mixture of the square and the circle.

Plato then continues his instructions:

"Again with the Same and the Different he made, in the same way, compounds intermediate between their indivisible element and their physical and divisible element."

Here, "the Same" can be interpreted as the thing we have just made, i.e. the triangle, and when he refers to the Different I think it can mean only one thing: that the triangle is placed within the diagram in a different manner from the first triangle.

We see this in *Fig. 168* in which we have placed the triangle in familiar fashion, i.e. turned through 180° in relation to the first triangle. We have here the "same" and the "different", or rather the same triangle but yet different, FGH. This construction is the same as the symbol we have called "P" (in *Fig. 74*).

Plato's dialogue on the Same and the Different is in fact not so obscure or strange as one at first supposes, even out of context. Another example may illustrate the point more vividly.

If in one hand you hold *one* variety of apple and in the other hand you take an-

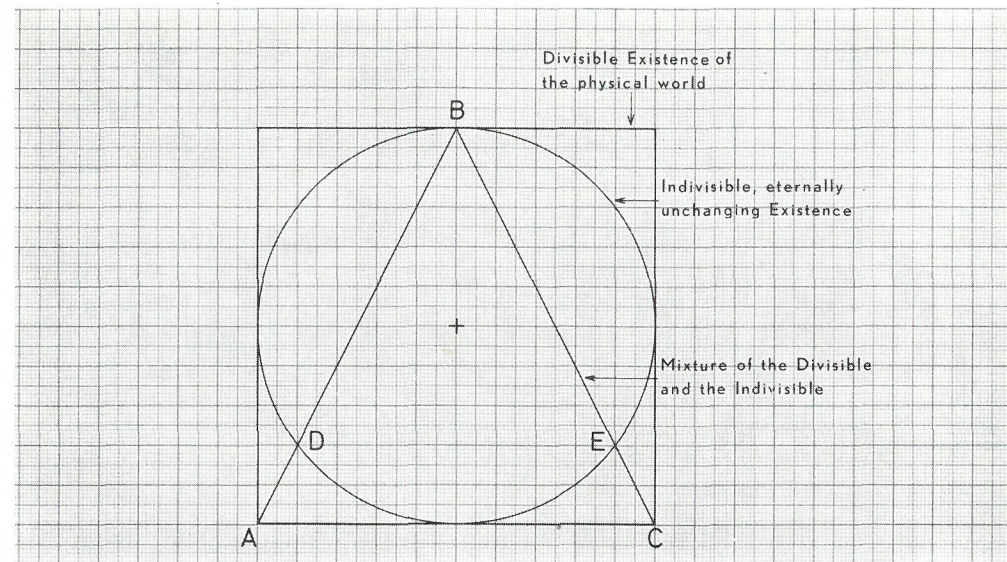


Fig. 167.

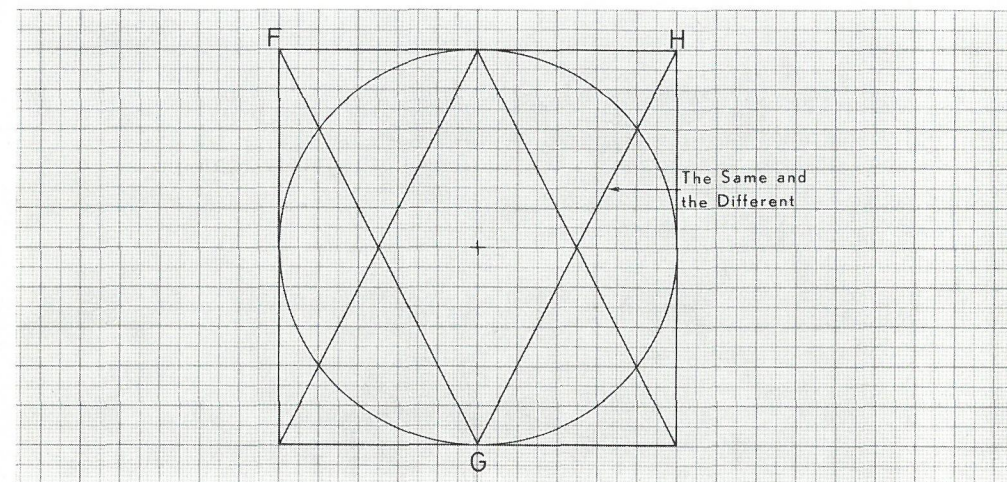


Fig. 168.

other variety, you have done what Plato demands. You have the same thing in each hand, namely an apple, but simultaneously there is a big difference between these two apples so you have fulfilled the demand regarding the Different.

Plato's use of this mode of expression for two triangles which are in reality

identical in size and shape, the difference being disguised in the fact that one is turned upside down, meets the demand of his phraseology perfectly. We are left musing over the mastery of his formulation which—on such a clear subject—has baffled able minds for more than two thousand years.

He continues:

"Taking these three components he mixed them into single unity, forcing the Different, which was by nature allergic to mixture, into union with the Same, and mixing both with Existence."

In this he produces yet another geometric construction, mixing the second triangle with the first triangle and his original circle-square.

There seems to be some discrepancy about the number of components (or mixtures) Plato has here. The text says he has "three components" but by my reckoning he has five. He started with the indivisible Existence (one) and the divisible Existence (two), producing a "third kind of Existence" (three). He goes on to mix the Same and the Different (four), and finally in the passage above he produces a mixture (five) of Same, Different and Existence.

Of course his reasoning may have been that a mixture of two components (divisible and indivisible Existence) produced *one unit*; a mixture of Same and Different a *second unit*; and a mixture of units one and two produced a *third*.

In Fig. 169 the latter is indicated by the figure JKLM, and we recognise this from earlier experience as the circle's rectangle and symbol "Q".

Thus we have produced the finished diagram, built up completely in accordance with Plato's esoteric instructions. I have tried to clear away the curtain of secrecy which Plato intentionally draped over his text to render it incomprehensible to non-initiates—in which he was successful. But if the piece is read and interpreted in this way and if the reader is familiar with the diagram, the text becomes neither mystifying nor incomprehensible, expressing instead a remarkably clear and logical train of thought brilliantly formulated. The complete diagram is

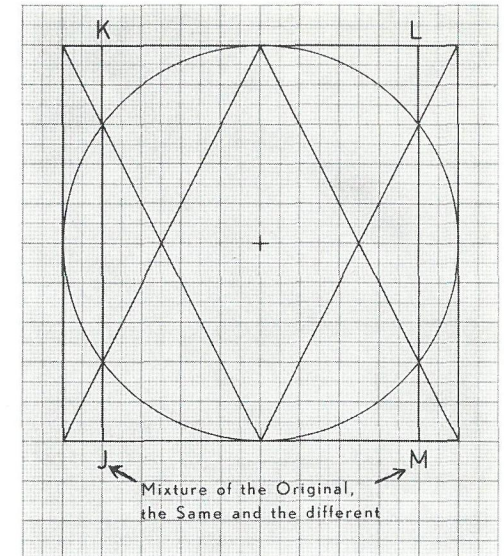


Fig. 169.

indicated in words only, no mention being made of a single line or geometric shape by its proper designation.

Plato then proceeds to prove how the circle and its rectangle really are related in the manner we know to be the case, i.e. that the area of the circle's rectangle is equal to that of the circle itself.

In this part of his tale it would be impossible for him to continue without mentioning certain figures and sizes, but since the preceding section regarding the divisible, the indivisible, the Same and Different, etc., is beyond the understanding of ordinary mortals without prior knowledge of ancient geometry Plato is at ease on this score.

We note also that Plato in his continuation mentions certain details about the diagram quite openly; there is no need to hide them as long as the point of origin is concealed.

He goes on:

"Having thus made a single whole of these three, he went on to make appropriate subdivisions, each containing a

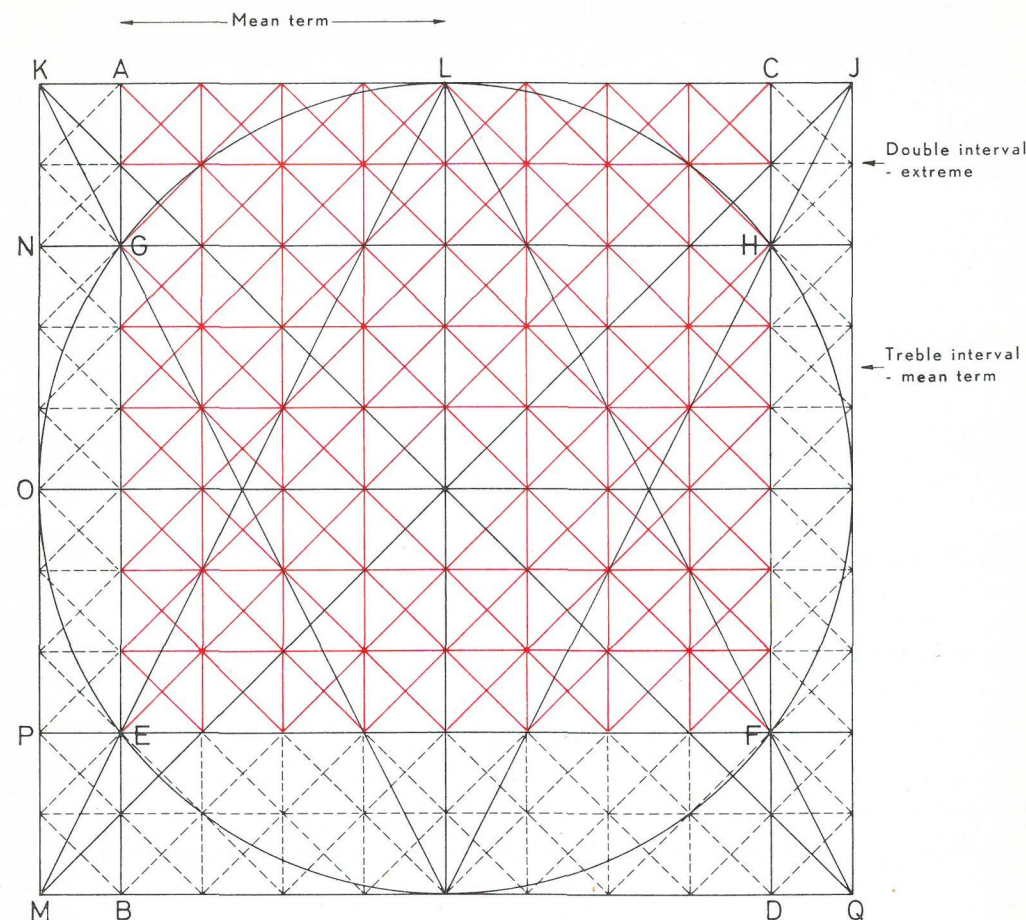


Fig. 170.

mixture of Same and Different and Existence."

He is informing us that the area so far achieved is to be divided into as many portions as deemed suitable. Since no instructions are given on what should be considered "suitable" we must search for a hint in the standard method of sub-division, i.e. triangulation, by which we have seen that a quadratic area can be split into as many small triangles as technique permits.

We must arrive at a size of unit suitably small to be used as factors in measurement, and the text later gives some indi-

cation in this direction—allowing us to check whether our selected size is correct.

Since we are to divide up a rectangle and not a square we must follow the special procedure of sub-dividing first of all the part of the rectangle that constitutes a square (i.e. the square on the circle's rectangle, symbol "U") and we see that not only does this division match in with the part of the rectangle outwith the square, but it also fits the whole diagram perfectly. We see this in Fig. 170 in which the circle's rectangle is bounded by lines ABCD.

The square on the circle's rectangle is AEFC, the base-line of which rests on the circle's circumference at the same points (E and F) as the circumference is intersected by the lines of the circle's rectangle. And it is naturally the case, too, that the circle's rectangle is marked by the sides of the acute-angled triangles as they intersect the circumference, i.e. the acute-angled triangle that can be drawn in the circle's surrounding square. These points of intersection are now crossed by all three lines, the vertical lines representing the sides of the circle's rectangle, the horizontal being the rectangle's square (or rather the part of the rectangle making up a square).

We recall from earlier working with the half-size square how it is placed to the right and left respectively, producing two overlapping squares which mark out a rectangle within the square.

The same technique is applied here, the square on the circle's rectangle being lowered to the base of the diagram and indicated GBDH. This provides a combination of symbols "U" and "Q".

Line GH has an equal status in the diagram to line EF.

We resort to our system of triangulation and divide square AEFC into small triangles, starting with the diagonal and vertical crosses. We call a halt when we have produced 256 small triangles. These in the process have constructed 64 small squares, thus our object square is divided into 8×8 smaller squares.

If we examine the upper side of the diagram we see it contains line AC which in turn is made up of eight square-sides and split by a vertical axis with four square-sides to the right and left respectively.

But we have executed our triangulation/quadrature process throughout the diagram and we note that lines KA and CJ also consist of one square-side each. The complete side of the main outer

square is thus divided into ten equal parts.

The upper line is now divided into two extremes, i.e. KA and CJ, and two mean terms both contained in line AC, on each side of point L. Thus we have first extreme KA, first mean term AL, second mean term LC and second extreme CJ.

If we similarly examine the diagram's vertical side KM we find it split up in like manner; none of the lines is in the least irregular, all are natural lines of division.

Line GH cuts precisely two rows of squares from the diagram. The diagram's horizontal axis cuts area GHFE in two, each with three rows of squares, and finally we see how line EF is produced to cut the two bottom rows of squares from the diagram.

In this way we have KN as the first double interval, NO as the first treble interval, OP as the second treble interval, and PM as the second double interval.

This division splits up our whole diagram. Vertically, into two mean terms and two extremes, and horizontally, into four areas Plato calls intervals, two double and two treble. The demands of Plato's text are seen here:

"There were two mean terms in each interval, one exceeding one extreme and being exceeded by the other by the same fraction of the extremes, the other exceeding and being exceeded by the same numerical amount."

He said expressly that we required two mean terms in each interval, using the expression "mean term" in both a horizontal and a vertical sense. And indeed we have two mean terms and two extremes.

In comparing the size of these mean terms with that of the extremes, we discover it is the horizontal division to which Plato refers.

We see that the rectangle bounded by the short side KN and the long side KJ holds 80 triangles. So does the other extreme, bounded by PM and MQ.

The two mean terms, which at the same time are the treble intervals, have short sides NO and OP and long sides all the width of the diagram (as with the extremes). These mean terms each contain 120 small triangles.

The difference between one mean term and two extremes is as follows:

$$\begin{array}{rcl} 2 \text{ extremes} & = & 160 \text{ triangles} \\ 1 \text{ mean term} & = & 120 \text{ triangles} \\ \hline \text{difference} & = & 40 \text{ triangles} \end{array}$$

Thus, if we re-examine that last piece of quotation, we find that one (of the mean terms) exceeds one extreme (by 40) and is exceeded by the other extreme by the same fraction (40).

The second requirement we had to meet was "the other exceeding and being exceeded by the same numerical amount". This is also fulfilled if we apply the same procedure to the other mean term, containing 120 small triangles.

From this figure we subtract the sum of the triangles comprising the two vertical extremes (KABM and CJQD), i.e. 40 each = 80.

$$\begin{array}{rcl} 1 \text{ mean term} & = & 120 \text{ triangles} \\ 2 \text{ extremes} & = & 80 \text{ triangles} \\ \hline \text{difference} & = & 40 \text{ triangles} \end{array}$$

This demand therefore is also met, and we achieve the "same numerical amount" (40) as mentioned earlier.

This precision may well be regarded as meaningless mental arithmetic, but it is nevertheless well formulated. With a familiarity with the subject matter the writer/reader has a much more accurate check on the relevant postulates than by merely stating a figure, which cannot be

compared or checked with anything in practice.

So far so good. By interpreting the text in this way we have fulfilled every requirement in, I trust, a clear and logical manner. The apparently disconnected has been bound up firmly in a diagram of immense import to esoteric geometry. But we have some distance to go yet.

Timaeus (or Plato) continues with the dialogue, turning to the proof that the circle and the circle's rectangle are equal in area:

"He began the division as follows. He first marked off a section of the whole, and then another twice the size of the first; next a third, half as much again as the second and three times the first, a fourth twice the size of the second, a fifth three times the third, a sixth eight times the first, a seventh twenty-seven times the first. Next he filled in the double and treble intervals by cutting off further sections and inserting them in the gaps, so that there were two mean terms in each interval, one exceeding one extreme and being exceeded by the other by the same fraction of the extremes, the other exceeding and being exceeded by the same numerical amount. These links produced intervals of $\frac{3}{2}$ and $\frac{4}{3}$ and $\frac{9}{8}$ within the previous intervals, and he went on to fill all intervals of $\frac{4}{3}$ with the interval $\frac{9}{8}$; this left, as a remainder in each, an interval whose terms bore the numerical ratio of 256 to 243. And at that stage the mixture from which these sections were being cut was all used up."

Plato's disclosure in this passage is that he used the sub-division of the whole diagram as a sub-division of the internal circle. He divided the circle in accordance with the above directions and replaced the

pieces in the circle's rectangle to prove that the two areas are in fact the same.

I am not inclined to believe that the fraction with which he finished, i.e. $\frac{256}{243}$, was evident from this particular diagram. It is not possible by the method at his disposal to achieve it. The numerator itself is self-evident. Square ACEF, the basic square of triangulation, comprises 256 triangles, and if he concludes by having slightly more than one triangle left it is possible that he arrived at this figure. But in order to gauge and express this tiny error he must turn to another and a finer standard of measure than indicated in his text.

But the application of the fraction ought not to be regarded in the same way as we today know fractions, for our treatment of numbers is quite different from the method applied in Plato's time. In an instance such as this we would, by $\frac{256}{243}$, recognise a particular portion in square centimeters or square inches. The standard of measure would be necessary, however, before we could appreciate the portion that was left over.

Timaeus had no experience or knowledge of this method and thus expressed the remainder in terms of his original unit-triangle $\frac{1}{256}$.

But let us revert to the actual sub-division. We are told that the circle is divided into seven pieces, each larger than the preceding. If we start with the first piece, we cannot discover how many triangles it comprises. We therefore assign to it the value "x".

The first part is thus $\frac{1}{x}$, the second twice as great $\frac{2}{x}$; the third $1\frac{1}{2}$ times as large as the second and three times the first = $\frac{3}{x}$; the fourth twice as large as the second = $\frac{4}{x}$; the fifth three times as large as the third = $\frac{9}{x}$; the sixth eight times the first = $\frac{8}{x}$; the seventh and last piece 27 times as large as the first = $\frac{27}{x}$.

Thus we have:

$$\frac{1}{x} + \frac{2}{x} + \frac{3}{x} + \frac{4}{x} + \frac{9}{x} + \frac{8}{x} + \frac{27}{x} = \frac{54}{x}$$

We see from Plato's text that the triangles comprising the circle are to be divided into 7 portions of differing sizes. We see, too, that the seventh piece is equal to the sum of the other six, i.e. that it occupies one half of the circle.

This reveals a little of the procedure. They had measured out the half-circle, and simply took the other equal half for the purpose of division.

We see this in *Fig. 171*.

If we count the small triangles in the circle's rectangle we find these total 320, and—working on the factor $\frac{54}{x}$ —we see that $\frac{1}{54}$ of the rectangle equals 5.926 triangles.

Since it is impossible to perform a geometric division of an area with such a fraction, we take the nearest whole number, i.e. 6. We shall assume that speculation was confined to the circumference of the circle and concentrate our sub-division on this. We are also aware that we need only work upon one half of the circle, the other half being equal to the seventh and final piece.

- 1) We marked out area A as a unit of 6 triangles.
- 2) Area B has twice as many as A, i.e. 12 triangles.
- 3) Area C has half again as much as B, i.e. 18 triangles.
- 4) Area D has four times as many as A, i.e. 24 triangles.
- 5) Area E has nine times as many as A, i.e. 54 triangles.
- 6) Area F has eight times as many as A, i.e. 48 triangles.

Thus we have used up one complete half of the circle and achieved a total of 162 triangles.

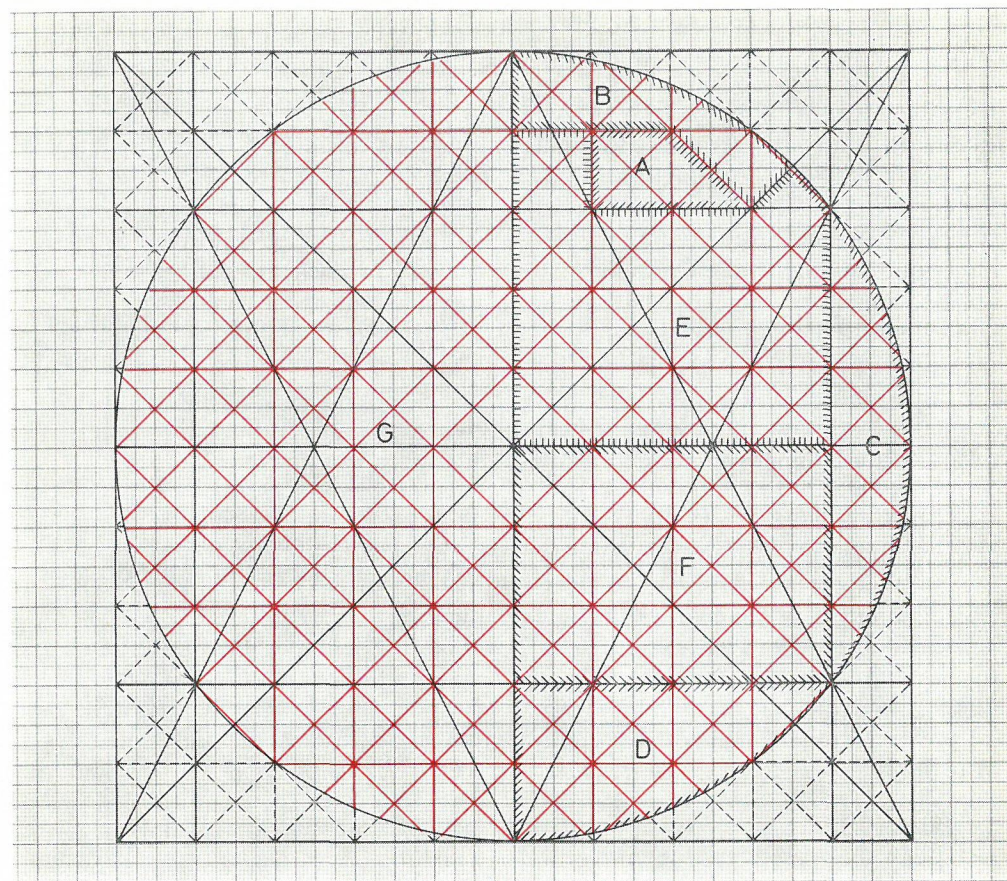


Fig. 171.

- 7) Area G, which is the seventh piece, must equal the sum of the other six areas, and must therefore have 162 triangles, the whole circle thus having or apparently having 324 triangles.

Division of the circle brought us to 324 and calculation of its rectangle to 320, making a difference of four triangles. But on the other hand we recall that we actually increased 5.926 to 6 and thus took a tiny fraction more each time.

Timaeus, who is telling Plato's story in the book, is fully aware of this and says so in the introduction to his speech:

"It is always most important to begin at the proper place; and therefore we must lay it down that the words in which likeness and pattern are described will be of the same order as that which they describe. Thus a description of what is changeless, fixed and clearly intelligible will be changeless and fixed—will be, that is, as irrefutable and uncontrovertible as a description in words can be; but analogously a description of a likeness of the changeless, being a description of a mere likeness will be merely likely; for being has to becoming the same relation as truth to belief. Don't therefore be surprised, Socrates, if on many matters con-

cerning the gods and the whole world of change we are unable in every respect and on every occasion to render a consistent and accurate account. You must be satisfied if our account is as likely as any, remembering that both I and you who are sitting in judgment on it are merely human, and should not look for anything more than a likely story in such matters."

We have an obvious demonstration here of the reservations he made in advance regarding the forthcoming postulates, the geometric truth of which the ancients knew well was suspect. But they were placed in the situation of acknowledging the error although unable to replace it by something more accurate—particularly in an oral text. They speculated considerably over the circle and its features, of that there is no doubt. We see that when Timaeus places the circle into its rectangle he finishes with a fraction which I think should be $243/256$, i.e. slightly less than one triangle.

We came across this observation in Chap. Five when the ancient mathematician, counting the triangles outside the arc of the circle, finished with a small remainder of which he could make no use.

After this division of the circle Timaeus suddenly turns aside from his original means of sub-division and considers the diagram as a whole, divided by intervals and links, stating that "these links produced intervals of $3/2$ and $4/3$ and $9/8$ within the previous intervals". This indicates that he began distinguishing between various sizes within the diagram. When he says that he then went on to fill "all intervals of $4/3$ with the interval $9/8$ ", we must assume that he refers to areas A, B and C in Fig. 172.

Here he estimates how to fit area C into area B in order to place the whole circle "between the links", i.e. that in fact in his proof he employs a more accurate assessment than his sub-divisions have in-

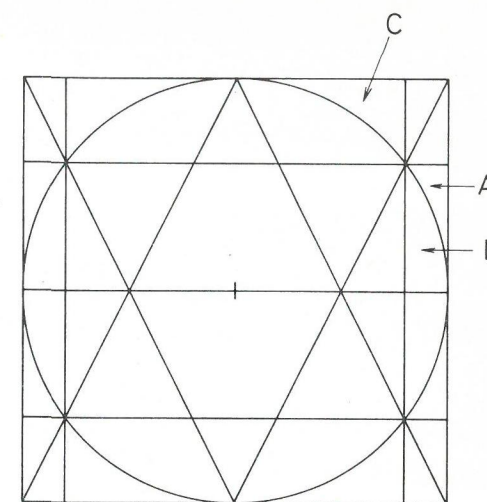


Fig. 172.

icated. This shows that he is familiar with a more accurate form of division than he is apparently able to disclose in his speech. He therefore goes straight to the point without detailing his method and without showing how he knows that area C is $4/3$ and area B $9/8$. But in both instances these areas are slightly in excess of $1/1$, converted to fractions C is $32/24$ and B $27/24$. By studying the areas we can by certainly appreciate that C is somewhat larger than B, but since there is nothing further in the text to help us we are left to guess about the sub-divisions applied by the ancient mathematician to achieve an accurate answer.

We know today that the circle is slightly less in area than the circle's rectangle and if we are to express their relationship in the ancient standard, i.e. triangulation, we find that the main square comprises 400 small triangles, its circle 314.159 small triangles, and the circle's rectangle of 320 triangles.

Whether those countries from whom Greece inherited her esoteric geometry came closer to 320 triangles, as shown in the diagram, cannot be proved. But there are some grounds for supposing that

Greek mathematicians arrived at the conclusion that the circle is slightly larger, for Timaeus says later, in a passage which seems to hold no other interest than precisely this point, that the circle is slightly larger than the rectangle. In fact he says, after using up the whole of the circle's area and placing it in the rectangle, that he finishes with a remainder which is expressed by the fraction $\frac{256}{243}$. It is not too clear whether this remainder is in the rectangle which is not completely filled up, or part of the circle which is left over, but he writes:

"He turned again to the same bowl in which he had mixed the soul of the universe and poured into it what was left of the former ingredients, mixing them in much the same fashion as before, only not quite so pure."

The creator thus carries on his work from what was left over of the diagram. Whether it was a remainder from the rectangle or from the circle must be judged from an assessment of the text. But since the creator, after "cutting off further sections and inserting them in the gaps", produces a rectangle, it is probably correct to assume that Greeks at the time of Timaeus, or at any rate Timaeus himself, supposed the circle to be slightly larger than its rectangle.

That he concludes with a rectangle is stated directly in the text. It says:

"He then took the whole fabric and cut it down the middle into two strips, which he placed crosswise at their middle points to form a shape like the letter X; he then bent the ends round in a circle and fastened them to each other opposite the point at which the strips crossed, to make two circles, one inner and one outer. And he endowed them with uniform motion in the same place, and named the movement of the outer circle after the nature of the Same, of the inner after the nature of

the Different. The circle of the Same he caused to revolve from left to right, and the circle of the Different from right to left on an axis inclined to it as the side of a rectangle to its diagonal."

Timaeus is saying here that he splits the fabric (or construction), which he has formed, into two halves. This construction of course is the circle's rectangle.

The immediate supposition might be that he divides this rectangle in two equal parts by drawing a line down the middle, parallel to the long sides, but he goes on to say that by placing them crosswise they form the letter X. Thus they must be divided by a diagonal if the two halves are not to be placed at an angle. Moreover the text indicates more clearly later that it is in fact a diagonal division. When he has constructed the two circles he actually says that they are "inclined" or proportioned as the side of a rectangle to its diagonal. In other words, he splits the circle's rectangle (the fabric) in two by a diagonal line. The two resulting triangles are placed together so that the hypotenuse of one intersects the long perpendicular of the other. He constructs from these two lines two circles, one having a circumference equal to the triangle's hypotenuse, i.e. the *diagonal*, the other having a circumference equal to the triangle's long perpendicular, i.e. rectangle's *side*. We see this in Fig. 173 in which we see one of the triangles as ABC and the other as DEF. A circle is now constructed of line AB and one of line ED, and we shall see how the areas of the two circles cover each other.

Thus again we have followed the directions of the text and produced a geometric construction from the details.

The story relates that this construction is an image of the creation of the whole world, not the earth but the entire universe. We shall shortly see how the struc-

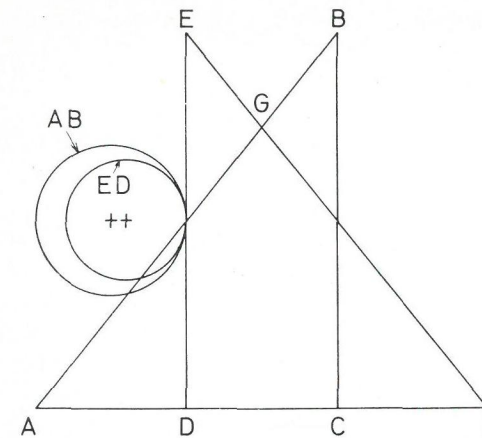


Fig. 173.

ture is further divided, but first let us remark on one point about the construction as it stands.

We will recall from our earlier reading that when we enter the diagonal in the circle's rectangle we produce two triangles which, placed long perpendiculars together, indicate precisely the proportions and angles of the Great Pyramid of Egypt. If we thus pull these two triangles in Fig. 173 slight apart so that points E and B, and D and C coincide, we again have the Pyramid angles in AFG.

We see therefore that Plato's directions require the side of the pyramid (the diagonal) and the pyramid's vertical height (the side of the rectangle) as the ideal dimensions for creation of the universe. This proves the colossal significance vested in these geometric speculations and results.

The text continues:

"He ... made the master revolution that of the Same. For he left the circle of the Same whole and undivided, but slit the inner circle six times to make seven unequal circles, whose intervals were double or triple, three of each; and he made these circles revolve in contrary senses relative to each other, three of them at a similar speed, and four at speeds different from each other

and from that of the first three but related proportionately."

In this passage Timaeus visualises the smaller of the two circles (the one made with the perpendicular) in the diagram of sub-division, Figs. 170 and 171.

We note in these two figures that the natural division by triangulation has itself produced a six-pointed star within the circle, and it is to this star that Timaeus refers when he says that the circle was "slit" into seven unequal smaller circles, corresponding to the double and treble links and intervals. We see this diagram in Fig. 174.

Timaeus places his six moon/planets in the tips of this star and rotates them around the seventh body, presumably the sun, each with a different revolution and speed.

Here we have a clear illustration of the prevailing belief regarding the structure of the universe, the circle created from the diagonal (the outer of the two in Fig. 173) being considered the outer extreme of the heavens. Within the circle lay the six most familiar planets revolving at varying speeds around the central point of the universe, the sun.

The text then switches to a more nar-

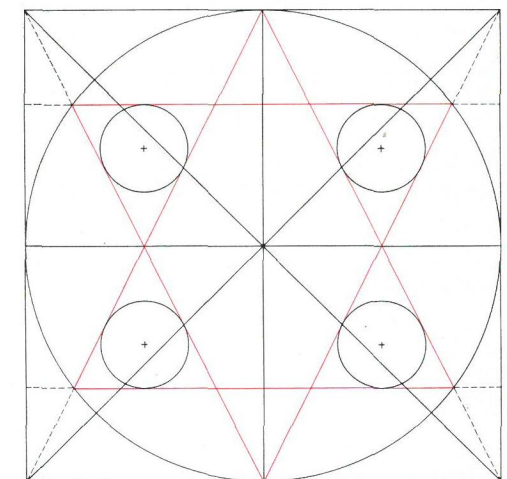


Fig. 174.

rative vein, but to complete the picture we should perhaps include a piece of dialogue which appears one or two pages later. Timaeus is summing up the main points of his long story:

"As a result of this plan and purpose of god for the birth of time, the sun and moon and the five planets as they are called came into being to define and preserve the measure of time. And when he had made a physical body for each of them, god set the seven of them in the seven orbits of the circle of the Different. The moon he set in the orbit nearest the earth, the sun in the next and the morning star and the one called sacred to Hermes in orbits which they complete in the same time as the sun does his, but with a power of motion in a contrary sense to him; consequently the sun, Hermes and the morning star all alike overtake and are overtaken by each other."

We should observe one thing in particular about this quotation. Timaeus says that seven planets, namely the sun, moon and five other planets, have been placed in the universe to "preserve the measure of time". Measure in this respect can only be a reference to the number of these planets, i.e. seven. But this figure was so sacred that it could not even be mentioned

directly at this stage, but in the fashion $2 + 5 =$ the measure (or numbers) of time.

With this final quotation I believe the most inaccessible portions of Plato's story through the lips of Timaeus have been analysed; and we are satisfied that when the text is explained from the point of view of ancient, secret geometry it opens up and loses its mystical, impenetrable initial facade.

It is a matter for discussion that the text does not contain as great a mathematical and philosophical insight as many researchers have tried to prove. But the explanation detailed here, combined with the actual story, provides in any event a logical continuity of thought. The story can be absorbed as a whole tale.

It must be granted that when all the more difficult passages can be revealed in content by the key of ancient geometry, and when each section builds on the previous piece of text, this explanation must be judged more fitting than any which deals with pieces of dialogue individually, without matching them to any cohesive pattern. And better than theories which end in a cul-de-sac of hypothesis with little or no connection with the story behind the text, the story—as seen by the ancients—of creation.

Temples of Antiquity

PRECEDING CHAPTERS have traced a geometric development from Man's initial observations of surrounding nature, the Sun and Moon, and we discovered how his observations led to a geometric expression of the first circle and how reflection on this shape produced wider and deeper experience until finally a positive system of geometric calculation evolved, the principal factors being the sacred cut and the sacred number seven.

We saw how the ancient pyramid-builders applied the system to their projects, and how Moses conveyed the same knowledge from Egypt, transplanting it among the initiates of the Israelites via his instructions for the Tabernacle.

The trail has led us to the period of Greek supremacy, with Pythagoras handing the Egyptian geometry to his Greek contemporaries, and we saw through Plato's text how he wrote intimately of the ancient geometric tradition.

What then became of the established tradition? Did it die with Plato and his era, vanishing from Man's mind? Or did the public success of the new, emerging systems supersede traditional methods by dint of their greater accuracy with numbers?

There is no doubt that in many spheres the up-and-coming systems took over from the old, but in one field the old method retained its position: the art of building.

Here, everything depended upon the established means of working with of course adaptations of design and materials. But new theory simply could not sweep aside the well-founded rhythm of construction—in spite of their more precise geometric speculation.

The power of the mystics and their temples had by this stage been partially broken. Public schools were set up, offering a training more or less independent of the religious orders. Temples were no longer the sole source of learning and training.

Fresh forms of religious belief arose. Their adherents had a different approach from established mystery communities. The emphasis switched from blind religious belief and faith to a demand for pure knowledge—backed by proof. Despite strong opposition from the Inner Temple these new groups became more and more popular. They suited better the needs of the people. Anyone so desiring could satisfy their religious needs within one of the new communities without—at the same time—having to undertake a course of practical training they did not really want. And those wishing knowledge for its own sake could fill their minds to the brim without blending it with unwanted religious ritual—and their studies were completed over a shorter period than in a regular temple.

Solid screeds of Temple wisdom gradu-