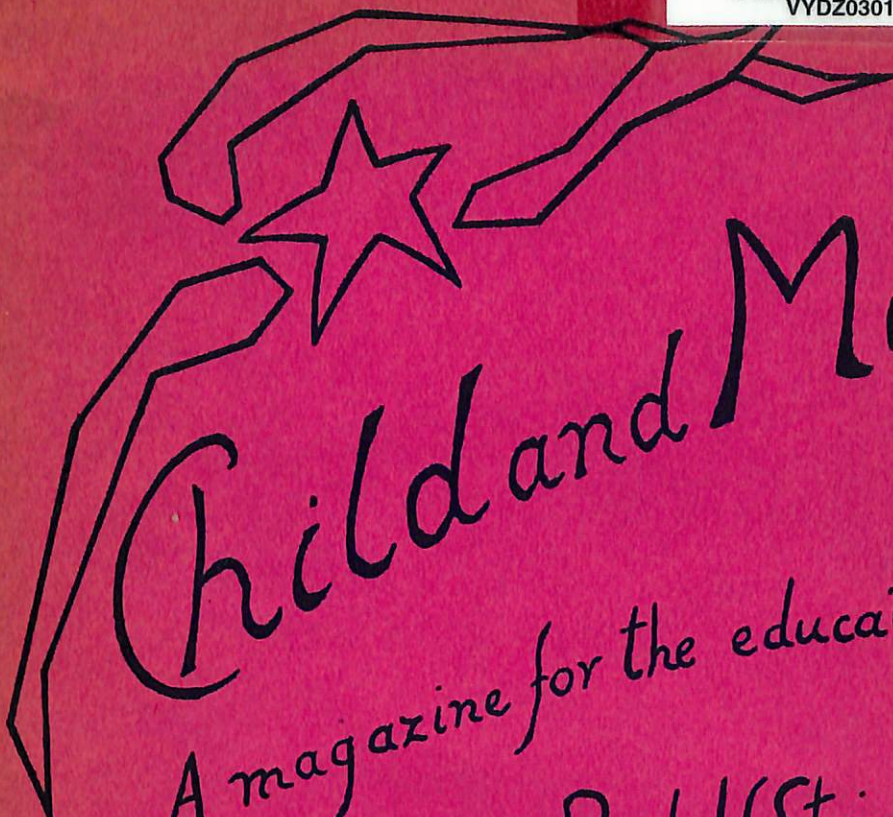


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Child and Man

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CHILD AND MAN

Edited by A. C. Harwood

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Contents

	PAGE
On Words and Names	I
The Geometry of the Pentagram	7
The History of Art	21
Poem on the School's Birthday	28

On Words and Names

EVERYONE who has to do with young children will have noticed the extraordinary delight they take in repeating names. To point to an object and repeat its name again and again, often in a tone far purer and more exact than that of the adults from whom the word was first learnt, is one of the great joys of early childhood. Then as soon as he can ask questions, the child's constant "What is this?" must be satisfied with the name of the thing he has seen—a name which, once heard, he will remember for the rest of his life.

It is a mistake, however, to imagine that this delight in words is merely the delight of recognizing objects through the senses. On the contrary, as the very purity and musical quality of the sound would indicate, the little child's experience of words is essentially a poetic one; which means that, like the poet, the child feels an inner, as well as an outer, relation between the sound and the thing. To the poet the words, Moon, flower, rain, are not arbitrary symbols, but the quality of their sound is related in some way to the quality of the

things they express. If it be asked in what way the only answer can be that the same formative or creative power which produced the thing works also in the moulding of the word. There is ideally a harmony between the word of human speech and the great creative word of God made manifest in the world of nature.

This harmony can be experienced in that fine inner ear with which one listens to music and poetry (for the physical ear hears only the sound), but it can be felt in a more comprehensive way in the movements of Eurhythmy. Anyone who practises the movements underlying the different sounds of speech as indicated by Rudolf Steiner will feel deeply the relation between the simple sound and its appropriate movement, and will begin to look upon nature with fresh eyes, not as the product of physical forces alone, but as the manifestation in its diverse forms of the creative power of the Word.

The name, then, in its original purity expresses the essence of the thing, and though in the course of time words have become degraded from their original high state, poetry in the different languages can only exist because some element of this creative force is still to be found in them. The languages of earlier peoples are not only more poetical than modern speech, but they are also more associated with power—like a creative power—exercised by means of the word. The charm and the spell, the uttering of the right word to make the occasion auspicious, were an essential and important part of daily life in earlier civilizations. Children still feel this old magic that lies in words. It is wonderful, for instance, to see how they are fascinated by the story of the giving of the first names by Adam in the Garden of Eden. The Lord God brings before Adam in turn all the fowls of the air and the beasts of the field. "And whatsoever Adam called each creature, that was the name thereof." But Adam not only knows the names of the creatures, he has also dominion over them—because he knows their names. Young children savour such a story of the first giving of names in a way unknown to adults—unless they understand and appreciate the creative origin of speech.

Folk tales and myths are also full of stories of power acquired through knowledge of the name. Everyone will remember the story in "Grimm" of the dwarf who lent his

aid to the miller's daughter by spinning the straw into gold on condition that when she was married to the King she should give him the child that should be born to her. When he claims the child, she must surrender it unless within a certain time she can discover his name. At last one of the Queen's servants hears him singing in the forest "Rumpelstiltskin is my name"; and when his name is known he is at once in the power of the Queen.

Hearing such a story, young children do not ask why the dwarf loses his power on his name being known; they still feel intimately the primeval power of the word. At a somewhat later age, too, when the children come to learn something of Egyptian History, it makes a profound impression on them to learn how a man of Egypt distinguished between his names. For at birth he was given two names—a public name by which he was to be known during his earthly life, and a secret name which was to be revealed to the priesthood alone, and by which he was to be called again only when at the moment of death he passed through the gates of the spiritual world. Such a custom signifies much for the knowledge of human evolution. For the secret name was the name of his true ego which at that stage of history could not be incarnated on the earth. It was the time also when the Jewish people could not pronounce the "unspeakable name of God" because that name contained in it the name of the ego which only descended to the earth with the coming of the Christ. Thereafter the "secret name" of the Egyptians became for the followers of Christ the "Christian" name which could be openly used. In words also the secret places were made plain and the rough places smooth.

The three stages of childhood described by Rudolf Steiner, and often outlined in this magazine, may be considered from this point of view of words and names. The child in the first six or seven years of his life takes the chief delight in the simple names of the objects around him. It is astonishing with how simple a story such a child will be satisfied. You can tell him of the farmer walking down the lane and seeing the horses drinking out of their trough, the cows lying in the meadows, the pigs in the pig-sty, etc., and then returning home again; and he will be completely satisfied with the almost bare list of names. And you will not be surprised that

he is so satisfied if you remember what the experience of the name meant to the earlier peoples of the earth; and that when you see a child sitting on the grass and saying "Flower, Flower, Flower" again and again to himself—or rather to the Universe—he is enjoying the flower in an immediate way which is lost to modern adult consciousness. For in the little child, as Rudolf Steiner has said, Body, Soul and Spirit are one, and he experiences the creative spiritual and soul force in the objects of nature around him. The repeating of the name is the affirmation of the spiritual principle which he recognizes and enjoys.

But after the seventh year a change comes over the lives of children. They will no longer be content with such simple stories, naming this and that object in which they delight. They begin to look for qualities of the soul in the stories to which they listen. They themselves must feel from the story hope, joy, sorrow, pity (which they readily give), triumph when the bad king comes to a bad end (in which even the worst children join)—all the feelings of the human soul presented to their eyes in the pictures of the story they hear. They like it also when the story reveals the soul quality of the kingdoms of nature, the tenderness of the flower, the anger of the sea, the majesty of the lion. For they still feel the physical world around them as the image of deeper powers, not as the ultimate fact of existence. But in passing to the stage when they appreciate the world as pictures they are descending one step further on their descent into matter, following in their small lives the path which the human race has trod in the long ages of history. For in the beginning man lived immediately with the spiritual forces of the world, with the gods; then with stories, picture images of the gods; and finally he denied the existence of the Divine, and explained the world by means of abstract laws reasoned out of physical appearances by abstract thinking.

It is this third stage which is reached by children about their fourteenth year; though, of course, it will come earlier if they are encouraged in critical thinking. From this time on children begin to take pleasure in those words in which no picture is inherent, distinctions such as "cause" and "effect," "quality" and "quantity" begin to engross their minds.

At the same time the natural artistic or poetic power which a child may have shown will often become barren. For Body, Soul, and Spirit have now become separated in his nature, and the physical world on which the child looks is the physical world and nothing more. He has reached the age when he must begin to learn to "give back to Nature what we owe" if he is to see the world in its entirety and not merely as the field of purely physical forces.

Whether the adult human being will be able to recover the natural vision and inspiration of childhood will depend on many things. But the greatest help he can have is to have been nourished in the right way as a child; and the thoughts and words of the adults around him are nourishment to the child no less than his physical food. For example, Rudolf Steiner has pointed out how bad it is for a child if his father or mother or nurse use baby language to him; the child cannot himself yet pronounce the names of the objects around him, but it is a true satisfaction to his Spirit to hear them pronounced by those who can. To speak clearly, beautifully, and truthfully, is one of the first things which parents owe to their children. Or when the children are older and begin to ask their innumerable questions a wise adult will always try to give his answer in some form of a picture, avoiding abstract words which deny a living process behind what the child sees. A child of seven or eight will perhaps ask, What is a rainbow? and his parent may endeavour to explain to him the process of refraction of light. But it is not "refraction" which awaked in the child the sudden joy which he felt on seeing the great shining arch, nor which made earlier peoples look upon the rainbow as the bridge between earth and heaven. The colours which arise between darkness and light, earthly darkness and heavenly light, are indeed a bridge between two worlds, and it is a right instinct which makes the child's soul feel something like a revelation of heaven in the shining colours. So it will perhaps be better to answer such a question by means of a story, even though it can, perhaps, only be promised at the time when the question is asked. But the child will cherish it all the more eagerly because of the interval of time. And if you give the child at this time a picture in words of what the rainbow is he will the more easily overcome the stage through

which he will almost inevitably pass when the rainbow, like the colours in the spray of the garden hose, is "only" refracted light.

During all his childhood, when the child's relation to words and names alters so profoundly, there is one word he uses which is of special significance, the one word which for all human beings possesses a different meaning. At about the third year the child for the first time calls himself "I," a word which has climbed into the high places of language only since the advent of the ego principle in Christian times. To-day we say "I think," "Je pense," because we feel thinking is a personal activity of our own; but to the ancient Greeks and Romans thinking was something superpersonal, and just as we say "*It rains, it thunders*," so they said "*It thinks in me*," *δοκει μοι, mihi videtur*. To-day, however, even as early as the third year a child feels the force of his individuality and calls himself "I."

But before he calls himself "I," he calls himself by the name his parents give him, and to a child his name—his Christian name—is of great interest and importance. In older times the giving of the name to a newborn child was an event of great importance, and in many stories the name is revealed to the parents in a dream, or by the appearance of an angel. Some parents still have a kind of secret intuition as to what their child should be called, but not infrequently nowadays a name is chosen at random, like the drawing of a lottery ticket. Rudolf Steiner himself often suggested double names for children, and in combination old names often spring into new life. How different, for instance, is the force of the name Michael when associated with the second name Angelo. But the important thing is that the name should be chosen seriously, for a reason which has some deep foundation in the parents' lives and thoughts. For just as the child finds his first relation to the world through the names he calls the things around him, so he finds the first relation to his own being through the name by which he is called. The names of the woods, the trees, the stars and the sun are wonderful gifts given to him by his Mother-tongue, and his mother and father can give him a no less wonderful gift if they can find the right name by which he should be called.

A. C. HARWOOD.

The Geometry of the Pentagon

[I would like to acknowledge with gratitude the booklet entitled *Die Geometrie des Pentagramms und der Goldene Schnitt*, by Dr. H. v. Baravalle of the Waldorf School, from which I received much help in the forming of these lessons.—A. R. S.]

THE world of nature is everywhere an expression of the laws of geometrical form. Sometimes the form is simple and regular, at other times substances may seem to be formless and chaotic. The latest researches of science go to show that even so-called amorphous matter really consists of minute crystalline structures. We cannot understand form in its manifold diversity and metamorphosis if we turn our attention only to the world of matter and to the forces of the physical world. Forces from beyond the earth raying down into physical matter create the natural forms which we see around us. These forces are active in the light as it streams down on to the earth. We may, indeed, say that the earth gave the substance silica, but that super-earthly forces, forces of light, conjured forth from the once liquid silica the form of the quartz crystal with its wonderful six-fold symmetry. The Greeks, to whom we owe so much in the sphere of geometry, expressed what has here been said in the words: God is eternally geometrizing; and throughout the ages mankind has tried to understand more and more deeply this divine geometry.

Now man himself is a creative geometrician, and he is so because his own organism embodies those same formative forces (etheric forces, Rudolf Steiner called them) which, raying in from the cosmos, build form into matter. In the physical expression of his geometry man has often created forms similar to the natural forms in his environment. On the other hand, there are forms which human imagination has created, and which we do not find immediately in the world of nature, but stand as symbols, as pictures, for man to gaze upon and comprehend as he strives to understand not only the world around him but the mystery of his own being within that world. The Great Pyramid is such a creation. Or again, the Egyptian temple, the Greek temple, and the Gothic cathe-

dral are all symbols in geometrical form of the evolution of humanity.

Behind the form of man himself there stands a geometrical symbol—the Pentagram:—

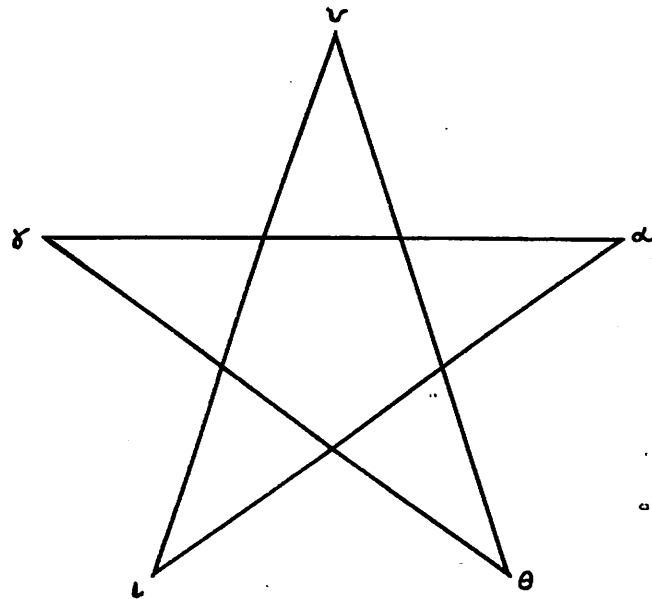


FIG. 1

Looked at superficially, one sees in it man standing on the earth with his arms outstretched. It is no mere arbitrary picture but a true symbol of the human being in his three-fold nature—in Greek times the Pentagram was sometimes called the triple triangle. Iamblichus, in his writings about the Pythagorean school of mathematics and philosophy, tells us that the Pentagram was the sign of that school. It was considered by the Greeks as symbolical of "health," and probably the angles were denoted by the letters of the word *ὑγίεια*—our word hygiene—the diphthong *αι* being replaced by a *θ*.

The figure is, of course, a re-entrant pentagon and consists of a single broken line which returns to its starting place.

In the Middle Ages the Pentagram had a mystical significance, and was used as a charm to keep away evil. In one of the

early scenes of Goethe's *Faust*, Mephistopheles appears to Faust in his study and after a short dialogue Mephistopheles asks permission to leave him (Mephistopheles entered the study in the form of a poodle which by magic changes into human form).

MEPH.: Pray let me leave you for the present.

FAUST: I do not see why thou shouldst pray.
Though our acquaintance be but recent,
Look in upon me day by day.
Here is the window, there the entrance,
A chimney I can offer you.

MEPH.: Let me confess—there is a trifling hindrance
Which bars my course the doorway through—
The wizard's foot upon your threshold.

FAUST: The Pentagram! that gives thee pain?
If that thy foot within the mesh hold,
Thou Son of Hell, how didst thou entrance gain?
Say, how was such a spirit cheated?

MEPH.: Observe it well! the figure's not completed;
Here, if you look but closely, it remains
A little open at this outer angle.

FAUST: A lucky chance, the Devil thus to entangle!
So thou'rt my captive for thy pains?
Nay, by my fay, that is a windfall!

MEPH.: The poodle leapt across it all unmindful,
But now things wear another face!
The Devil cannot void the place.

Johan Kepler, the great German astronomer and mathematician, in his book, *Mysterium Cosmographicum de admirabile proportionem orbium coelestium* (1596) states that he considers the two most important phenomena in the whole of geometry are the theorem of Pythagoras and the proportions of the Pentagram. Indeed, this figure has the most remarkable geometrical properties—almost magical properties, one might say, and we shall find that the geometry which it reveals to us plays a most significant part in our understanding of form in nature and in art.

The lessons now to be described have recently been given to a class of boys and girls of about fifteen years old. The work is especially suitable for this age when the children should be studying the relationships of lengths and areas, and nothing could be better for leading them to these ideas than the geometry of the Pentagram.

We began the lessons, apparently far away from the subject, by talking about series of numbers. The children themselves made up many different number series and then we all tried to find out the various mathematical processes involved in their formation. Thus we learnt all about the simpler series, Arithmetical Progressions (e.g. 2, 4, 6, 8, 10, 12, 14, etc.) and Geometrical Progressions (e.g. 2, 4, 8, 16, 32, 64, 128, etc.), and we noticed here that the numbers in an arithmetical series increase or decrease in a regular, even way, while those of a geometrical series increase or decrease with greater and greater rapidity the further we go in the series; we put it in this way—that the arithmetical series proceeds in a rather dull and sluggish way while the geometrical series has great activity within it.

We examined many different number series and at last I wrote the following one on the blackboard: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, etc. The children quickly saw that this progression is built up in such a way that each term is the sum of the two preceding terms. This is the well-known Fibonacci series (I have already referred to it in an article entitled, "Children in a Scientific World," *Child and Man*, Vol. 2, No. 1), named after Leonardo Fibonacci of Pisa, who had a very great reputation as a mathematician during the early years of the thirteenth century, and who introduced the use of Arabic numerals into Christian Europe.

We took successive terms of this Fibonacci series, expressing them as ratios and finding their decimal values:—

$\frac{1}{1} = 1$	$\frac{21}{34} = 0.61764 \dots$
$\frac{1}{2} = 0.5$	$\frac{34}{55} = 0.61818 \dots$
$\frac{2}{3} = 0.66666 \dots$	$\frac{55}{89} = 0.61797 \dots$
$\frac{3}{5} = 0.6$	$\frac{89}{144} = 0.61805 \dots$
$\frac{5}{8} = 0.625$	$\frac{144}{233} = 0.61802 \dots$
$\frac{8}{13} = 0.61538 \dots$	$\frac{233}{377} = 0.61803 \dots$
$\frac{13}{21} = 0.61904 \dots$	etc. etc.

[10]

The children saw that the different ratios are alternately greater and less than a certain number, and that the ratios approximate more and more closely to this number the further we go in the series. We compared this process with the vibration of a pendulum, imagining the pendulum swinging first to one side and then to the other, each swing being less than the one before it and all the time getting nearer and nearer to its mean position but never quite "dying down."

We next built up another series of numbers in the same way as the previous one and expressed this as ratios: For example: 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, 199, 322, 521, 843, etc.

$\frac{1}{3} = 0.33333 \dots$	$\frac{47}{76} = 0.61842 \dots$
$\frac{3}{4} = 0.75$	$\frac{76}{123} = 0.61788 \dots$
$\frac{4}{7} = 0.57142 \dots$	$\frac{123}{199} = 0.61809 \dots$
$\frac{7}{11} = 0.63636 \dots$	$\frac{199}{322} = 0.61801 \dots$
$\frac{11}{18} = 0.61111 \dots$	$\frac{322}{521} = 0.61804 \dots$
$\frac{18}{29} = 0.62068 \dots$	$\frac{521}{843} = 0.61803 \dots$
$\frac{29}{47} = 0.61702 \dots$	etc. etc.

Again we found that the same thing happened, that out of quite different ratios a number gradually appears and, moreover, that this number is the same as for the previous series, i.e. 0.61803... The children soon found that they could choose any two numbers they liked and build up from them such a "Fibonacci Series" and that the ratios thus obtained would always approximate to this same strange number.

I now wrote on the blackboard the expression $\frac{\sqrt{5} - 1}{2}$ and asked the children to work it out. They found that $\frac{\sqrt{5} - 1}{2} = 0.6180339885 \dots$ (as far as 10 places of decimals).

[11]

$\frac{\sqrt{5}-1}{2}$ is the exact mathematical expression for the number to which the Fibonacci series ratios approximate. This number has an endless series of decimal places—it is an irrational number because $\sqrt{5}$ is irrational—and now we find that it has very special and remarkable properties. For example, if we calculate its reciprocal, i.e. divide it into unity, we obtain a whole number (unity) followed by exactly the same series.

Thus:—

$$\begin{aligned}\frac{\sqrt{5}-1}{2} &= 0.6180339885 \dots \\ \frac{2}{\sqrt{5}-1} &= \frac{1}{0.6180339885 \dots} \\ &= 1.6180339885 \dots\end{aligned}$$

This number is quite unique and we referred to it in the lessons as the Golden Number and denoted it by the letter G ; i.e. $G = 1.6180339885 \dots$. We next found that the two following expressions, the first a continued fraction and the second a continued square-root, were also further ways of expressing G :—

$$G = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \text{etc.}}}}}}$$

$$G = \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \sqrt{1 + \text{etc.}}}}}}$$

For example, if we stop the continued fraction at different points and simplify it we always get a ratio whose numerator and denominator are consecutive terms of the Fibonacci series. Thus in the above case the fraction simplifies to $\frac{21}{13}$

Another remarkable property of the Golden Number is shown by the following:

$$\begin{aligned}G &= 1.618 \text{ (correct to 3 decimal places)} \\ G^2 &= 2.618 \quad \quad \quad \text{''} \quad \quad \quad \text{''} \\ G^3 &= 4.236 \quad \quad \quad \text{''} \quad \quad \quad \text{''} \\ G^4 &= 6.854 \quad \quad \quad \text{''} \quad \quad \quad \text{''}\end{aligned}$$

From which we see that

$$\begin{aligned}G^2 &= G + 1 = 1 + G \\ G^3 &= G^2 + G = 1 + 2G \\ G^4 &= G^3 + G^2 = 2 + 3G \\ G^5 &= G^4 + G^3 = 3 + 5G \\ \text{etc.} \quad \quad \quad \text{etc.} \quad \quad \quad \text{etc.}\end{aligned}$$

Thus

In the third column of the above table the numbers of the Fibonacci series again appear.

So far we have considered certain number relationships and have discovered a number which has very remarkable and unique qualities, and the children certainly felt that this was a very special number—truly a Golden Number. It should be noticed here how such a study of the quality of numbers can give children the greatest interest in mathematics. They feel that there are wonderful secrets hidden within numbers, and they see how the simplest arithmetical processes reveal these secrets. Mathematics is something more than a science of calculation for utilitarian purposes, which in ordinary school work it so much tends to become; children can and should feel the quality of numbers and they can then gain some understanding for the Greek conception of number. Aristotle, referring to the Pythagorean school of mathematics, says:—

“They thought they found in numbers, more than in fire, earth, or water, many resemblances to things which are and become; thus such and such an attribute of numbers is justice, another is soul and mind, another is opportunity, and so on; and again they saw in numbers the attributes and ratios of the musical scales. Since, then, all other things seemed in their whole nature to be assimilated to numbers, while numbers seemed to be the first things in the whole of nature, they supposed the elements of numbers to be the elements of all things, and the whole heaven to be a musical scale and a number.”

We shall now see how all that we have studied here is really the mathematics of the Pentagon. The children first drew the Pentagon by two methods, first by construction

and then by measurement of angles and sides. The method of construction for drawing a Pentagon in a circle is carried out in the following steps:—

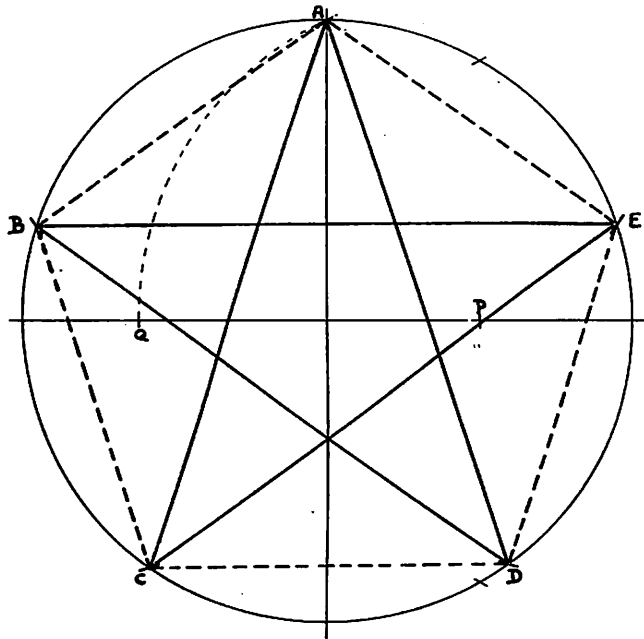


FIG. 2

Draw a circle and in it place two diameters at right-angles; bisect one of the radii (pt. P); with centre P and radius PA draw arc AQ; then distance AQ (stepped off with compasses) will go exactly five times round the circle, giving points A, B, C, D, E. If now these points are joined in their order a pentagon is obtained and if alternate points are joined we get a Pentagram.

The second method of drawing a Pentagon by measurement involves knowing the angle of the pentagon, namely 108° . The children calculated this angle by applying the Euclid proposition which says that all the angles of any rectilinear figure, together with four right angles, are equal to twice as many right angles as the figure has sides. Thus if α is the angle of a regular pentagon then,

[14]

$$\begin{aligned} 5\alpha + 4 \text{ rt. angs.} &= 10 \text{ rt. angs.} \\ 5\alpha &= 6 \text{ rt. angs.} \\ &= 540^\circ \\ \alpha &= 108^\circ \end{aligned}$$

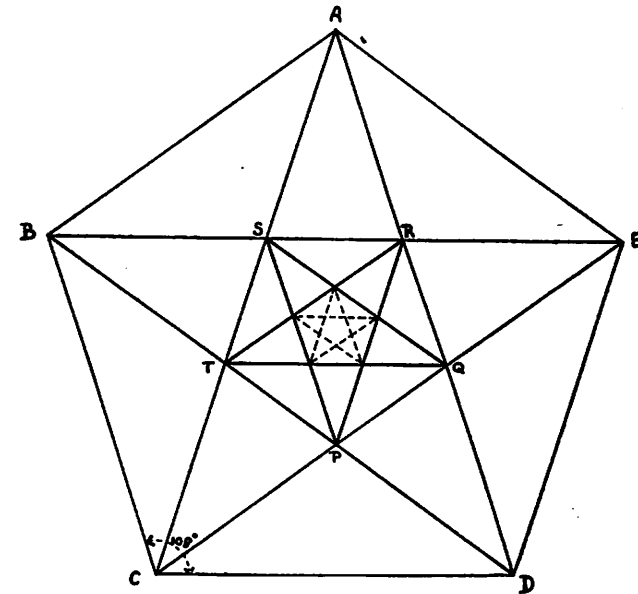


FIG. 3

It was evident to the children that all the sides of the Pentagon are of the same length and that the figure is symmetrical with respect to a line joining an angular point to the centre; there being clearly five such lines the Pentagon has a five-fold symmetry. One of its sides is always parallel to one side of the enclosing pentagon and thus there are five such pairs of parallel lines giving rise to five equal parallelograms. AEPB (Fig. 3) is such a parallelogram, moreover it is a rhombus. The children could pick out of the Pentagon-Pentagram various other figures with which they were familiar, e.g. a trapezium ABCE, a smaller pentagon PQRST. From this last figure we see that a Pentagon has the wonderful property of reproducing itself, for we can go on drawing Pentagrams within one another, each one being smaller than the previous one and also being alter-

[15]

nately erect and inverted. Here again further forms are revealed such as the rhombus ASPR.

The angles of the Pentagon-Pentagram are of three sizes and the children easily could see that these angles are 36° , 72° , 108° , i.e. 36° , $2 \times 36^\circ$ and $3 \times 36^\circ$. The triangle of the type ASR is an unique isosceles triangle in that each of its base angles is double the vertical angle. Let us now consider the angles grouped round say point S:—

ang. TSP = 36°	..	..	..	1
ang. TSQ = 72°	..	..	..	2
ang. TSR = 108°	..	..	..	3
ang. TSA = 180°	..	..	..	5
reflex ang. TSB = 288°	..	..	..	8

The numbers in the right-hand column show the proportion of these angles and in these numbers we at once recognize the first few terms of the Fibonacci series.

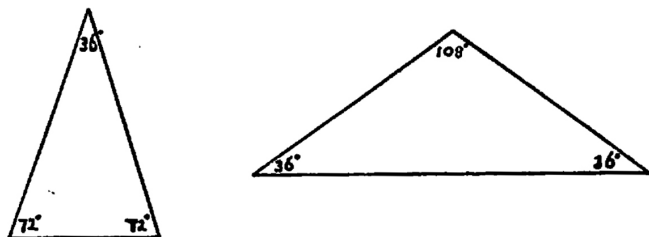


FIG. 4

I now asked the children to find out all the different kinds of triangles contained in the Pentagon-Pentagram figure. They saw that they were all isosceles triangles, and that these were of two kinds—acute angled and obtuse angled, or as we referred to them, a tall form and a flat form in which the vertical angle of the one kind became the base angle of the other.

Then we noticed that in each of these two series of triangles the length of the smallest side of one size is the same as the length of the largest side of the next size. If we now consider the lengths of lines in the Pentagon-Pentagram figures in consecutive order going from the longest lines to the shortest we find that *each length is the sum of the next two smaller lengths*

following in the series. For example AC, AB, AS, ST are lengths in order of magnitude, and

$$\begin{aligned} AC &= AT + TC = AB + AS \\ AB &= AT &= AS + ST \end{aligned}$$

We see again that such a series of lengths is a Fibonacci series. Further, if we express each of these lengths as a ratio with the length following in the series then all these ratios are equal because the lengths are the sides of figures which are similar. I now showed the children that these equal ratios give the Golden Number. To do this we considered the various ways in which a line could be divided in geometry to give certain proportions and among them we came to the well-known proportion of the Golden Ratio:—

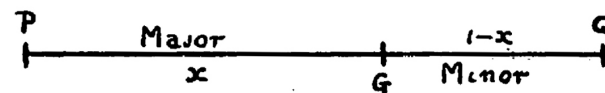


FIG. 5

The line PQ is divided in Golden Ratio at the pt. G if the following condition is fulfilled: The ratio of the whole line to the larger part equals the ratio of the larger part to the smaller part:—

$$\begin{aligned} \frac{\text{Whole line}}{\text{Major part}} &= \frac{\text{Major part}}{\text{Minor part}} \\ \frac{PQ}{PG} &= \frac{PG}{GQ} \end{aligned}$$

Such a condition is fulfilled many times over in the Pentagon-Pentagram figure. For take two similar triangles such as ACD, ATQ; because they are similar

$$\frac{AC}{CD} = \frac{AT}{TQ}$$

But

$$CD = AT = AB$$

and,

$$TQ = AS$$

Thus we have

$$\frac{AC}{AB} = \frac{AB}{AS}$$

These ratios are formed from consecutive lengths AC, AB,

AS, which we have shown to belong to a Fibonacci series. It now only remains to show that the Golden Number $\frac{2}{\sqrt{5}-1}$ is the numerical expression of this Golden Ratio.

If the whole line to be divided in Golden Ratio is of unit length and the large part is x then the small part is $(1-x)$. Then we have:—

$$\begin{aligned}\frac{1}{x} &= \frac{x}{1-x} \\ x^2 &= 1-x \\ x^2 + x - 1 &= 0 \\ x &= \frac{-1 \pm \sqrt{1+4}}{2} \\ &= \frac{\sqrt{5}-1}{2} \text{ neglecting the negative value}\end{aligned}$$

$$\begin{aligned}\text{Thus, } \frac{\text{Whole line}}{\text{Major part}} &= \frac{\text{Major part}}{\text{Minor part}} = \frac{1}{\frac{\sqrt{5}-1}{2}} \\ &= \frac{2}{\sqrt{5}-1}\end{aligned}$$

To sum up, we see that *every* pair of consecutive lengths in the Pentagon-Pentagram figure expressed as a ratio gives us the Golden Number $\frac{2}{\sqrt{5}-1}$. This ratio occurs again and again in the figure. Indeed, we may say that the Pentagon is built up on the Golden Ratio—the whole figure is “saturated” with it. It can also be shown that certain areas in the figure also stand to one another in Golden Ratio, e.g. the areas of pairs of consecutive triangles, the triangles being arranged in order of magnitude.

$$\text{Thus } \frac{\text{area tri. ACD}}{\text{area tri. ABE}} = \frac{\text{area tri. ABE}}{\text{area tri. ATQ}} = \text{etc.} = \frac{2}{\sqrt{5}-1}$$

It is very interesting to notice the different names which have been given to this geometrical proportion. Pacioli (c. 1450–1510) called it “Proportio divina”; Kepler (1571–1630) referred to it as “Sectio divina”; while Leonardo da Vinci (1452–1519) gave it the name of “Sectio aurea”—Golden Ratio. Nowadays, if this same proportion is looked

up in any school geometry book it will be found under the name “Medial section.” Such a name, which might mean anything, gives us no feeling at all for the importance and the quality of this proportion. This again is a good example of the way in which any understanding for the qualitative element in mathematics has been lost.

Now what is the importance of this Golden Ratio? First of all we find this proportion expressed everywhere even down to the smallest detail in the human figure, in so far as it is perfectly formed. Just as one can say that the Pentagon is built up on the Golden Ratio, so one can say that everywhere in the human form we find this ratio revealed. Hence we may see the real significance underlying the use of the Pentagon as a symbol of man. The Golden Ratio is the chief proportion which is aesthetically pleasing; we can gain immediate satisfaction for our artistic sense in looking upon this proportion whether it be expressed in nature or in artistic production.

To take a few examples of Golden Ratio from the human form: From foot to head the division is at the waist (major length below, minor above) or where the end of the middle finger comes when the arms are straight down by the side (minor length below, major above).

From tip to tip of fingers when arms are stretched out horizontally the division is at the shoulder (acromion).

The hand

Wrist to knuckle	..	..	..	Major }	
Knuckle to 1st finger joint	..	..	..	Minor }	Major }
1st finger joint to 2nd joint	..	..	..	..	Minor }
2nd finger joint to tip	..	..	..	..	Major }
				..	Minor }

The face

The division is at the root of the nose (major below, minor above) or the tip of the nose (minor below, major above).

These are only a few examples of how the human form is an expression of the Golden Ratio. (The subject is dealt with exhaustively in a book entitled *Der Goldene Schnitt* by Dr. Goeringer). Furthermore, “nature has ordered that the Golden Ratio applied to the human figure holds also for sitting, lying, or kneeling, etc., because the limbs are all built up according to this proportion. But in those positions

which disturb the law the human figure seems either to be ugly or falls within the sphere of the grotesquely tragic or comical and such positions do not enter into real art."

Again, all the greatest works of art embody the principle of the Golden Ratio. A most beautiful example of this is Leonardo da Vinci's "The Last Supper," perhaps the greatest masterpiece of painting in existence. Here we find the relation of the Golden Ratio throughout in the minutest detail in the

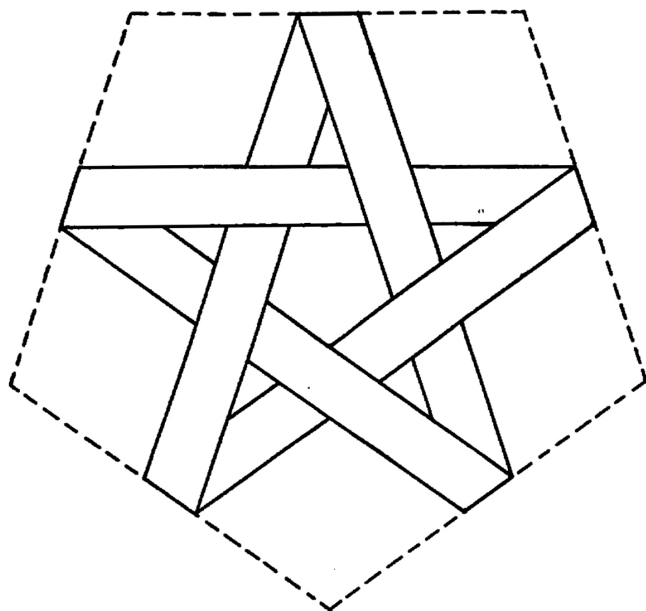


FIG. 6

whole composition of the picture and the grouping of the figures. A great artist uses the proportion, perhaps even unconsciously, because it expresses what is aesthetically beautiful.

In great works of architecture (e.g. a Greek temple) we find over and over again the embodiment of the same principle.

From what has been said here it can be realized that such a geometrical relationship is not just something arbitrarily thought out by the mathematician, but is inherent in all that is beautiful around us in the world of nature and in art. And

the geometrical form in which we find it uniquely expressed is the Pentagram.

Such a study as this, where so many threads have been woven together, can bring the children real and living interest for mathematics and for the laws underlying form in their own being and in the world around them. They feel then that mathematics and geometry are not merely utilitarian, but that there is a divine geometry and a divine mathematics in the whole plan and structure of the universe.

During the course of the lessons the children did many geometrical drawings in connection with the Pentagram, among them the beautiful Pentagram-band shown on previous page.

A. R. SHEEN.

The History of Art as a Necessary Subject in the Curriculum of the Child at Puberty

THE curriculum of Schools working on the principles of Rudolf Steiner makes the History of Art the subject of a special lesson for children of the ninth class (age 14-15).

At the age of puberty the child develops a strongly intellectual understanding of his surroundings—and in order to maintain his balance of soul he needs also an understanding in the sphere of art. To children of this age, therefore, the development of painting and plastic art from antiquity up to the modern age is shown by taking striking examples of southern and northern artists.

Dr. Steiner always tried to show how the child himself, in all the rapidly changing phases of his growth of body, soul, and spirit, must indicate to the teacher what is to be taught and when. If this were accepted as a guiding principle, many of the mistakes in the education of children could be avoided. Let us try to form a picture in our minds of the child at the age of puberty.

Why does the child often appear sad and depressed at the age of 14 or 15? The glory of the world of imagination

becomes more and more clouded. The world, robbed of a light which only childlike enthusiasm can cast over it, appears drab, and the child feels a connection between this outer darkness and a certain darkness within himself. I have endeavoured to answer this question more fully in an article on "The age of puberty" in a former number of this magazine.* At this age the children sometimes have a great thirst to go out into the world, to experience all the things that they have heard of, but have been forbidden till now, to enjoy the freedom of the adult. But when this happens a great disappointment usually comes over them, the world *is* disappointing to-day, and young people who have had the misfortune to go out into it too soon, only too often fall into a rut, which holds them fast to the end of their lives. This not only applies to the profession they have taken up (often chosen by them at the age of 14 and 15 and later sadly regretted) but also to their own attitude of soul—that, too, remains in a rut.

At this age a true education which is in conformity with the needs of the child must stimulate the highest ideals of humanity, and one way of doing this is to bring before the children the works of art which are the visible result of the struggling of the human soul to express its loftiest ideals—or in other words its connection with a divine world. When the child at the age of puberty can follow step by step the life of some great artist, seeing the struggle that goes on in that life, then the overcoming of difficulties, and finally the masterful reproduction of an imagination, something which bears the stamp of a higher reality, when the artist has risen to a degree of selflessness that makes him a pure vessel for the reception of the highest truths—when all this is experienced by the child he dimly feels the kinship of the soul of man with a divine being; he feels that, although that instinctive and natural purity of early childhood have vanished, the child in man is waiting to be awakened, and, once awakened, will have infinite and never-ageing powers of creation. Such a feeling roused in the child will make him long for this higher self to be born, he will look hopefully to the future and not shrink from it, and will gain confidence in the world and in human

* Vol. 2, No. 1.

beings. Some beautiful examples of this gaining confidence and trust in human beings could be given, for often children have emerged from this four or five weeks' period of art quite changed.

One can begin in such a course of lessons by speaking in a simple way of what art really is. Having done a good deal of artistic work in various spheres (painting, drawing, modelling, etc.) the children can be reminded that in the early years of their school life all such work came to them as play, they naturally expressed what they felt without thinking much about it or becoming conscious of the origin of their creative ability. But as they approach their present age the work is not easy, but often presents problems. Sometimes they think, "If only I could draw well, everything would be easy" but soon they find that it is not this faculty which gives the picture its charm, but rather an element of composition, of colour and so on—in other words qualities which can be got without the specialized faculty of being able to reproduce sense perceptions. And so gradually the question of the real nature of imagination will arise and to the children it is quite natural to speak of the imagination as a reality which in no way needs to be bound to perception through the senses. One can remind them of the myths which are the imaginations of an earlier humanity handed down from father to son by word of mouth till they come before our eyes and ears in their present form.

These imaginations were concerned with the relationship between the human being and the divine world. In very ancient times, as Rudolf Steiner shows us, men were not so wide awake in the daytime, nor so fast asleep at night, but a dream consciousness brought before their souls imagination-pictures of the divine ordering of the world. Gradually these visions were dimmed and the earth in all its naked reality stood out more and more. But there remained amongst a few chosen people, who themselves had to go through the most rigorous training of soul, an experience of higher divine beings—in fact, these few became the channels through which the divine will was brought to the people at large.

In the course of the Egyptian civilization, many years before the birth of Christ, we find such imaginations taking

on physical form in earthly material—statues such as that of the Sphinx are brought into being. The Great Sphinx is a gigantic stone monument erected to the memory of man in one vital stage of his development, the moment of his stepping down on to earth—the moment of incarnation from out of divine substance. Erect and peaceful, the Sphinx stands before us, a riddle to humanity to-day and ever. The Greek legend of the riddle of the Sphinx tells us that a dreadful fate befell all who tried to solve the riddle and were unsuccessful—and human sacrifices in great number had to be offered to the monster to appease its wrath. Every child to-day knows the simple version of the riddle which has survived—What being walks on four legs in childhood, on two legs in its middle years, and on three legs in old age—and the answer: “Man.” The Sphinx consists of an angelic face—neither man nor woman—man as an archetypal form—but with the breast of a lion, the body of a bull, and wings of an eagle. The three animals have a deep connection with the threefold nature of man as it has often been described in these pages. The eagle represents the head with the power of thinking, the lion represents the breast with the rhythmic processes, and the bull represents the limbs and the metabolic processes. Man in his threefold aspect of thinking, feeling, and willing is thus represented in the Sphinx. The Sphinx was dedicated to Ra Harmachis the Sun God (i.e. the visible sun) and as the sun rises day after day in the east and is born, as it were, out of the cosmic ether, so man again and again enters on the plane of physical existence—the mystery of birth is put before him in a striking picture.

The following passage from a hymn to the sun may, perhaps, help us to appreciate the reverence that the Egyptian felt for the golden orb of the sun in all its power and glory.

Thou appearest beautifully in the horizon of the heavens.
 Thou living sun that livedst first!
 Thou risest in the Eastern horizon and fillest the earth with thy beauty
 Thou art beautiful and great and gleaming and high above the earth
 Thy rays embrace the lands as many as thou hast created.

To the ancient Egyptian at a much less independent stage of development than the Greeks, the solemn steadfast gaze of the Sphinx looking into distances of time and space far beyond

the narrow limits of human vision, must have had an almost hypnotic effect, and we can understand how this statue was copied over and over again, in some cases avenues of Sphinxes being placed facing one another along the approach to a temple, speaking a dumb yet eloquent language to the throngs of worshippers entering the temple. We might put the mute expression of the Sphinx into the Latin words:

“Ex Deo nascimur.”
 “Out of God we are born.”

And now let us turn to the opposite extreme in Egyptian art—the Pyramid. It dates from a later time and only gradually develops into the stern triangular structure which we know.

The pyramid is a tomb which is also a symbol of death; its triangular sides point upwards to the starry heavens where dwells Osiris the spiritual sun and celestial Father. These gigantic structures were erected in order to ensure the safe conduct of the soul after death to Osiris. In earlier times no such elaborate precautions were taken, a simple grave with little covering sufficed. After a time a wall was erected and a roof covered the whole tomb. Then the walls were doubled and the roof raised. At the same time the base was widened and the apex tapered. This was known as the Mastaba, which then developed into the pyramid.

The pyramid is connected with the mystery of death; it is a tomb in the first place, but it is a monument to all those who have passed through the gate of death; and from the importance of these monuments it might appear that the Egyptian was more concerned with life after death than with earthly life. In actual fact the opposite was the case. The Egyptians developed an art which was essentially bound up with earthly matter—all their plastic and architectural work ran to enormous dimensions. The sheer weight of stone erected over a dead body, or as a monument to some person of rank, seems to drag every soul down to earth and to fetter it there.

A material counterpart of the human being as he had lived on the earth, with his name carefully inscribed on it, was regarded as a guarantee for the life of the soul after physical death, and the destruction of such a statue or the erasing of the name meant serious harm to the soul in its passage to Osiris.

In this connection one can speak to the children of the process of mummification which also developed only at a later period.

It has often been pointed out that the consciousness of man has changed and is still constantly changing. The waking and sleeping life of man were not always such great contrasts as they are to-day. Man was still aware of the working of divine forces in the Egyptian era, but within this era there took place a gradual darkening of the spiritual world, as against a continual brightening of the world of senses.

Some impression of this can be gained by considering such an answer as the Egyptian priests gave when questioned as to who was their first king. They said "King Menes (i.e. Minos, about 3400 B.C.) was our first King; before then the Gods reigned over Egypt." To Menes we attribute the building of the labyrinth of Crete and it is, indeed, symbolical of the labyrinth of the human brain in whose workings a man can indeed be lost when the direct guidance of heavenly powers are withdrawn from him.

How much the Egyptian Pharaoh was governed by Divine inspiration even at a comparatively late time in the whole Egyptian period can be seen from the well-known story in the Old Testament describing Pharaoh's dreams. Dreams were realities in former ages, and the Pharaoh knew that these messages, which could no longer be understood even by the most learned Magi but were accessible to the mind of Joseph, had a direct bearing on the affairs of every-day life and on the right administration of the country. It was the Pharaoh's peculiar task and privilege to dream. Formerly the dreams were clearer and the Pharaoh did not have to turn to others for elucidation; he himself was the initiate priest directly receiving the communication of divine beings. An early statue of Chefredjep in Cairo shows the Pharaoh sitting on his throne in a typical attitude. The body is quite erect, the legs are parallel side by side, on exactly the same level, the arms are parallel and close to the body and the lower arms rest on the legs. There is absolute symmetry between left and right with the one exception that the right hand is clenched to a fist and the left hand rests actively on the left leg with palm downwards. But what fascinates us and draws our look as if by magic is the face of this man. Can a human being

look so immovable and yet so benign, so stern and yet so just, so entirely objective? The face is round, it is in no way hard, the cheeks are full, the nose is well developed, the lips are full of life and expression, the upper and lower lips in even balance. Only the chin is drawn out to a pointed beard indicating the power of will. The ears are wide open, and slightly away from the head, but modelled with beautiful harmony, and then there is the gaze that steadfastly goes out into the distance. If you stand aside it passes you by, if you stand in the line of vision it goes right through you. Physical objects are no obstacle to the inner vision of which these eyes are capable. We seem to remember this look—where have we seen it before? Is it not in the Sphinx, this same ever-gazing look, ever inquiring, ever satisfied, ever emotionless to the ebb and flow of mere human existence? All the senses of this man are awake, but none perhaps so much as the ears. What are these ears listening to? The common Egyptian man and woman may never have known, for, as it stood in the temple, they only had the frontal view of the statue of this human being almost divine in sublime restfulness. But we who can look all round it can see, immediately behind the head of the statue, a bird with wings outspread in an attitude of protection, joined to the headdress of the Pharaoh. Wisdom seems to be flowing from this hawklike bird into the Pharaoh. Like a child blissfully receiving his natural nourishment, so the Pharaoh seems to drink in heavenly wisdom from his inspiring bird. In most languages the bird has been retained in the sense of an unnamed informant—in this statue of Chefredjep we see the origin of this use of the word.

(To be continued)

A. W. KAUFMANN.

*Recited by Class XI at the Celebration of the
School's Birthday, 19th January, 1935*

WHEN human heads at last were veiled in night,
Winter had thrown athwart the glowing sun
His curtain dark, repelling warmth and light,
And grasped the Earth with gnarled fingers white,
So that no more her waters wide should run,
A streaming robe of life ethereal spun,
But harden into death beneath his might.

“O give us life again!” the Earth did cry,
“My sons are weak, a heavy load we bear,
If comes no help, we must for ever die!”
Then did the Son of God in love draw nigh,
Become the Son of Earth, the brother dear
Of men, familiar with their pain and fear.
He comes to every man, and clear doth say,
“Let us together tread Earth’s mortal way,
And we will welcome e’en its sharpest spear,
And bring the Earth from death to newest day.”

J. DARRELL.

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