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The Pythagorean Concept of Measure

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NEW MEANINGS TO BE FOUND IN AN OLD
PERCEPTION THAT QUANTITY
(MEASURE) AND QUALITY (VALUE)
COEXIST AT THE ROOT OF NATURE

SINCE THE TIME RENAISSANCE MAN turned from the reading of the Book Divine to that of the Book Natural, an astounding development of science and technology has taken place. Their spectacular successes induced, little by little, an intellectual inebriation culminating, about the turn of the century, in a sort of a religious faith in reason believed to permeate man's nature, thus making him a being molded as well as moved by reason.

The year 1914 brought a fearful awakening from the absurd dream. The subsequent events disclosed even to those who had inclined toward an interpretation of the catastrophe as a momentary setback, the existence of a frightening gulf between the state of science and the state of man. It appeared that man's moral being had remained untouched by man's scientific activities. It appeared that modern science, being concerned with only one value, that of "finding out," had in fact become a specialty within the circle of human endeavors—hence, had become humanistically irresponsible.

Today's universal anguish is not simply a result of the fear of destruction. If doomsday came to be announced for tomorrow, our fear thereof would have a quality quite different from the anguish we presently experience, because our anguish is coupled with a feeling of senselessness. Science has given us marvellous insights into nature. Technology has made our life more comfortable in many ways. However, both science and technology have failed to make our life meaningful. The destruction which threatens us at this hour assumes the character of a stupid accident, showing none of the moral implications of doomsday, except perhaps to one who chose to detect the workings of a diabolic principle in the very fact that humanity did run away on the road of intellectual arrogance.

The loud accent we are putting on the scientific attitude does not imply an unawareness of the existence of other values. People still profess to be religious, to respect philosophy and art. It is apparent, however, that these values have been largely dissociated from "real" life. They have been pushed unto the fringe of life—they have become "Sunday values." In fact, they have been "museumized," just as beauty in our cities finds itself "parked away" at safe distance from a prevailing and overwhelming ugliness. Necessarily, the inner dichotomy of our being is mirrored in our creations which, in a thousand different ways, point to the rift existing within us.

In this our present situation, help cannot be expected from the outside.

THE PYTHAGOREAN CONCEPT OF MEASURE.
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MAIN CURRENTS. 21:51-57, JA-F 65,
LANGUAGES: ENGLISH
DOC TYPE: JOURNAL ARTICLE
JOURNAL ANNOUNCEMENT: RIF
DESCRIPTORS: METAPHYSICS; PYTHAGOREANISM; MEASURE; QUALITY

442
LEVY, E.
1965

At 440

We must heal our inner being, and we might well begin by trying to bridge the gap in us, which in the last analysis is one that separates the realm of quantity from that of quality.

Is it necessary to say that whereas the postulate of a change of attitude, of a reversal of values, can be clearly stated, there exists no automatic cure, no panacea for the evil that besets us? Is it necessary to explain that when a goal is passionately striven for, there will be no want of ways to approach it? But also, is it not evident that a chosen method should be pursued till the goal is reached?

It is in this spirit that we wish to direct the attention of the reader to a trend of thought endeavoring to bridge the gap from which we are suffering. That trend, originated, according to tradition, by Pythagoras (6th century B.C.), founded anew and developed in our time by Hans Kayser, takes as its starting point the musical tone, proceeding toward an acoustical philosophy, an understanding and evaluation of things through the sense of hearing (*akroāsis*).

It might at first seem an odd idea to choose the musical tone for an epistemological tool. Let us say at once that philosophy, like art or mathematics or religion, presupposes an individual gift, a talent. Any particular way of philosophizing also presupposes a talent, not only because the talent will determine the subjects about which to philosophize, but also because it will incline one towards the use of some philosophical tools rather than others. Now the Pythagorean viewpoint presupposes the gift of musical sensitiveness. Those who do not possess a musical instinct will neither understand nor admit Pythagorism. A philosopher to whom the world would be the same were music absent from it, will never be a Pythagorean. But there will be Pythagoreans as long as there are musical philosophers, or philosophical musicians.

The essence of the Pythagorean doctrine may be explained with the aid of a string stretched between two fixed points, and some device for the division of the string, as for instance a bridge. Such an apparatus is called a monochord, and has been used from time immemorial for acoustical experiments.

The stretched string, when plucked, will emit a tone, which for convenience we shall call "C," its absolute pitch being of no concern to us. The plucking of a single note on a string is certainly a most primitive experiment, and yet it provides food for thought. We set the string into motion, and hear a tone. What is a tone? It is, first of all, an impression received through a sense, the ear. By analysing our impression, we shall be able to distinguish several attributes: loudness, timbre, pitch—specific *qualities*, like bitter, hot, red, or soft. The physicist, however, will define those qualities in his own terms: amplitude, vi-

bration-form, frequency. In general, he will define tone as something produced by periodical vibrations of the air striking the ear-drum. These are all *quantitative* terms. The physicist mathematizes the musical impression. The reduction of qualities to quantities, to that which can be measured, is characteristic of the scientist's approach. Whitehead says: "All science as it grows toward perfection becomes mathematical in its ideas." And further: "For example, it might be asked at dinner: 'What was it which underlay my sensation of sight, yours of touch, and his of taste and smell?' the answer being 'an apple.' But in its final analysis, science seeks to describe an apple in terms of the positions and motions of molecules, a description which ignores me and you and him, and also ignores sight and touch and taste and smell." (1) Thus, the qualities of phenomena disappear in the scientific processing. I expose the physicist to a tone, and he hands me back a figure. He really does not explain the tone, but describes some measurable counterpart in the physical world. That abstraction from quality, that voluntary—one is tempted to say, heroic—self-limitation has made science great. It has also made it one-sided, and its inherent disregard for quality, that is to say for value, proves increasingly dangerous to man.

So far the gap between the two worlds, as exemplified in the difference between the musical and the physical terms, has not been bridged, but rather the sharpness of the contrast has been more nicely stated.

We are now going to produce tones of "higher" pitch (physically, of increased frequency) by shortening the string, while avoiding the alteration of its tension. This is done simply by applying the bridge to the string, thereby dividing it into a sounding and a silent portion. By moving the bridge along the string, we may obtain as many different divisions as we wish. We proceed systematically, and one of two methods may be chosen. According to the first method, we divide the string successively into two, three, or more parts, corresponding to the series of integers, and we then observe the resulting intervals. According to the second method, we divide the string by ear, seeking to obtain certain intervals arranged in a hierarchical succession, and we then observe the resulting ratios. It will be noticed that a musical principle of order can only be a principle of value, whereas a scientific principle of order can only be one of size.

Let us proceed according to the second method. The first two intervals, in order of their musical importance, are octave and fifth. Allowing our ear to be the judge, and continually testing the string while moving the bridge, we shall notice that the sound of the octave will occur when the string-length is exactly one half. Continuing to push the bridge in the same direction, we next obtain the fifth above the octave at one-third of the total string length. Now, knowing that one-half the string-length corresponds to the octave, we can predict that

one-quarter, one-eighth, or twice, four times the string-length will all correspond to octaves of the fundamental tone "C." In short, we may say that all powers of 2 produce octaves. Similarly, if we divide or multiply the figure $1/3$, corresponding to the fifth "G," by powers of 2 ($1/3, 2/3, 4/3 \dots 1/3, 1/6, 1/12, 1/24 \dots$), we shall always obtain the tone "G," in various octaves. On the other hand, it is easy to see that multiplying and dividing by powers of 3 will correspond to a progression by fifths: $1/3^0 C, 1/3^1 G, 1/3^2 D \dots 3^0/1 C, 3^1/1 F, 3^2/1 B \dots$. In other words, we may predict the tone corresponding to any figure constituted by powers of two, three, and their combinations. The tone of any following prime number, however, will have to be determined by experiment, or at least its presumed hierarchical position will have to be tested. The musical meaning of the prime number is the birth of a new tone. This shows that the value (tone) cannot be derived from the measure (string-length) any more than the measure may be derived from the value. In fact, we did not derive one from the other. We only put the elements of two orders into a one-to-one correspondence.

We are now ready to bridge the gap. To accomplish this, a mental attitude is required which many among us will be reluctant to assume, because it is contrary to the scientifically determined mind. The definition of that attitude is simple enough. It consists in this, that we must be willing to ascribe equal reality and equal importance to quality and quantity. On the physical side, the tone is represented by a figure. It is a symbol for a material, or "haptical" measure (from "haptikos" in Aristotle, meaning "able to lay hold of"). On the musical side, tone is a qualitative experience. We have heard the physicist give his explanation of the tone. Let us now listen to the musician with equal seriousness. His argument might run as follows:

Take the octave as the object of our discussion. Here we have two tones which are distinct from one another, different from one another, and yet in a way identical—so much so that indeed we call them by the same name. That particular identity of the octave, that sameness and yet otherness—truly a remarkable and unique phenomenon—how is it possible to apprehend it except by the musical ear? If I asked you to name something which is the same and not the same, would you not be tempted to scorn the answer, and accuse me of mysticism? If I then had you listen to an octave, and asked you to describe it, would you not say that the two tones composing it were alike and different at the same time? Now, having discovered that this remarkable interval corresponds to the ratio which comes right after that of identity, namely the ratio one to two, does it not seem perfectly legitimate to identify that ratio with the octave, to let it partake of that specific octave-quality? Wouldn't it, then, appear that the octave is an "explanation" of the ratio one to

two just as much as the ratio is an "explanation" of an octave?

What our musician says about the octave holds, of course, for any interval, any chord; in each case we may ascribe to a figure the value of the corresponding musical phenomenon. Thus we introduce quality into quantity, value into size. We are musicalizing mathematics, so to speak. The figure, from a mere symbol of quantity, becomes a symbol of both quantity and quality. It becomes what should fitly be called a *number* in count distinction to a *figure*. Specifically, we call such an "expressive number" a *musical number*. It is a bridge between quality and quantity, between the worlds of value and of sizes. It represents the *Pythagorean concept of measure* as one both *haptical* and *normative*, the norm being more particularly defined as musical.

Thus the antithetical concept-pairs, soul-intellect, feeling-thinking, intuition-reflection, are synthesized in the musical number as a psycho-physical symbol. Its two sides—musical value and haptical measure—are connected by a relation which is exactly and spontaneously apprehensible. Those who find it difficult to accept the Pythagorean viewpoint might ponder the following quotation from Viktor Goldschmidt: "Our capacity to apprehend the outside world may be explained thus, that there are processes in our mind (microcosm) which are analogous to those in nature. These psychological processes we call natural laws." (2) Now, there does not seem to be any good reason why this epistemological postulate should be monopolized by the haptical outlook. If I admit quantity in the outside world and a psycho-physical parallelism which makes that quantity apprehensible, stand on equally firm (or equally uncertain) ground when projecting into the outside world the value apprehended by the same psycho-physical process. In other words, and once more taking the octave as an example: Why should there be more truth in the numerical ratio "one to two" than in the musical "octaveness"? Why should I not claim that the psycho-physical parallelism is equally valid for quality? If an affirmative answer to these questions is granted, it still remains to be proved that our value-concepts are not merely an emanation of our soul. If they are, then they would stand only in terms of an aesthetic outlook. Their value would remain strictly humanistic, and could not be paralleled in the outside world. If, however, it could be shown that the acoustic value-scale manifests itself in a corresponding value-scale in nature, then the postulate of a psycho-physical parallelism would stand not only in respect to quantity but also in regard of quality. One of the tasks of harmonics is to find out whether such a correspondence exists. Results obtained so far permit us to affirm that it does.

One might object that an optical apprehension of the outside world could be postulated with the same right as we perceive

tulate an acoustical one. That is true. However, the ear possesses certain advantages over the eye which seem to make it a better and more readily available tool for the building of a bridge between quality and quantity. We have remarked a moment ago that the relation between tone and number is apprehended "exactly and spontaneously." We may, exactly and spontaneously, apprehend by ear a mathematical ratio. We notice, for instance, whether an octave is "perfect," as we say, or even slightly "out of tune." We are thus able to divide a string according to certain ratios, by the sense of hearing. The eye is unable to perform a similar operation in respect to color. Indeed, the ratio between two color frequencies cannot be recognized by the eye. Another, though less important, observation to be made concerns the range of frequencies, which for the eye is restricted to about one octave. Thus the ear appears more immediately useful for our purpose, and is even likely to provide a basis for the study of optical value-scales. Attempts in this direction, from Newton on, have been rather crude and a bit fanciful. It is hoped that the application of the more strict methods of harmonics will yield better results in the future.

Aristotle says of the Pythagoreans, "They assumed that the elements of numbers were the elements of all things." The assumption of number as the first principle, or "world-stuff," constituted an immense advance over the hypotheses of the earlier philosophers. Thales had thought that the world-stuff was water. Anaximenes had said that it was air. It is at once apparent that number has two advantages over all other assumed first principles: a great variety of things can be reduced to number (possibly all of them) and a system may be built. Modern science has borne out the Pythagorean hypothesis, more than any Pythagorean would ever have dared to dream. Burnet says: "It is impossible not to be struck by the resemblance between this doctrine and Dalton's theory of chemical combinations . . . the diagrams of modern stereo-chemistry have also a curiously Pythagorean appearance. We sometimes feel tempted to say that Pythagoras had really hit upon the secret of the world when he said 'Things are numbers.'" (3)

To modern science indeed, "all things are numbers." But from these numbers, the soul of things has been excluded. They do not represent the whole, but only its quantitative, haptical side. They provide only the size-measure of things, disregarding the value-measure. By introducing musical significance into the haptical number, we reestablish measure in its Pythagorean meaning as both *size-measure* and *value-measure*.

The day Pythagoras hit upon the discovery of the relation between pitch and string-length was the birthday of Western science. His experiment was indeed a scientific one. He succeeded in proving the existence of an exact mathematical relationship between the pitch of

tones and string-lengths, between that which can be evaluated and that which can be measured. However, his attitude toward the results of the experiment was significantly different from that which is characteristic of the modern scientist. Whereas the modern scientist discards the value (tone) to retain but the haptical measure (string-length), Pythagoras' enthusiasm was aroused rather by the fact that *mathematics could be heard*. The ear confers value-meaning on the numbers; thus the proportions varied in music will also be varied, not only for the eye, but for the cosmos of our soul as well as for the cosmos of the universe, both being subjected to the same laws. "The same numbers that appeal to the ear appeal in a marvelous way to the eye and to the soul." This sentence, ascribed to Pythagoras, very well sums up his position.

The influence of Pythagorean thought on Greek art and philosophy was considerable; it accounts to a great extent for the special consideration enjoyed by music, which was believed to contain the secret of the world. Now it should not be supposed that the Pythagoreans, confining themselves to general ideas, had built their cosmology upon the simple hint provided by the string experiment. On the contrary, they had worked out a system which was based on a table obtained through an interpolation of the division and multiplication series of the string—an operation, by the way, strikingly similar to the setting up of the Periodic Table. That Pythagorean Table has been reconstructed by Albert von Thimus (1806 - 1878) from a diagram and indications found in Iamblichus. Thimus' monumental work, entitled *Harmonikale Symbolik des Altertums*, (DuMont-Schauberg, Köln, 1868) served Kayser as a starting point for his own work. Whereas Thimus had been interested mainly in the historical aspects of Pythagorism, Hans Kayser (1890 - 1963) recognized at once the intrinsic significance of the *tabula pythagorica* for modern thought.

The Pythagoreans themselves had been led to remarkable concepts by the Table symbolism, which among many other views suggested to them that of heliocentrism, two thousand years before Copernicus. All through the Middle Ages, Pythagorean thought, transmitted by such men as Aristotle, Vitruvius, Boethius, may be traced in various forms. Number symbolism as embodied in the proportions of Gothic cathedrals belongs to the Pythagorean tradition as well as to St. Augustine's fundamental views on music and poetry. In Kepler, (1571-1630) harmonical thinking produced its last achievement. Kepler's Third Law was indeed found through a typically harmonical method—a fact which modern scientists unfortunately shrink from recognizing. With the advance of experimental science, the emancipation of number from value progressed rapidly, and by the end of the seventeenth century the haptification of science had become pretty general.

It is interesting to follow that process of haptification, that transition from the medieval to the modern attitude, and to consider some of its consequences.

The theologian-philosophers of the Middle Ages had erected a grandiose cosmic monarchy in which, toward the end, the world became a petrified system of symbols. We may say, in Pythagorean language, that value was over-emphasized, the phenomenon neglected. Such an attitude is characteristic of exclusively deductive thinking. One of its outstanding qualities is a sense for morphology. The world is an organism ordered by God. Knowledge starts with God-given, that is to say archetypal form-concepts, proceeding thence down to the phenomenon. The obvious danger of such a speculation "from above" lies in a trend to blindness toward the evidence of facts, or in a temptation to distort the facts to make them fit the preconceived ideas, the religious-aesthetic archetypes. On the other hand, the danger of inductive science lies in disregard for morphological value. There is a trend to uniformize, to make everything appear of equal importance, lastly, to become purely descriptive, a position of renunciation, or of resignation, which many modern scientists have deliberately taken. It is a logical outcome of the haptical view. In 1928, the embryologist Joseph Needham wrote, "Materialism is the only philosophy upon which science can get to work... and if I do not believe in it for a moment as a man, I recognize its fundamental importance as an experimentalist." (4) It is impossible better to express the dichotomy of modern man, that "double life" mentioned before. The founders of modern science, however, did not take such an extreme stand. They were still aware of the necessity to unite the deductive and inductive attitudes. In a letter addressed to Michelangelo Ricci, on February 10, 1646, the physicist Torricelli, disciple of Galileo, writes: "Whether the principles of the doctrine *de motu* be true or false is of very little concern to me. For, if they are not true, one has to imagine that they are true according to what we had assumed, and then one has to take all the other speculations derived from those principles... in a purely geometrical way. I imagine or assume that some body or point is moving up or down with the known proportion, and horizontally with equal speed. This assumed, I then say that all Galileo and myself have said will follow. Now if the balls of lead, iron, stone do not observe those assumed proportions, that's just too bad for them; we shall say that we simply won't talk about them..." (5)

The statement is delightfully humorous—yet its essential seriousness cannot be doubted.

On May 30th, 1698, Newton writes to John Harington, "I have, in former considerations, examined these things, and wish my other employments would permit my further noticing thereon, as it deserves much our strict scrutiny, and tends to exemplify the simplicity in all the

works of the Creator.... In fine, I am inclined to believe some general laws of the Creator prevailed with respect to the agreeable or displeasing affections of all our senses; at least the supposition does not derogate from the wisdom or power of God, and seems highly consonant to the macrocosm in general." (6)

Little by little, the archetypal form-concepts, which may be regarded as a sort of grand-style hypothesis, were replaced by so-called working hypotheses. In former times, the accent had been on the form-concept. The phenomenon was expected to conform. If it did not, "suo danno" as Torricelli says—too bad for the phenomenon! Now, however, the stress was shifted to the phenomenon, which was asked to speak through the experiment. True, some a priori assumption was still needed. But if it proved false, "suo danno"—too bad for the hypothesis, which then had to be changed to fit the newly acquired view!

The failure of science to tackle successfully questions of morphology—a failure intimately tied to its very method—is one of the more obvious consequences of the purely haptical position. It is clear that a mechanistic or utilitarian view will never do when faced with the task of explaining, say, the forms of living organisms. Cell-division alone will not provide an explanation. The stones do not explain the architecture. The tones do not explain the symphony. We read that "they say that Pythagoras had been the first to call the universe Cosmos—that is: order, harmonical structure." (7) Now order means diversification of uniformity and unification or harmonization of diversity. Of the three terms—uniformity, diversity, harmonization—we disregard the last one, which, on the cosmic level, raises questions which may be forever unanswerable. It may be noted that sometimes the extreme terms are mixed up, in the sense that the first term (construction unit) is erroneously identified with the last one (supreme morphological principle). The main business of science is to reduce diversity to uniformity. The scientific progression from effects to causes is descending, not ascending. Morphology, however, has to show the flowering of diversity from uniformity. As Warrain puts it, "... for every scientific problem whose object is to reduce the diversity of the real world to a unity of origin there exists another scientific question whose object is to report on the actual selection of the realities among the possibilities allowed by the generality of the law." (8) In other words, after having reduced reality to some primary building-stone—the "world-stuff" of the ancient Greek philosophers, the "energy-quantum" of modern physics—it remains to be explained why the world-stuff agglomerates into such and such phenomena. We might even ask: If the world is but a set of "variations" on a "theme," why did the Creator go at all into the trouble of creation? Why did the world become phenomenalized? These are questions

which cannot be answered "from below." To investigate them, we need morphological concepts, which are value-concepts.

One such concept in music is, for instance, that of the so-called perfect chord, or triad, contained within the first six numbers, or senarius (prime: 1-2-4, fifth: 3-6, third: 5). Octaves being considered identities, the senaric values extend, first, over the numbers 8-16-32 . . . 12-24-48 . . . 10-20-40 . . . , and further, over products between senaric values, e.g., 9 (3-3), 15 (3-5), etc. The senaric principle is widely and variously embodied in nature, for instance in whorled flowers. A particularly striking and beautiful example is the passion-flower (*passiflora coerulea*), where a tripartite pistil is combined with a quinquepartite stamen, the octave of which is shown in the petals. Such a form-tendency can only be understood when paralleled with the corresponding musical phenomenon.

Another consequence of the haptification of modern science is its separation from philosophy. Newton is still speaking, not of "natural science," but of "natural philosophy." With the disappearance of the value-concept from haptified science, the "Universal Harmony," as it was still called in the seventeenth century, came to be regarded as of no more concern to science, and was handed over to the philosophers. Thus a break between science and philosophy occurred. One might be tempted to classify it under the heading of "division of labor," and it may perhaps be considered an occurrence parallel to that brought about by the Industrial Revolution. Its real significance, however, lies in this, that it is a break within man himself, a division of his innermost being—the dichotomy to which we have pointed before. The effect of the separation on science has been described: science has become "amoral." The effect on philosophy is just as disastrous. Squeezed between religion whose source of divine inspiration she doesn't share, and science whose methods she cannot use, philosophy has in the main turned critical and historical, abandoning all claim to the royal position she once held. That is the situation brought about by the tremendous development of one branch of human pursuit, and the gradual etiolation of all other branches. In these days of collective man-made catastrophes, no one dare say that the problem is an academic one. And if it were? The disparaging term "academic"—to wit, purely theoretical—does it not depict our state of mind, a haptical mind, valuing only that which is "practical" in an immediate and utilitarian sense? Does it not, in substance, mean that ideas are nothing, haptical successes everything? True, we desperately cling to a few "ideas"—liberty, democracy, justice—because we obscurely feel that in the last analysis it is precisely such "academic" things that keep us going and acting. Yet we should be warned: a civilization that stakes everything on haptics may finally abandon even

those last spiritual strongholds. If we don't take heed, we might, in the end, resemble the man trying to propel the boat in which he sits, by blowing into the sail.

Our postulate, then, must be the *reunion of philosophy and science*, a reunion in which neither partner will be the handmaiden of the other. Such a reunion should eventuate in the establishment of a philosophic-scientific body of knowledge fitly termed "Normative Science," a science where philosophy tests its findings by the methods of science, and where science acknowledges the selection-principles of philosophy.

There is nothing utopic in such a postulate. On the contrary, it is the separation that ought to be looked upon as artificial. All creative processes of the mind, from mathematics to art, are characterized by a peculiar interplay between deduction and induction, the idea and the experiment, the method "from above" and that "from below." Now if we imagine on one hand a value-concept foreign to science, and on the other hand a haptical concept, foreign to philosophy, what we should look for is a means of translating one into the other. Such a translation should be based on phenomena in which the attributes of quality and quantity are united in such a way as to afford an exact and spontaneous apprehensibility of their relationship. At the present time, we know only one such phenomenon, though others may exist: the musical tone, as symbolized in the musical number.

It would seem that for some time there has been a growing awareness of the necessity for a change of mind. Strangely enough, it has been facilitated, while probably not prompted, by the recent revolutions in physics—as much, perhaps, as it has been promoted by the anguish of our times. The symptoms are numerous. Whitehead's *Science and the Modern Man* is easily among the most significant ones. In a speech delivered July 20th, 1928, on the occasion of the unveiling of a monument at Kepler's birthplace, Sir Arthur S. Eddington said, "It is only in the latest years that we have gone back to something like Kepler's outlook, so that the music of the spheres is no longer drowned by machinery." The introduction of the Gestalt concept not only into psychology, but into other fields as well, is also significant: "People banded together in an economic community are more than a simple sum of individual beings. As 'members of one another' they form a biological organism whose whole is always greater than the sum of its parts." (Dewey and Dakin) (9) In general, publications disclosing a more or less conscious or avowed Pythagorean viewpoint are no longer a rarity today. Future generations, however, will recognize Kayser as the first modern pioneer of harmonics, in both an historical and a qualitative sense. To date he is the only author to have treated harmonics methodically and comprehensively. His first

say (*Orpheus*) was published in 1924, while his first basic book appeared in print in 1932. (10)

Thus there is a good chance that once more we are standing on the threshold of a renewal in man's thinking—a renewal which would be characterized by the general idea of the "Pythagorean Measure." The road will be long, but we have learned to bridle the impatience that in former times prompted the erection of great deductive systems. The lesson of haptical science has not been lost. Normative science will be built up gradually. And it appears, surprisingly but naturally enough, that

continual contact with values—though we learn the story but little by little, and may never learn it whole—is so highly satisfying that our patience actually grows as the work advances. We begin to understand that we do not have to erect at once a comprehensive system to soothe our impatience. It is enough that each stage of the slow advance confirms the existence of immutable values.

But those are things everybody has to experience for himself. "What we need is not to 'know' the truth, but to experience it." (Jung) (11) Thus we transform facts into values.

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Professor Levy has written extensively, principally on musical subjects. At present, in collaboration with Dr. Siegmund Levarie, he has in preparation a textbook of acoustics. He has also written fourteen symphonies (of which three have been performed in this country), in addition to a cello concerto and works for orchestra, for the organ and the piano, choral works, and chamber music. His piano music has been published by Boosey and Hawkes and Associated Music Publishers, and Mercury has published his choral setting of Four Folk Songs from Switzerland.