La sphère et l'intervalle. Le schème de l'harmonie dans la pensée des anciens Grecs d'Homère à Platon by Anne Gabrièle Wersinger

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Reviewed by
Sylvain Perrot
Université Paris IV, Sorbonne
sylvain.perrot@paris-sorbonne.fr

In 2008, two books were published about ἁρμονία (harmony) in ancient Greece. We must admit that until then no book had dealt with the question of ἁρμονία so precisely as these books, which are consequently welcome in this research field of ancient Greek philosophy. *The Science of Harmonics in Classical Greece* by Andrew Barker, who is well known as a great specialist of ancient Greek music, examines the Greek science of music in classical times: its purpose is to understand how the ancient Greeks dealt with questions of musicology in the fifth and fourth centuries BC. Barker's interest is with musical theory. So we may underline two important differences with the book by A.-G. Wersinger.[1] First, she is a philosopher, not a musicologist; and the concept of ἁρμονία is, for her, not limited to music. Second, she aims at understanding how the notion of ἁρμονία was born in Greece and developed from its beginnings until classical times, though mainly in archaic times. In my view, both books are complementary and very important for modern scholars who study philosophy and musicology as well as mathematics, because all of these sciences were studied together in antiquity.

Wersinger's book presents two big difficulties that she herself points out. Most archaic Greek texts (except Homer's and Hesiod's epics) are fragmentary, and so her project entails reconstructing a whole way of thinking largely from ashes. But this is even more problematic than it seems: these fragments are mostly extracts chosen and quoted by later ancient authors, e.g., Plato or Aristotle. Consequently, we cannot always be sure that these texts were quoted

[1] The table of contents of this book can be found on the editor's website, http://www.millon. com/collections/histoire/horos/spheretm.html.

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accurately and fairly: ancient authors typically want to prove something particular and so may edit or even falsify their sources. But Wersinger is conscious of these problems and is very cautious, so that her method and her results are absolutely convincing.

Wersinger considers the evolution of the notion of ἁρμονία in Greek thought. She proceeds by studying a different philosopher or philosophy in each chapter, broadly moving forward in time. The book itself is divided into two parts answering to the title: the sphere and the interval. In this way, the author aims to prove that this distinction lets us see two ways of understanding ἁρμονία in ancient Greece. As she says: ‘at the beginning, the scheme of ἁρμονία is the circle and the infinite signifies perfect circularity; in the end, the infinite has become the interval between more and less, whereas ἁρμονία is identified with limit and unity’ [11]. But we have to be very careful with the notions of Presocratic philosophy, since, for many of these notions, there are no equivalent words in our modern languages.

As expected, the author begins with ἁρμονία in Homer’s epics. Of course, there is not any theory of ἁρμονία in archaic poetry. But Wersinger succeeds in finding many clues in descriptions of ‘archaeological’ objects (wheel, shield) and ritual events (the crane’s dance, also called the dance of the labyrinth). We might think that ἁρμονία is to be seen in a perfect circle, but it was not actually so in those times: ἁρμονία was viewed more narrowly as the junction between both ends of the circle. There is a bond, a connection, but it is invisible. Aristotle says that the circle is infinite because there is not any end. For archaic writers, the circle is infinite in that there is no join for the eye to see. Consequently, the circle, formed by bending a straight line so that its ends meet, is, like ἁρμονία, the result of two main processes: tension and articulation. These terms belong first to physiology: body is at once fibrous or stringy (μέλος) and articulated into limbs (γυῖα). In Greece, a μέλος is also music or melody. Each sound has a particular tension, an inflection or pitch; it is not yet considered as a part of a musical interval. For archaic poets, ἁρμονία results from an articulation of sounds, whereas Pythagoras’ and Aristotle’s schools describe it as a succession of intervals.

Empedocles, the first of the Presocratic philosophers, uses the same terminology as Homer but in a new framework. For Homer, the σῶμα is a corpse; whereas for Empedocles it is a body. Articulation and tension are no longer only properties of body but of a whole nature. For Empedocles, body is a degree of ἁρμονία because it forms a unity due to the mutual articulation of members and organs; Homer, however, thinks body is made of multiplicity. Wersinger notices opportunely that Empedocles' theory of ἁρμονία appears in his poetry, what she calls 'harmonization of *melea*' [67]: it corresponds to repetition of set expressions, which characterizes Empedocles' style. Repetition builds a circle, a unity between all the verses of a poem: it is composed of several important moments comparable to peaks. Repetition is like a path that connects all the summits. There is another relevant metaphor in Empedocles' poems, the κώδων [see Diels and Kranz 1951–1952, 31B99]. The κώδων is a Greek bell, a percussion instrument, and at the same time a trumpet bell; it is also for Empedocles the bell in the ear which transfers sounds inside the head. It is not only a resonator but also a musical instrument which plays what it has heard. So there is repetition. Unity is the purest form of ἁρμονία but it is not its principle: ἁρμονία is a kind of net made of juxtaposition.

Heraclitus introduces a new concept into the definition of ἁρμονία: community. The junction of both ends of a circle is thought of as a union with common elements, a kind of fastening. In Homer's epics, a ἀρμονία could be a pact or agreement: Heraclitus shows that ἀρμονία forms a community of interests in politics or a community of principles in ontology. Like his predecessors, he thinks that infinity is in fact invisibility but for him it is due to density: there is a hidden circularity in universe. Therefore, contraries are bound together like day and night in the circle of 24 hours. Heraclitus' reflection about ἁρμονία is first a reflection about astronomy, particularly the transition between day and night. Heraclitus' astronomy rests on four new propositions:

- the Sun's journey through the sky no longer fixes the limits of night and day;
- the Sun no longer goes under the Earth (during the night);
- there is not any exclusive difference between day and night (only a variation of hot and cold exhalations, whose ratio is to be understood in relation to distance from the Sun); and
- the Sun does not form a unity.

Night and day are like tenon and mortise, bound together in themselves. Consequently, Heraclitus builds a theory of the whole universe by organizing the four elements in a circle [see Diels and Kranz 1951–1952, 22B31]: fire is changed into water by condensation, water into earth and air by solidification, and then earth into water by dissolution, water into fire by rarefaction. In fact, it is a circle of fire, which appears to be the most important element in Heraclitus' system. Wersinger examines too a fragment about music, Diels and Kranz 1951–1952, 22B10, which refers to the heptachord, the seven-note system of the seven-stringed lyre in archaic times. This heptachord is joined in that the seven notes follow one another without any 'break'—in our modern notation, this would be

$$ABCDEFG \text{ or } CDEFGAB.$$

In this case, the octave is not heard and so is 'invisible'; but if you restore the missing note, you obtain a circle and thus ἁρμονία. Archaic lyres had seven strings: three of them were pegged to the right, four to the left. So there is a difference: concordance (the octave) comes from difference. In fact, the heptachord (the octachord with the invisible note) is made of two tetrachords. The central note (*mese*) is common to both: from this community you have musical ἁρμονία (by adding the invisible note). ἁρμονία is at once visible and invisible and that is Heraclitus' style: it is made of argumentative prose (where the theory of ἁρμονία is visible) and aphorisms (where it is invisible).

A new conception of the circle may be found in Parmenides' fragments. As before, the circle is formed by the junction of two ends; but it is also geometrically defined in relation to its center, the circumference being conceived as a limit. So Parmenides poses an ontological problem: being is something limited. Empedocles and Heraclitus had their own style: Parmenides for his part composes many circles and each of them has a center. Limit is associated with identity and indivisibility: limit contains and maintains each being. It does not mean that limit is between more and less because that would amount to saying that being is made of multiplicity, which is not possible for Parmenides. If being were a multiplicity, it would disappear. Only later is there limit between more and less, as far as being able to grow or shrink. From Homer to Parmenides, the idea of the circle has been retained to define ἁρμονία. But the nature of the junction of both ends has been interpreted differently: for Parmenides, this union is a kind of universal binder, a coalescence which permits integrity.

The second part of Wersinger's book is devoted to the notion of interval and how the archaic vision of harmony as circle was changed into that new notion. Wersinger thinks that the missing link is to be found in Anaximander's philosophy. There is only one relevant fragment [Diels and Kranz 1951–1952, 12B1], which Wersinger analyzes grammatically, morphologically, and philologically. For Anaximander, the ἄπειρον (infinite) is at the beginning of generation, but there is no circle because the philosopher does not speak of corruption at the end of being. He invents the notion of γόνιμον, that is, the separation of two opposite qualities from the ἄπειρον. The ἄπειρον is a kind of 'panspermic' marrow. It combines the forces of differentiation and combination, Chaos and Eros. In consequence, it is the model of ἁρμονία, like sap, with a circular and discriminatory structure—for the sap of a tree both creates a living periphery and causes death (wood) at the center, thus combining two contraries, life and death, to form a tree. This is not the model of κόσμος which is an arrangement of different astral wheels with their hubs on the same line: so center is very important. In Homer's epics, the center is the place of conflict, of hard battle; in Anaximander's philosophy, it is the place of measure, of symmetry and balance. The whole universe is organized in circles, and so by the number three, which is in fact the best approximation at that time of the number π. Wersinger notices that Anaximander's reflection is inspired by Doric architecture, particularly the circular drums of a column. So Anaximander theorizes two forms of ἁρμονία: ἄπειρον (where ἁρμονία combines opposites) and κόσμος (where ἁρμονία is symmetry).

The Pythagorean school introduces its conception of number into the problematic of ἁρμονία. But modern scholars have to understand properly what number represents in those times: Is it the thing itself or just an instrument of knowledge? Wersinger answers that Pythagorean philosophers do not revere numbers but think that numbers are in a relationship with παθός (affection of being). So they said that the whole sky is ἁρμονία and number: there is the rhythm of the stars' movement and the ἁρμονία of astral sounds. There are two ways of interpreting numbers: the 'arithmo-geometric' one and the 'logistic' one. The first corresponds to the theory of ψῆφοι in which the little stones by which the ancient Greeks voted are used to figure numbers. The number 5, for example, is figured by five ψῆφοι which are arranged in two parallel lines each of two stones with the remaining stone in between the lines, thus signifying that this number is odd. So you have a constellation of identical arithmetic units. The second model, the 'logistic one', corresponds to the theory of λόγοι (ratios). A unit is composed of limit and ἄπειρον: the best example is that of the λογοὶ ἐπίμόριοι, superparticular ratios defined by the form $(n+1)$:n (where n is a whole number). One part can be measured and another one cannot. The first model seems to ignore ἄπειρον. That is why Zeno's argument about Achilles and the tortoise is against this arithmo-geometric interpretation: for Zeno, being is continuous and arithmo-geometric numbers cannot reveal that continuity. The question is what is between two units? Between two opposites? Many Pythagoreans, therefore, invented a table where there are two columns of absolute opposites, the συστοιχίαι. But, for other Pythagoreans, there is between beings a διάστημα, an interval, which lets one distinguish various fields in the ἄπειρον. As far as numbers are concerned, there is the 'geometric progression', but Archytas theorized two others: the arithmetic and the harmonic. Intervals may vary according to one's point of view. Intervals can limit or be infinite, as observed in music. The problem is to divide the tetrachord: the tetrachord is delimited by the interval of a fourth, which in modern terms is viewed as two tones and a half; for the Pythagoreans, the fourth is composed of two tones (9:8) and a λεῖμμα, literally, the rest of the interval (which is only approximately a half tone).[2] So an interval can be limiting (the tone, 9:8) or indefinite (the λεῖμμα).

Infinite and limit are constitutive of the circle for Pythagoreans: circumference is infinite whereas radius is limiting. Consequently, a sphere, like a circle, is created by an interval, in the relationship between the center and periphery. Many of them consider that the sky dome results from 'pulling' the external curve to the center by the means of the radius. However, the philosopher Philolaus held that the universe (κόσμος) is like a sphere: it results from harmonization of the Indefinite (τὸ ἄπειρον). The ἄπειρον is divided to produce the center of a spherical space: the center is made of fire and the

[2] The ratio of this interval, 256:243, is superpartient.

periphery of air, the envelop of sky. To harmonize is to divide the ἄπειρον (which is made of more and less) into intervals that demarcate degrees. So Wersinger thinks that Philolaus is a Pythagorean in so far as he holds that ἁρμονία combines opposites, but that he departs from that school in understanding that intervals do not definitively limit ἄπειρον: this is particularly clear in his conception of music. There is an interval between high-pitched tones and the low register. But inside this interval, there are other intervals and so on: interval is at once infinite and limited. As we have seen, Pythagoreans conceived music as mathematical ratios and a particular ratio is associated with each interval. All intervals are not fixed: the *diesis*, for example, is only approximately a half-tone. Therefore, limit and ἄπειρον are always in a relationship with one another. This relationship permits ἁρμονία: Philolaus is said to have invented the disjunct heptachord, also called 'Pythagoras' octachord'. In the disjunct heptachord, the highest-pitched note (the *nete*) is one tone higher than in the conjunct heptachord; so Philolaus creates a bigger interval from the *mese* to produce the octave with only seven notes (heptachord). But it is not yet the standard octachord because one note is 'mute' due to the organization of octave. For Philolaus, the octave was

$$EFGABCD.$$

Since he wanted to have an octave with only seven notes, he created the sequence

$$EFGABD$$

so that the C is mute and there is a tone and half between B and D.

Philolaus theorizes superparticular ratios from the octave, which is typically for him musical ἁρμονία. The octave is made of a fourth and a fifth. All these intervals have for Pythagoreans superparticular ratios: the octave is 2:1; the fourth, 4:3; and the fifth, 3:2. The tone articulates the octave, as far as it is the link between two fourths, and so the difference between the fifth and the fourth, a difference obtained by division (3:2/4:3 :: 9:8). The octave is like a circle whose center is the *mese*, the central note which creates limit; both extremities of the octave are also limits. The infinite is the interval which envelops the transition from conjunct to disjunct heptachord: one interval persists in another during transition. In this case, there is a 'redistribution' of notes inside the second tetrachord so as to maintain the same number of notes in a bigger interval. Therefore, the disjunct heptachord, Philolaus' ἁρμονία, is made of limits and ἄπειρον (tonic intervals and *dieseis*). For Wersinger, Philolaus' ἄπειρον is 'active diversification' [301]: there are unlimited possibilities to place *dieseis* inside the tetrachord.

Archytas has yet another point of view: he wants to measure all the differences and thinks that whole universe is made of proportions, like the great sculptor Polyclitus in his *Canon*: all the measures of the human body are proportional to the smallest phalanx in the little finger. But Archytas fails to find a geometrical average in the octave: he can only find an approximation, because it is in fact $\sqrt{2}$. It is typically the problem of ἄπειρον. For Archytas, the ἄπειρον is not measurable: there is no symmetry or visible proportionality. Since he does not want to see ἄπειρον in melodic ἁρμονία, he has a hard problem to solve. However, Philolaus admits the ἄπειρον in ἁρμονία; it is even one of its principles. Thus, ἁρμονία is the interval between the ἄπειρον and limit and at the same time it is the result of this bond, viz. a κόσμος.

Anaxagoras, Pericles' famous teacher, is the last philosopher whom Wersinger examines. He represents the last step before Plato and Aristotle in the question of ἁρμονία. For him, the universe (κόσμος) is just a blend of every quality. Infinite and limits are not separated. But how is it possible to conceive identity when everything is mixed? The answer is the theory of homeomery: following Barnes [1982, 20], we can say that a property P is homeomerous if it is the case that when x has P, every part of x has P. Anaxagoras thinks that the infinite is indeed an infinity of parts. It is not extensively infinite, but the number of parts is infinite; furthermore, opposite qualities are extended into one another. So, the ἄπειρον is relative, a circularity that is always at the same time more and less big. The whole universe is always between more and less: one could say 'everything is in everything'. Wersinger opportunely compares Anaxagoras' philosophy with theater scenery in the fifth century BC. (what a spectator sees depends on the place where he sits) and acoustics (you can speak with a high-pitched voice to sound like people who scream from a distance). According to Anaxagoras, we only see differences: the more you look at microscopic level, the more things seem similar.

Therefore, the infinite is a swirl of all differences. Anaxagoras introduces nothingness into being. Parmenides thinks that there is no infinite because being is limited. For Anaxagoras, there is not any limit or else there would be nothingness.

To conclude, Wersinger describes the evolution of the notion of ἁρμονία as 'leaving multiplicity' [335], which is not chronological, because most of the Presocratic philosophers lived at the same time. But each one belongs to Greek culture which begins with Homer and variously interprets this heritage. For the famous blind poet, the infinite corresponds to the invisibility of the bounds that bind the circle. Empedocles invents the notion of unity. Heraclitus thinks that invisibility is not enough to explain the ἄπειρον: for him, it is the expression of a unity which contains a certain multiplicity. Unity is the ἁρμονία of multiplicity. Parmenides and the others try to leave multiplicity: the continuous is identified with the indivisible. For Parmenides, limit is the key; for Zeno, the ἄπειρον is made of more and less and multiplicity leads to nothingness, chaos. When one conceives the ἄπειρον as made of more and less, the notion of interval is used. So it is easy to imagine that there are intermediate positions between both extremities of the interval. And so ἁρμονία is not represented as circle any more, but as an interval.

In sum, I would say that Wersinger's work consists in trying to isolate Presocratic philosophy from all the Pythagorean, Platonic, or Aristotelian elements. These schools have studied the Presocratic philosophers but have interpreted them in their own way. I personally think that Wersinger succeeds in understanding how the ancient Greeks elaborated this very difficult notion of ἁρμονία. Her method is meticulous, her knowledge of Greek philology and philosophy indisputable. For other sciences like musicology, she has consulted great specialists, which validates her results: the bibliography is complete and the historiography well digested. Of course, this book is sometimes difficult to understand because of the complexity of the subject, but the author tries to help her reader: each chapter concludes with a clear recapitulation of the most important points of the argument.

For all these reasons, I warmly recommend Wersinger's remarkable essay.[3]

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3 While completing this review, I learned that Wersinger's book has been awarded the Prix François Millepierres by the Académie Française.