PART ONE

CONCEPTS OF SPACE

CHAPTER I

THE MEANING OF "SPACE"

1.1.

"Space" in language

A survey of definitions of space included in *The Oxford English Dictionary* (1989) brings forth the surprising conclusion that the predominant meaning of space is time.[1] The earliest citation, dating back to the year 1300, reads: "faith lasted littel space."[2] Here, "space" denotes a duration, a "lapse or extent of time between two definite points, events, etc." (sense **1.a** in the *OED*; cf. Table I-1).[3] In relation to time, space has other, similar meanings: "the amount or extent of time comprised or contained in a specified period" as well as "a period or interval of time," that is *a space of time*. These senses appear in many literary sources. For instance, Jonathan Swift writes about the "space of ten hours," John Keats about "a moments's space" and Harriet Beecher Stowe about "a space to say something."[4]

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[1]The following summary includes senses of "space" chosen because of their possible relevance for music; numerous denotations have been omitted as obsolete or rare.

[2]*The Oxford English Dictionary*, 2nd ed., vol. 16, 1989, p. 87-89. In subsequent citations, I will use the abbreviation to OED.

[3]The Table I-1 (at the end of section 1.1) contains a selection from the meanings of "space" listed in the entry in the *OED*. Here, I include some of the infrequently encountered meanings of "space" to illustrate the polysemous character of this term.

[4]Swift's citaiton comes from *Gulliver's Travels* (1726), Keats's from *St. Agnes* (1820), and Stowe's from *Uncle Tom's Cabin* (1852); all from the *OED*.

The temporal senses of "space" associate this term with the ideas of "measurement" and "distance." This conceptual link underlies the philosophical idea of the "spatialization of time" (Bergson 1913; see section 1.5 of this Chapter). Indeed, the expression "the space **of** time" is as common as "the space **and** time"--the former denoting the measurement of time, the latter the totality of existence.[5] Here, the problematic nature of the notion of space becomes apparent.[6] The two meanings of space as the complement and the attribute of time are diametrically opposed, yet frequently intertwined; this "entanglement" has consequences for the meaning of space in music (cf. Chapter II).

Another large group of the senses of space refers to area and extension. "Spatial" is what co-exists simultaneously, what is present at the same temporal instant. Again, as in the group of "temporal" senses, the relation of space to measurement is of primary importance. The 17th-century poet, John Milton writes: "Twixt Host and Host but narrow space was left. A dreadful interval" (Milton 1667; in the *OED*: 87). Here, space means "linear distance; interval between two or more points or objects." In this sense, space has one, measurable dimension.[7]

"Space" may also mean "superficial area, extent in three dimensions." Thus, all three-dimensional objects, including musical instruments and bodies of the musicians "occupy a certain space." If so, space may be sufficient or insufficient for

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[5]This conclusion may be reached on the basis of citations listed in the *OED*; these quotes are gathered to document linguistic practice, rather than delimit the range of possibilities (i.e. the Dictionary is descriptive, not prescriptive).

[6]"Space" is equally polysemous in other Indo-European languages; to the extent that these languages express the experience and heritage of a common, Western-European culture, the main areas of denotation remain the same (time, area, extension, interval, void, etc.).

[7]A specific application of the general notion of space as interval appears in the rudiments of Western musical notation: notes are written on lines or in the spaces "between the lines of a staff." The same general meaning underlies a specific typographic sense of space as "an interval or blank between words, or lines, in printed or written matter."

a purpose (synonym to "room"): "there is no space!" writes Chaucer (1374; OED: 87). Finally, space may mean "continuous, unbounded, or unlimited extension in every direction." It is a common notion in astronomy where it denotes "the immeasurable expanse in which the solar and stellar systems, nebulae, etc., are situated; the stellar depths." This definition recalls the Newtonian conception of "absolute space" (cf. section 1.2), a "cosmic" space which is usually coupled with time and associated with "emptiness" and "immensity."

In summary, space may be understood as "an interval, a length of way, a distance," or as "a period of time," or as "a void or empty place," or as "the dimensional extent occupied by a body."[8] This plurality of linguistic spaces reflects the richness of human experience of space; space is lived in, travelled through, measured, shaped and contemplated. The complexity of human relations to space increases because of the continuous development of new conceptions of space in art, philosophy and science. In mathematics, for instance, the meaning of space differs from the ones encountered in everyday language. Here, space is "usually regarded as a set of points having some specified structure."[9]

The multiplicity and diversity of associations evoked by this one term opens up a vast realm of potential significations of "space" in music. Not surprisingly, as we shall see in Chapter II, the meaning of "musical space" differs depending on whether "space" signifies an interval or a definite extension, if one means by "space" a vast, unlimited expanse, or a slot, a place for something, if one refers to a set of elements or to a cosmic void. All these "spaces" are constructs, yet all are superimposed upon a reality of human experience of and existence in space. The clarification of the various meanings of space will help to see these conceptual knots untangled.

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[8]For a fuller list of senses of "space" see Table I-1.

[9]E.g. *metric space*, *topological space*, *vector space*. The mathematical notions of space are discussed in Section 1. 3.

Table I-1: Meanings of "space" in *The Oxford English Dictionary*

I. Denoting time or duration.

1.a. Without article: Lapse or extent of time between two definite points, events, etc.

2. (*Obsolete*): Time, leisure, or opportunity for doing something.

3. With *the (that*, etc.):
3.a. The amount or extent of time comprised or contained in a specified period.
b. The amount of time already specified or indicated, or otherwise determined.

4.a. With *a*: A period or interval of time.
b. With *of* (Frequently *a space of time*).

II. Denoting area or extension.

**Without article, in generalized sense.*

5.a. Linear distance; interval between two or more points or objects.

6.a. Superficial extent or area; also, extent in three dimensions.
b. Extent or area sufficient for some purpose; room.
c. Extent or room in a letter, periodical, book, etc., available for, occupied by, written or printed matter.

7. (*Metaphorical*): Continuous, unbounded, or unlimited extension in every direction, regarded as void of matter, or without reference to this. Frequently coupled with *time.*

8.a. (*Astronomy*): The immeasurable expanse in which the solar and stellar systems, nebulae, etc., are situated; the stellar depths.

Table I-1: Meanings of "space," continued.

8.c.	In more limited sense: Extension in all directions, esp. from a given point.
	***In particularized or limited senses.*
9.	A certain stretch, extent, or area of ground, surface, sky, etc.; an expanse.
10. a.	A more or less limited area or extent; a small portion of space (in sense 6 a).
b.	A part or portion marked off in some way; a division, section.
c.	A void or empty place or part.
11. a.	An interval; a length of way; a distance.
12.	(*Obsolete, rare*): Course, custom, procedure.
13.	The dimensional extent occupied by a body or lying within certain limits.
14.	(*Music*): One or other of the degrees of intervals between the lines of a staff.
15.a.	An interval or blank between words, or lines, in printed or written matter.
16.	In specific uses (quotations from medicine, etc.).
17.	(*Mathematics*): an instance of any of various mathematical concepts, usually regarded as a set of points having some specified structure; cf. *metric space*, *topological space*, *vector space*.

1.2.

Selected philosophical concepts of space

The conceptual "thickness" of space in modern English is paralleled in the term's complicated historical evolution, of which only the briefest of accounts can be given here (again, considering only the notions of space which have a potential relevance for music). According to the venerated Western-European tradition, history begins with ancient Greeks, and the history of the concept of space is not an exception: Alexander Gosztonyi's monumental study of the notion of space in philosophy and science (Gosztonyi 1976) opens up with Hesiod's "chaos."[10] In classical (Greek to pre-Kantian) philosophies of space its physical, cosmological, metaphysical and existential dimensions are intertwined; only the advent of modern science separates these domains, with important consequences for the modern opposition of positivist ("objective") and phenomenological ("subject"-oriented) views of space.

For **Aristotle** (Gosztonyi 1976: 90-110; Jammer 1954: 15-21), space is inseparably associated with "place" (this connection is reflected in the linguistic senses II.1-3 and III.1-4, above). "Topos" is a quantity; it is continuous, infinitely divisible, exactly definable, and three-dimensional. However, Aristotle uses six rather than three dimensions--thus reflecting human-centred orientation of the "place:" up--down--left--right--before--behind (Gosztonyi 1976: 94). While emphasizing this existential focus, the "Aristotelian school tried to get along without the concept of independent (absolute) space" (Einstein 1954/1976: xv).

This concept is an artifact of classical science, usually referred to as Cartesian, Euclidean, or Newtonian space. For **René Descartes** (1596-1650), space exists

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[10]The title of Gosztonyi's book (*Der Raum. Geschichte seiner Probleme in Philosophie und Wissenschaften*) does not specify its limitation to the domain of Western-European culture. Although the book contains references to Arabic philosophy of the Middle Ages, it does so only because of the reception of this philosophy in medieval Europe (Gosztonyi 1976: 164-167).

materially; it is a continuous, homogeneous, static mass (Gosztonyi 1976: 245). Moreover, he ascribes to it a geometric structure expressible in a three-axial coordinate system (with notions from Euclidean geometry, e.g. point, line, plane). In the account of Maurice Merleau-Ponty:

> It was necessary first to idealize space, to conceive of that being--perfect in its genus, clear, manageable and homogeneous--which our thinking glides over without a vantage point of its own: a being which thought reports entirely in terms of three rectangular dimensions. . . Descartes was right in setting space free. His mistake was to erect it into a positive being, outside all points of view, beyond all latency.
>
> (Merleau-Ponty 1964/1972: 69)

The opposition underlying the Aristotelian and Cartesian conceptions (space made manifest in and through objects, and space in itself) has been formulated by Albert Einstein who contrasts two basic understandings of "space:"

> (a) space as positional quality of the world of material objects; (b) space as container of all material objects. In case (a), space without a material object is inconceivable. In case (b), a material object can only be conceived as existing in space; space then appears as a reality which in a certain sense is superior to the material world. Both space concepts are free creations of the human imagination, means devised for easier comprehension of our sense experience.
>
> (Einstein 1954/1976: xiv)

Space of Einstein's type (b), that is, the absolute space described by Descartes, plays a very important role in the philosophy of **Isaac Newton** (1643-1727). As Michael Friedman puts it: "Newtonian physics pictures material objects or bodies as embedded or contained in an infinite, three-dimensional Euclidean space" (Friedman 1983: 12). For Newton and his followers, as for Descartes, "space is very much like a material body, of a very ethereal kind, but not entirely" (van Fraassen 1985: 109). In his *Philosophiae naturalis principia mathematica*, the basis of classical physics, Newton writes: "Absolute space in its own nature, without relation to anything external, remains always similar and immovable."[11] This space is then associated with

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[11]Quoted from Jammer (1954: 97). Source of this quotation: F. Cajori, ed., *Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World. A Revision of Mott's Translation*, (Berkeley: University of California Press,

God's "boundless uniform Sensorium," i.e. God's way of perceiving and creating things (Jammer 1954: 110-112, Gosztonyi 1976: 338-344).[12] The Newtonian identification of the omnipresence of space with the omnipresence of God, used later as a proof for the Divine existence,[13] forms the basic contradiction within his conception of space: the location of a metaphysical Being at the centre of a hypothetical-deductive system of mechanical physics.

The universal acceptance of Newtonian physics led to the adoption of the notion of absolute space as a basic, scientific truth, not an artifact of limited scope and applicability. An awareness of the paradigmatic status of this notion ("paradigmatic" in the sense introduced by Kuhn in 1962) arose only with the renewed interest in the nature of space spurred by the development of relativity theory in the 20th century (discussed in Section 4, below). Meanwhile, one philosopher who adopted a Newtonian world-view, **Immanuel Kant** (1724-1804), formulated a new notion of space that influenced philosophical discourse on space for several generations.

As Patrick Heelan writes, "so persuaded . . . was Immanuel Kant of the apodicticity of Newtonian physics, that he proposed as a self-evident truth that the space of empirical objects and intuitive experience is Euclidean" (Heelan 1983: 250). Heelan has criticized Kant's limitations from the position of a phenomenologist; Michael Friedman points out that for the positivist as well, Kant's conception of space suffers from "its too intimate connection with outmoded mathematics and physics" (Friedman 1983: 7). Nonetheless, Kant's theory continues to influence research into

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1934, 6). The notion of absolute space is contrasted by Newton with that of the relative spaces, which are, in contemporary language, different frames of reference (cf. van Fraassen 1985: 115).

[12]As Newton writes about God: "He is not eternity and infinity, but eternal and infinite; He is not duration or space, but He endures and is present. He endures for ever, and is everywhere present; and by existing always and everywhere, He constitutes duration and space" (Newton/Cajori 1934: 544; quoted by Jammer 1954: 110-111).

[13]For instance by Samuel Clarke, cf. Gosztonyi (1976: 346-348) and Jammer (1954: 127).

issues of space in different domains, e.g. in psychology (cf. Eliot 1987).

But what is space for Kant? According to Alexander Gosztonyi (Gosztonyi 1976: 400-456), Kant's ideas of space differ greatly in the pre-critical and critical periods of his philosophy. For the sake of brevity, only the final, "critical" formulation will be discussed here.[14] For Kant, space is by no means "absolute." In the *Critique of Pure Reason* (1781) he posits that space is, along with time, a form of "pure intuition" (reine Anschauungsform) which is a precondition for all perception (Gosztonyi 1976: 429-432; Heelan 1983: 41). Max Jammer explains that, according to Kant,

> Not itself arising out of sensations, the concept of space is a pure intuition, neither objective nor real, but subjective and ideal. . . Space is a form of intuition, instrumental in the process of cognition as an ideal organizer of the contents of sensations.
>
> (Jammer 1954: 132-133)

In Kantian philosophy, space is synthetic a priori. It is a pure form of sensibility (*reine Anschauungsform*): pure--because antecedent to all experience, and universal--because independent of the particular data of our sensations (Jammer 1954: 134-135). Contemporary philosophers of science often disagree with the Kantian "a-prioricity" of space which implies its unrevisability and necessity. As Michael Friedman points out, "if the developments in post-Kantian mathematics and physics show anything, they show that one central Kantian formal component--the Euclidean-Newtonian picture of space and time--is clearly not *a priori* or unrevisable" (Friedman 1983: 18). Patrick Heelan (whose phenomenological philosophy of science is discussed in Section 5 of this Chapter), agrees with Friedman only partly, for he does not share the "anti-a-priori" conviction:

> In summary, while all philosophy today is pursued in the light of the Kantian heritage, and philosophers accept the view that what we find in experience is prefigured in intentionality, and that the empirical object as known is actively constructed according to a priori rules, still it is evident that the undisputed

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[14]Kant's critical writings dealing with the topic of space include: *Critique of Pure Reason* (1781), *Critique of Practical Reason* (1787) and *Prolegomena* (1783).

> content of that legacy is unclear. This is particularly so as regards the uniqueness of the geometrical rules active at the transcendental level, and their origin in the subject, or possibly in ways in which subject and World collaborate to construct space--visual, perceptual (in the broader sense), physical (of our local environment, or cosmological).
>
> (Heelan 1983: 42)

Finally, Alexander Gosztonyi notices that the Kantian postulate of the transcendental ideality of space does not provide solutions to the ontology of the physical space in itself (Gosztonyi 1976: 455). In the light of Gosztonyi's critique, Kant's most important contribution to the development of the idea of space lies in his analysis of the spaces of intuition (Anschauungraumes) conducted from a phenomenological point of view. Here, Kant notices the importance of the temporal moment of spatial perception (i.e. the connection of space and time in human experience) and opens up the way to phenomenological studies of space by Husserl, Heidegger and Merleau-Ponty (Gosztonyi 1976: 456).[15]

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[15]In the domain of musical thought, the Kantian legacy has particular significance for the German theorists of "musical space" (cf. Chapter II, section 1).

1.3.

Notions of space in mathematics

What Kant could not have known, that space is not necessarily Euclidean, has slowly come to be understood over the course of the 19th century--the time of the development of various non-Euclidean geometries.[16] Their emergence has heralded the birth of mathematical notions of space which have little to do with the experience of the human (bodily and environmental) spatiality. In mathematics, space is "usually regarded as a set of points having some specified structure" (linguistic sense III.9 listed in Section 1).[17] The main stages in the evolution of such counter-intuitive concepts of space are outlined below.

According to the classical formulation of **Euclidean geometry** (that of the *Elements* by Euclid), spatial relations between elementary entities (point, line, plane) are supposed to fulfil five postulates, of which the fifth one, the so-called parallelism postulate is the most questionable. Bas van Fraassen formulates these postulates in the following manner:

> (I) If x and y are distinct points, there is a straight line incident with both.
> (II) Any finite straight line (segment) is part of a unique infinite straight line.
> (III) If x is a point and r a finite distance, there is a unique circle with x and radius r.
> (IV) Any two right angles are equal.
> (V) If a straight line falling on two straight lines makes the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which the angles are less than two right angles.
>
> (van Fraassen 1985: 117-118)

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[16]For an overview of these developments see van Fraassen (1985); a detailed history is given by Gray (1979).

[17]Whether any particular mathematical spaces can be coordinated with entities from the physical reality (i.e. discovered) or whether their existence is purely ideal (i.e. invented or construed) is a matter of contention. Some philosophers assert that the geometry of space has little to do with spatial intuition or experience (cf. Gosztonyi 1976: 467-473).

Numerous attempts to prove the truthfulness of the fifth postulate have ultimately led to the discovery of new, **non-Euclidean geometries** (hyperbolic, spherical and elliptical geometries were the first to be studied).[18] Other non-Euclidean geometries developed in the 19th century are more basic than Euclidean geometry because they involve fewer primitive (i.e. undefinable) concepts. According to van Fraassen, "in *affine geometry* the notions of distance and perpendicularity do not appear, in *projective geometry* neither these nor parallelism appears, and in *topology (analysis situs)* even the notion of line does not appear" (van Fraassen 1985: 122). As Jeremy Gray explains, "before, roughly, 1800, mathematicians hoped to show that Euclidean geometry was the only possible geometry of space, whereas afterwards they sought to establish the possible validity of other geometries" (Gray 1979: 155). In the course of this development, the basic tenet of Kantian epistemology, that of the a-prioricity of Euclidean geometry of space, was abandoned. According to Hans Reichenbach,

> We must therefore reject the arguments for the priority of Euclidean geometry within mathematics. The geometrical axioms are not asserted to be true within mathematics, and mathematical geometry deals exclusively with implications; it is a pure deductive system. . . . Mathematical geometry is not a science of space insofar as we understand by space a visual structure that can be filled with objects--it is a pure theory of manifolds. . . . The visual elements of space are an unnecessary addition.
>
> (Reichenbach 1927/1958: 92, 100)

For Reichenbach, geometry is a theory of relations, and all geometrical

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[18]By denying postulate (V), Euclidean geometry is transformed into hyperbolic geometry (Karl Friedrich Gauss, Janós Bolyai, and Nikolai Lobachevsky). By replacing postulate (V) with (V*) "there is no line parallel to any other line" and changing postulate (II) into (II*) "any two lines have two distinct points in common" spherical geometry is developed (Bernhard Riemann). If postulate (V*) is supplemented with (II**) "any two lines have a unique intersection" elliptical geometry is introduced (van Fraassen 1985: 120-121). For a popular explanation of spherical geometry see Einstein's "Geometry and Experience" (1921/1976); for a discussion of the nature of geometry as a theory of relations and the problem of the visualisation in Euclidean and non-Euclidean geometries see Reichenbach (1927/1958: 37-90); for a detailed history of non-Euclidean geometries see Gray (1979).

concepts can be expressed as functions of basic, purely logical concepts, such as *"element, relation, one-to-one correspondence, implication*, etc." (Reichenbach 1927/1958: 93-94). And, if space is a visual container of objects, geometry has nothing to do with space. But what if "space" means a "manifold"? This notion was introduced in Bernhard Riemann's habilitation dissertation of 1854.[19] As van Fraassen writes,

> In this work, Riemann presented the general concept of a manifold: the spectrum of color hues is a one-dimensional manifold, and space, as ordinarily conceived is a three-dimensional manifold. The term 'manifold' is not much in use any more; today we speak of spaces instead of manifolds. Riemann defined a *n*-dimensional space to be one in which each position can be characterized by a set of *n* coordinates. Thus, he envisaged space of more than three dimensions.
>
> (van Fraassen 1985: 126)

Riemann's study of discrete and continuous manifolds as well as his trigonometric descriptions of various geometries have led to "the reformulation of geometry in local terms, rather than global ones: 'line' and 'plane' were defined in terms of geodesics and curvatures" (Gray 1979: 158). His discovery of the notion of the metrically amorphous manifold "allows us to see all the different kinds of geometrical structures--Euclidean and non-Euclidean; constant curvature and variable curvature; two-, three-, and higher dimensional spaces--as particular instances of the very general ideal of an n-dimensional manifold" (Friedman 1983: 10). These mathematical developments proved invaluable for the introduction of new theories of space-time and for the formulation of relativity theory by Albert Einstein.

In special branches of mathematics, such as general topology, various types and properties of space are identified, defined and refined, e.g. the concepts of topological space, distance and metric space. The definition of the **topological space** (the most basic and least structured space) reads:

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[19]The significance of Riemann's dissertation, *On the hypotheses which lie at the foundations of geometry* is discussed by Gosztonyi (1976: 493-500), and van Fraassen (1985: 126-129).

> Let X be a non-empty set. A class T of subsets of X is a *topology* on X iff T satisfies the following axioms.
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> $[0_1]$ X and ϕ belong to T.
> $[0_2]$ The union of any number of sets in T belongs to T.
> $[0_3]$ The intersection of any two sets in T belongs to T.
>
> The members of T are then called *T-open sets*, or simply *open sets*, and X together with T, i.e. the pair (X,T), is called a *topological space.*
>
> (Lipschutz 1965: 66)

In order to proceed from a topological space to a **metric space**, the notion of distance needs to be introduced. In general terms, distance is defined as a real-valued function satisfying several axioms (that a distance from any point to another is never negative, that a distance from a point to itself is zero, etc.; cf. Lipschutz 1965: 111). After defining distance, the establishment of the conception of a metric space is possible, with "point" and "distance" as basic notions. Therefore, a metric space is simply "a collection of points with as metric a distance function on that collection" (van Fraassen 1985: 127). Moreover, each of the Euclidean and non-Euclidean geometries mentioned earlier is a particular type of metric space and can be axiomatized by articulating exact conditions for the concept of distance.

Finally, one related notion of space should be mentioned: the **logical space**--first introduced by **Ludwig Wittgenstein** in his *Tractatus Logico-Philosophicus* of 1922. For Wittgenstein, "logical space" is (proposition 2.11) "the existence and non-existence of atomic facts" whereas (proposition 1.13) "the facts in logical space are the world" (Wittgenstein 1922/1988: 39, 31). Therefore, as the philosopher explains (proposition 2.0131), "a speck in a visual field need not be red, but it must have a colour; it has, so to speak, a colour space round it. A tone must have a pitch, the object of the sense of touch a hardness, etc." In Wittgenstein's definition, the musical notion of "pitch" is a logical space.[20]

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[20]Nonetheless, the musical implications of this "state of affairs," to use Wittgenstein's term, have not been consciously explored. The applications of mathematical concepts of space in music theory and composition appear only in the

Bas van Fraassen explains that a logical space is "a mathematical construct used to represent conceptual interconnections among a family of properties and relations" (van Fraassen 1985: 102-104; cf. also Reichenbach 1927/1958: 132). This logical space may be used to represent physical space. If each event receives three space coordinates (real numbers), "the logical space in which . . . all spatial relationships are represented, is the set of all triples of real numbers" (p. 167). If, on the other hand, events are considered in a four-dimensional space-time, "the logical space, in which, for us, all spatio-temporal relationships are represented is the set of all quadruples of real numbers" (p. 167).[21] In addition, van Fraassen argues that time is a logical space, and "furthermore, that this logical space (time) is the real line being used to represent all possible temporal relations among events and the conceptual interconnections among these relations" (van Fraassen 1985: 102). So much for absolute, independent time and space! Having begun this survey of concepts of space from an intuitive conception of "the space of time" (cf. linguistic senses I.1--I.3 in Section 1), we reach one philosopher's conclusion that time is a logical space.

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writings of those composers or theoreticians who have studied mathematics, and have sought to transplant mathematical ideas into music (cf. Boulez, Xenakis and Morris in Chapter II).

[21]The logical space exemplified by van Fraassen resembles very closely Riemannian notion of an n-dimensional discrete manifold.

1.4.

Space-time theories in modern philosophy of science

As Hans Reichenbach states lucidly, "mathematical space is a *conceptual structure*, and as such ideal. Physics has the task of coordinating one of these mathematical structures to reality" (Reichenbach 1927/1958: 287).[22] This opinion of a prominent representative of logical positivism,[23] reflects the state of affairs in mathematical physics, in which competing views on space and space-time are constantly being proposed, tested and rejected.

The breakthrough came with **Albert Einstein**'s relativity theory supported by the Minkowskian model of space-time as a four-dimensional manifold (Einstein 1934/1976, 1954/1976; Friedman 1983; Gray 1979). The significance of Einstein's theory is, partly, due to the fact that "it exhibits such an intimate interdependence of temporal and spatial relations that time and space can no longer be treated as essentially independent subjects" (van Fraassen 1985: 140). Thus, as Minkowski triumphantly proclaimed, "three-dimensional geometry becomes a chapter in four-dimensional physics. . . . Space and Time are to fade away into the shadows and only a world in itself will subsist."[24] Hermann Weyl explains this unification of the two formerly independent entities in the following manner:

> The scene of action of reality is not a three-dimensional Euclidean space but rather **a four-dimensional world, in which space and time are linked together indissolubly**. . . . It is a four-dimensional continuum, which is neither 'time' nor 'space.' Only the consciousness that passes on in one portion of this world experiences the detached piece which comes to meet it

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[22]Albert Einstein expresses a similar view in his lecture of 1921, "Geometry and Experience," (published in English translation in *Ideas and Opinions*, in 1976: 227-239).

[23]As Reichenbach announces in the introduction to *The Philosophy of Space and Time* this work is meant "to give an example of the superiority of a philosophical method closely connected with the results of empirical science" (Reichenbach 1927/1958: xv).

[24]Minkowski's statement from a lecture of 1905, cited by Gray (1979: 171).

> and passes behind it as **history** that is as a process which is going forward in time and takes place in space.
>
> (Weyl 1918/1952: 217)

There is an essential difference between the four-dimensional space-time of special relativity and the space-time of the classical physics in which every event is also given four coordinates (three spatial ones and a time coordinate) and in which the totality of physical events is also "embedded in a four-dimensional continuous manifold" (Einstein 1954/1976: 350-366). As Einstein explains, in classical physics, unlike special relativity, this continuum can be separated into a one-dimensional time and a three-dimensional space of simultaneous events.[25] By introducing the relativity of simultaneity, "the four-dimensional continuum is now no longer resolvable objectively into sections, which contain all simultaneous events; 'now' loses for the spatially extended world its objective meaning" (Einstein 1954/1976: 360). In other words, "there is no physical basis for the relation of simultaneity between events that are spatially separate" and therefore "one and the same pair of events may be simultaneous in one frame of reference . . . and not in some other frame of reference" (van Fraassen 1985: 155).[26]

This dissolution of the independence of time and space by the relativity of simultaneity implies a radical transformation of the scientific world-view, because from now on, as Einstein writes, it is "more natural to think of physical reality as a four-dimensional existence, instead of, as hitherto, the *evolution* of a three-dimensional existence" (Einstein 1954/1976: 361). Distant echoes of this Einsteinian

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[25]The connection of space and time into space-time is by no means intuitively obvious, for as Hermann Weyl notices: "it is remarkable that the three-dimensional geometry of the statical world that was put into a complete axiomatic system by Euclid has such a translucent character, whereas we have been able to assume command over the four-dimensional geometry only after a prolonged struggle" (Weyl 1921/1976: 217). Hans Reichenbach disagrees with this dissolution of space and time into a continuous space-time and emphasizes the differences between the two notions as "a fundamental fact of the objective world" (Reichenbach 1927/1958: 109-112, 279).

[26]"A frame of reference is simply an assignment of time and space coordinates to all events" (van Fraassen 1985: 157).

revolution may be perceived in Merleau-Ponty's phenomenological philosophy of existence (cf. section 1.5).

The transition from the Newtonian notions of absolute, separated space and time to their alliance in the four-dimensional space-time continuum of Einstein's special theory of relativity (1905) was hardly final.[27] According to Michael Friedman, in special relativity "there is indeed no three-dimensional, Euclidean embedding space, but there is a four-dimensional, semi-Euclidean space-time in which all physical events are embedded" (Friedman 1983: 16). The introduction of general relativity in 1916 was partly motivated by Einstein's desire to get rid of that rigid, embedding four-dimensional space-time.[28] Einstein believed that general relativity solved the problem of the existence or non-existence of absolute space and he maintained that "there is no such thing as an empty space, i.e. a space without field. Space-time does not claim existence on its own, but only as a structural quality of the field" (Einstein 1954/1976: 365). Nevertheless, contemporary physicists and philosophers of science are still greatly divided on this issue, and the existence of space-time as well as its structure are the matter of an on-going debate. As Lawrence Sklar reminds his colleagues, "in considering formalization of the spacetime theory of general relativity, we must remember that this one theory allows at least the lawlike possibility, relative to its

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[27]Hans Reichenbach opposes the view advocated here and emphasizes the distinction between space and time: "Calling time the fourth dimension gives it an air of mystery. One might think that time can now be conceived as a kind of space and try in vain to add visually a fourth dimension to the three dimensions of space. It is essential to guard against such a misunderstanding of mathematical concepts. If we add time to space as a fourth dimension, it does not lose in any way its peculiar character as time. Through the combination of space and time into a four-dimensional manifold we merely express the fact that it takes four numbers to determine a world event, namely three numbers for the spatial location and one for time." (Reichenbach 1927/1958: 110). These reservations have been shared by Henri Bergson (Bergson 1922/1965; cf. below, section 1.5).

[28]Michael Friedman defines general relativity as "a theory of gravitation formulated in the context of the conceptions of space and time due to special relativity" (Friedman 1983: 17).

laws, of many distinct spacetime worlds" (Sklar 1985: 127). Hence, there is "a wide variety of spacetimes compatible with the theory," because in general relativity "spacetime is itself a variable dynamic element in the theory" (ibidem).

For **Michael Friedman**, the general principle of relativity is neither as revolutionary as, nor analogous to, the special principle of relativity for "it merely replaces a flat affine-metrical structure (of space-time) with a nonflat one" (Friedman 1983: 29). In general relativity, space-time is variably curved and "endowed with a perfectly definite metric . . . which is related in a definite way to the distribution of mass-energy by Einstein's field equations. . . . There is no sense in which this metric is determined by arbitrary choice or convention" (Friedman 1983: 26). Friedman emphasizes the distinction of intrinsic and extrinsic features of a space-time: intrinsic features of a space-time reflect those aspects of geometrical structure that objectively characterize the space-time while extrinsic features vary from one coordinate representation to another (Friedman 1983: 339). In particular, that the space-time is a four-dimensional manifold is only a local assertion, for, as Friedman writes, "space-time in the large can be finite or infinite, closed like a sphere or open like a plane, connected (no holes or missing pieces) or disconnected (with arbitrary deletions) and so on" (Friedman 1983: 33).

If space-time is "the set of all places-at-a-time or all actual and possible events," theories of space-time picture the material universe (i.e. "the set of all actual events") as embedded in a space-time which possesses a specific type of geometric structure. Where the various theories disagree is what this structure really is. According to Friedman's view, the basic or primitive elements of space-time theories are of two kinds: "space-time and its geometrical structure; and matter fields--distributions of mass, charge, and so on--which represent the physical processes and events occurring within space-time" (Friedman 1983: 32). Friedman's critique is directed against relationalism, which does not require the existence of space-time independently of matter and energy. As Hartry Field puts it:

> According to the relational theory of space-time, the physical world contains spatio-temporal aggregates of matter (spatio-temporally extended physical

> objects, spatio-temporal parts of such objects and aggregates consisting of spatio-temporal parts of different objects); these aggregates of matter are interrelated in various ways by various geometric (and also non-geometric) relations, but the physical world does not contain a space-time over and above these aggregates of matter and their interrelations.
>
> (Field 1989: 171)

Einstein himself (1954/1976), Reichenbach (1927/1958), Grünbaum (1963/1973, 1977) and van Fraassen (1985) have all subscribed to the relational view on space-time which defines this entity merely as an attribute of matter or field.[29] The opposite, substantival view, represented by Friedman, is equally possible in the light of general relativity. In the words of Hartry Field:

> According to the substantival view of space-time, the physical world contains not only aggregates of matter (physical objects, their spatio-temporal parts etc.) but also (over and above these, i.e., not logically constructed from them) space-time and its spatio-temporal parts.
>
> (Field 1989: 171)

It is quite natural to identify an object with the part of space-time that it occupies--hence, for instance, the absence of absolute space in Aristotelian thought. The debate, whether space-time theories describe only spatio-temporal relations or independent entities of space-time, and whether spatio-temporal relations and properties can be reduced to or defined by other relations and properties is far from being solved (Friedman 1983: 62; Sklar 1985: 8-9).[30]

These discussions about space-time in contemporary philosophy of science

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[29]Friedman distinguishes two types of relationalism: (1) Leibnizean--limiting applicability of space-time concepts, and (2) Reichenbachian--limiting vocabulary of space-time theories to relations defined in a proper way (Friedman 1983: 63). Elsewhere, Friedman labels Reichenbach's position "conventionalism" rather than "relationalism" (Friedman 1983: 264-339).

[30]Lawrence Sklar, one of the participants in the debate between substantivism and relationism describes the kinship of relationism to other "doctrines regarding theories, doctrines which attribute genuine reference only to the names and predicates of the theory which aim to denote observable entities and properties, and which treat the apparently denoting terms which allegedly refer to nonobservable entities and properties as not really referring in nature at all" (Sklar 1985: 11).

concentrate on spatio-temporal properties and relations, objects, processes and events. What is excluded is human consciousness and the lived experience and perception of space-time on an intermediary scale, neither macro- nor microcosmic. These aspects are the subjects of philosophical reflection in phenomenology.

1.5.
Human experience and perception of space: philosophy of life and phenomenology

One of Minkowski's arguments for the validity of his theory of a unified four-dimensional continuum of space-time refers to human perceptual experience: "No-one has yet observed a place except at a time, nor yet a time except at a place."[31] Here, space and time do not have independent existences. As Jeremy Gray comments (alluding to Newtonian metaphysics): "Put like that it is unarguable, but it dethrones God from his Sensorium of space in which time passes" (Gray 1979: 171).

Henri Bergson (1859-1941) apparently did not intend to "dethrone God," because his existential philosophy emphasizes a complete opposition of time (duration, *durée*) and space (*espace*) in human experience (Gosztonyi 1976: 869-872).[32] For Bergson, space is the sworn enemy of duration while spatial representations rule tyrannically over human cognition and language. As humans think in spatial terms, they confuse duration with extension, quality with quantity, real succession with

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[31]Hermann Minkowski's statement is here quoted from Gray (1979: 171). Minkowski, the German scientist, should not be confused with Eugène Minkowski, a French psychiatrist and philosopher of a phenomenological orientation (cf. Kockelmans and Kisiel, eds. 1970: 235).

[32]This review of Bergson's philosophy of time is based on *Essai sur les données immédiates de la conscience* (1883-1887, published in 1889, 6th ed. of the English translation published in 1950) and *Durée et Simultanéité* (published in 1922, in English translation in 1965).

simultaneity. False, spatial representation of time, based on "homogeneous time" has nothing to do with duration which is experienced in the flow of consciousness, but makes time a "phantom of space" instead. Bergson explains: "pure duration is wholly qualitative. It cannot be measured unless symbolically represented in space" (Bergson 1889/1950: 105). Homogeneous time, emptied of its experiential content, may be measured and co-opted to space as its fourth dimension; it may be **spatialized.** According to Bergson, we spatialize time "as soon as we measure it" and, thus, we produce "a time dried up as space" (Bergson 1922/1965: 60).[33] The association of spatiality with stasis and with the quality of being measurable, the idea of spatialized time, and the antinomy of space and time so forcefully argued in Bergsonian philosophy have had a tremendous significance for the development of the idea of musical spatiality (cf. Chapter III, section 2). Interestingly, Bergson himself used a musical example to prove that measured time is spatial. When listening to a series of strokes of a distant bell people "range the successive sounds in an ideal space and then fancy that they are counting them in pure duration" (Bergson 1889/1950: 86). This is not the case, argues Bergson: if the bell sounds are counted and arranged in a rhythmic pattern, this operation takes place "in space"--the space of time (p. 87).[34]

Following the emergence of Einstein's theory of relativity, with its central notion of "space-time," Bergson attempted to argue the superiority of his dualistic

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[33]Bergson's philosophy of pure duration may be seen as a reaction against the traditional, spatial image of time in which it is modelled as a line with a moving point representing the present moment (temporal intervals can be measured as distances on this line). This spatial image of time may be found, for instance, in the pre-critical writings of Kant (e.g. his *Inaugural Dissertation*, according to Prof. Alison Laywine; private communication). Incidentally, Martin's Heidegger's theory of the ontological primacy of time which led him towards grounding space in time (*Being and Time*) is also based on the negation of the temporal spatialization. According to Prof. Philip Buckley (private communication), Heidegger's criticism of Bergson's philosophy relates to its dualist nature which is manifest in the opposition of lived and spatialized time.

[34]"If the sounds are separated, they must leave empty intervals between them. If we count them, the intervals must remain though the sounds disappear: how could these intervals remain, if they were pure duration and not space?" (Bergson 1889/1950: 87).

theory of time and space over a unified model of a four-dimensional space-time continuum (Bergson 1922/1965). He criticized treating time as "the fourth dimension of space" (p. 140) and claimed that space and time "remain what they were, separate from one another, incapable of mingling except as the result of a mathematical fiction intended to symbolize a truth in physics" (p. 155).

In seeking to formulate a general philosophy of life, Bergson explores dualities: concrete and abstract, intuition and intellect, time and space. Intuition, associated with a pure temporality, has an absolute primacy over the intellect which is linked to spatial abstractions. Curiously, as Gosztonyi notices, Bergson is aware of two different types or aspects of space: homogeneous (i.e. abstract, construed or imagined) and heterogeneous (i.e. concrete, encountered in experience). Contrary to what might have been expected, the philosopher gives priority to the homogeneous space, which is singularly detached from the physical reality. This space is static, immovable and unchangeable. Here, the familiar, absolute space of Newton and Descartes makes an unexpected reappearance (compare especially Merleau-Ponty's critique of Descartes in Section 2 above). Bergson contrasts his innovative conception of duration, that is, "time-as-experienced," with "space-as-conceived-of" (the homogeneous space resembling absolute space from earlier accounts) rather than with the duration's natural counterpart, that is "space-as-experienced" (the heterogeneous space encountered in human life). When both time and space are taken in their experiential immediacy their opposition is bound to disappear and what is left is a lived "space-time." Despite this logical and conceptual weakness, the virtue of Bergsonian philosophy is the renewed focus on the human, subjective experience of time (and space).

The interest in "space" in **phenomenology and existential philosophy** has been far less pronounced than the interest in "time." This is apparent in the titles of the main phenomenological writings, for instance Husserl's *The Phenomenology of Internal Time-Consciousness*, not "Space-Consciousness," or Heidegger's *Being and*

Time, not "Being and Space".[35] The balance here is completely different than in the philosophy of science, which has examined the problems of time to a much lesser extent than those of space.[36] The difference in treatment of time and space is a result of a difference in purpose: the connection of human life and consciousness with time is more obvious than with space, and these are the central domains of phenomenological and existential philosophies.

The belief that consciousness is purely temporal and non-spatial has been quite wide-spread, for it has been associated with a disembodiment of human identity in its purely "spiritual" rather than the "psycho-somatic" interpretation.[37] This disembodiment has constituted a basic tenet of Western-European thought since antiquity, and has been challenged only in the 20th century (e.g. by Merleau-Ponty's phenomenology of perception). Even Hans Reichenbach, a logical positivist, writes that "time order is possible in a realm which has no spatial order, namely in the world of the psychic experiences of an individual human being." The philosopher continues:

> This is the reason why the experience of time is allotted a primary position among conscious experiences, and is felt as more immediate than the experience of space. There is indeed no direct experience of space in the direct sense in which we feel the flow of time during our life. The experience of time appears to be closely connected with the experience of the ego. 'I am' is always equivalent to 'I am now,' but I am in an 'eternal now' and feel myself remaining the same in the elusive current of time.
>
> (Reichenbach 1927/1958: 110)

In the phenomenological philosophy of **Maurice Merleau-Ponty** (1900-1961)

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[35]For a discussion of the problem of space in the constitutive phenomenology of Edmund Husserl see Gosztonyi (1976: 844-861); the connections of space and time and the metaphysics of lived space in the existential philosophy of Martin Heidegger are presented by the same author (Gosztonyi 1976: 885-895).

[36]In science, "some philosophers have believed that a philosophical clarification of space also provided a solution of the problem of time . . . [which] has none of the difficulties resulting from multidimensionality" (Reichenbach 1927/1958: 109).

[37]For many philosophers, though, the disembodiment of human consciousness is linked to its supra-temporality; "I" exist above time, in the perennial present.

Letter of Intent

By and between the

Los Angeles County Department of Children and Family Services,
Phoenix Houses of California, Inc. and The Village Family Services

Attn: Terri Morgan, MFT
Chief Administrative Officer
The Village Family Services
6736 Laurel Canyon Boulevard, Suite 200
North Hollywood, CA 91606

Dr. Michael J. Rauso, Division Chief
Department of Children and Family Services
Resource Management Division
425 Shatto Place, Suite 303
Los Angeles, CA 90010

This Letter of Intent shall serve as notice of the intention of the parties named above to work together to achieve the overall goals and objectives of the Administration for Children and Families (ACF) grant and the Integrating Trauma-Informed and Trauma-Focused Practice in Child Protective Service (CPS).

The primary goal of this collaborative effort is to work with other community members and law enforcement personnel to initiate systemic changes in child welfare programs in Los Angeles County by increasing the awareness of trauma focused assessment and care, develop solutions to the problems, work together over time to implement the solutions, monitor the success of the programs and respond to changing community needs with cultural competency.

As collaborative agencies, we agree to participate in the training of our direct service staff, supervisors and managers and will adopt and deploy the program specifics as outlined by the grant request submitted by The Village Family Services to ACF. We are in support of Trauma Informed Care and look forward to impacting the overall health and well being of children living in Los Angeles County.

This collaboration will support the goals and objectives of the effort in a variety of ways and will provide representation and input at meetings.

Phoenix Houses of California, Inc., will also contribute to the success of this project by agreeing to:

- Provide staff time to participate in necessary trainings and/or meetings during the initial months of project funding to gain further understanding of the program and help develop the program work plan;
- Designate a representative to the meetings who will work with members of the collaborative to identify underlying issues in the community that lead to systemic failures to address trauma symptoms in the child welfare system;
- Refer eligible individuals to Evidence Based Services that address culturally appropriate trauma informed care;
- Actively cooperate with any information/data sharing needs that will help serve youth as well as evaluate program efforts.

The Village Family Services agrees to:

- Be the lead agency for the grant award;
- Will commitment personnel and time to coordinate and implement grant program activities.

The Los Angeles County Department of Children and Family Services and Phoenix Houses of California, Inc. look forward to being active partners in this effort to improve the lives of young people and health of wellness of our communities. This Letter of Intent will be in effect from July 2011 through August 2016.

The following authorized personnel have agreed to the above responsibilities

Name, Title
LA County DCFS

Date

Winifred B. Wechsler
Senior Vice President and
Regional Director
Phoenix House

7/13/11
Date

Terri Morgan, CAO
The Village Family Services

Date

"I am" means "I am **here** and now" because "I" is understood as an "incarnate subject," that is a spatio-temporal, psycho-somatic being (Merleau-Ponty 1945/1981, 1964/1972).[38] Body and soul are not separate entities, which may exist independently: in the actual world, "we are the compound of soul and body."[39] As the philosopher writes, the body that the soul animates,

> is not, for it, an object among objects, and it does not derive from the body all the rest of space as an implied premise. The soul thinks with reference to the body, not with reference to itself; and space, or exterior distance, is stipulated as well within the natural pact that unites them. . . . For the soul, the body is both natal space and matrix of every other existing space.
>
> (Merleau-Ponty 1964/1972: 71)

Therefore, the notion of space is dramatically changed:

> Space is no longer . . . a network of relations between objects such as would be seen by a witness or my vision or by a geometer looking over it and reconstructing it from outside. It is, rather, a space reckoned starting from me as the zero point or degree zero of spatiality. I do not see it according to its exterior envelope, I live in it from the inside; I am immersed in it. After all the world is all around me, not in front of me.
>
> (Merleau-Ponty 1964/1972: 73)

Body and soul are not separated, and neither are space and time:

> We must therefore avoid saying that our body is *in* space, or *in* time. It *inhabits* space and time. . . . Just as it is necessarily 'here,' the body necessarily exists 'now' . . . In so far as I have a body through which I act in the world, space and time are not, for me, a collection of adjacent points nor are they a limitless number of relations synthesized by any consciousness, and into which it draws my body. I am not in space and time, nor do I conceive space and time; I belong to them, my body combines with them and includes them. (Merleau-Ponty 1945/1962: 138)

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[38]My account of Merleau-Ponty's philosophy of space does not include some of his important concepts (e.g. "spatial level" and "field of presence") which are discussed in detail by Gosztonyi (1976: 919-925) and Kockelmans (1970: 274-316). These ideas are omitted because they are not fundamental for this dissertation.

[39]According to Prof. Philip Buckley (private communication, 17 February 1994), Merleau-Ponty developed the notion of the "incarnate subject" or "body-subject" on the basis of Husserl's concept of the "lived-body" (*Leib*) which was introduced in the second part of *Ideas* (Merleau-Ponty studied this work in manuscript).

This connection of human, lived spatiality and temporality is of great significance in the "spatio-temporal" context of the modern philosophy of science. Paradoxically, it is in phenomenology, a philosophy first formulated as a critique of the impersonal, objectivist quality of science (embodied in empirical and logical positivism),[40] that the junction of space and time posited by science is considered a central characteristic of human existence.[41] Positivism (e.g. Reichenbach) still assumes the existence of a transcendental ego, in the eternal "now"--thus adopting uncritically a notion from outmoded anthropology. In the *Crisis of European Sciences*, Edmund Husserl, Merleau-Ponty's mentor and predecessor, writes:

> The world is a spatiotemporal world; spatiotemporality (as 'living,' not as logico-mathematical) belongs to its own ontic meaning as life-world. . . All objects in the world are in essence 'embodied'; and for that very reason all take part in the space-time of bodies. . . The human spirit, after all, is grounded on the human physis; each individual human psychic life is founded upon corporeity.
>
> (Husserl 1937/1970: 168, 216, 271)

How do humans experience time and space? In movement, for it encompasses simultaneously position, temporality and identity (Langer 1989: 85). Merleau-Ponty considers corporeal spatiality in association with human "motility," that is, the potentiality of the exploration of space in time (chapter 3 of Part I in the *Phenomenology of Perception*, 1945/1981).[42] "Movement is not thought about

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[40]Husserl, Ingarden and Merleau-Ponty all consider positivism, empiricism and materialism as epistemologically deficient. A brief discussion of Husserl's critical attitude towards modern science and empirical or logical positivism is contained in Patrick Heelan's phenomenological philosophy of science (Heelan 1983). *Phenomenology and the Natural Sciences*, a collection of essays and translations (eds. Kockelmans and Kisiel; 1970) includes three in-depth studies of Husserl's attitude towards science. I thank Prof. Jeff Mitscherling of Guelph University for information about this book.

[41]According to Joseph Kockelmans, Merleau-Ponty excludes the possibility of considering spatial relations of co-existence outside of time: "the coexistence defining space is not alien to time; this coexistence is the 'appertaining' of two phenomena to the same temporal wave" (Kockelmans 1970: 294).

[42]Merleau-Ponty's *Phenomenology of Perception* commences with a study of the body (Part I), and the perceived world (Part II), to conclude with an analysis of being-

movement and bodily space is not space thought of or represented" (Merleau-Ponty 1945/1962: 137). The capabilities to and experience of movement are the potential and actual sources of knowledge; movement provides us with access to the world and to the objects situated within this world. Motility elucidates spatial existence; human spatiality, inherently dynamic, is the pre-condition, not only for the perception but also for the creation of a meaningful world (Langer 1989: 47).[43]

One of Merleau-Ponty's examples of this grounding of meaning in the spatial situation of incarnate subjects is drawn from music--that is, from performance. An experienced organist is capable of performing a piece of music on a new instrument, with a different arrangement of manuals and stops, than the one he usually plays, only after a short rehearsal during which,

> he does not learn objective spatial positions for each stop and pedal, nor does he commit them to 'memory'. . . Between the musical essence of the piece as it is shown in the score and the notes which actually sound round the organ, so direct a relation is established that the organist's body and his instrument are merely the medium of this relationship. . . The whole problem of habit here is one of knowing how the musical significance of an action can be concentrated in a certain place to the extent that, in giving himself entirely to the music, the organist reaches for precisely those stops and pedals which are to bring it into being.
>
> (Merleau-Ponty 1945/1962: 146)

In this case, the body of the organist articulates an expressive space, constituted and possessed in and through movement (action). The world of human perception is inseparable from human awareness of the body in its placement, orientation and motility. For Merleau-Ponty, the human being is not a pure thinker but a body-subject situated in a world; this ontological change towards incarnate

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for-itself and being-in-the-world (Part III).

[43]This association of space or spatiality with movement in human existential experience had been articulated earlier in the philosophy of Max Scheler, especially in his *Idealismus--Realismus* of 1927-1928 (Gosztonyi 1976: 873-879).

subjectivity redefines epistemology.[44] As Monika Langer writes,

> Merleau-Ponty points out that all knowledge takes place within the horizons opened up by perception, that the primordial structures of perception pervade the entire range of reflective and scientific experience, and that all forms of human co-existence are based on perception. . . . Ideas are never absolutely pure thought, but rather cultural objects necessarily linked to acts of expression whose source is the phenomenal body itself as already primordially expressive. (Langer 1989: xiv-xv)

Merleau-Ponty's philosophy of incarnate subjectivity implies a crucial shift in the notion of space (chapter 2, Part II of *Phenomenology of Perception*), for he seeks to overturn the antinomy of "objective-subjective" space. In descriptive phenomenology, the subject of experience is the phenomenal body inseparably bound up with the world in which a human being lives and moves, is situated and orientated. The human body is the vehicle of one's "being-in-the-world." As Joseph Kockelmans writes, "body and world constitute a unity of mutual implication. . . We are in the world through our body and perceive it with our body" (Kockelmans 1970: 278, 280). The "body-subject" is inescapably located in space. This anchoring of the body in the world opens up a possibility for the creation of a "human space" encompassing the world of emotions, dreams, myths and madness, as well as the world of reflection (Langer 1989: 87).[45]

The notion of the world used by Merleau-Ponty differs from the physical "totality of all actual events" and is inseparably bound with incarnate subjectivity. The world is known, created and encountered in human experience. In the phenomenological philosophy of **Patrick Heelan**, a World is "the preexisting structure

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[44]According to Monika Langer, Merleau-Ponty rejects Husserl's idea of the transcendental ego, an important element in Husserlian transcendental idealism (Langer 1989: xiv). Incidentally, Roman Ingarden, was critical of the same element in the thought of his teacher (Rieser 1971/1986: 161).

[45]Kockelmans calls these spaces of myths, hallucinations, and dreams "anthropological spaces" and discusses the tension between living in any of these spaces co-constituted by our intentionality and the physical belonging to a geometric, "nonhuman" space (Kockelmans 1970: 304).

of actual and possible objects of our experience" which include "the space and time of our perceptions" extended and influenced by technology and science (Heelan 1983: 10).[46]

> A World, though singular in that it applies exclusively to a particular community at a particular place and period, is not the only World: Worlds are historical and anthropological, differentiated by peoples, times, places, and perhaps professions. A World is always intersubjective, the shared space of a historical community with a particular culture that uses a common language and a common description of reality.
>
> (Heelan 1983: 10)

The "World" is not only a particular space at a particular time, a spatio-temporal region. It is a *Lebenswelt*[47] created and inhabited by human beings who are simultaneously the World's objects (physical and material) and subjects (nonphysical and immaterial, i.e. exercising responsibility and rationality). The individual human subject, a *being-in-the-World*, is "not just a piece of irritable organic material, a "third-person process," nor just a disembodied Cartesian spirit, but a Body" (Heelan 1983: 12). For Heelan, as for Merleau-Ponty, the human subject is an embodied subject "connoting physicalities as well as intentionalities" and "neither science nor unaided perception give us anything other than a world-to-and-for-human-embodied-

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[46]Heelan's notion of the "World" draws from the concept of the *Lebenswelt*, introduced in the late writings of Edmund Husserl and defined briefly as "the world of common experience" (Gurwitsch 1972: 350). The *Lebenswelt* has two main senses: (1) the pre-cognitive world of experience, common to all human beings, (2) the world created by humans, including science, art, culture, etc. Heelan discusses both meanings and reveals how the primordial World (*Lebenswelt I*) is obscured and blurred by cultural conditioning. I owe the clarification of this issue to Prof. Philip Buckley.

[47]The lived world presents itself to human consciousness directly and in an immediate experience; its opposition is the world of science, "a theoretico-logical superstructure which, in the thinking of modern Western man, passes for reality" (Gurwitsch 1972: 352). In the second sense, *Lebenswelt* has a historico-social connotation and "is relative to a certain society at a given moment of its history" (ibidem).

subjects" (Heelan 1983: 13, 279).[48] Hence, the principle of the "ontological primacy of perception" which, together with the methodology of hermeneutics and "horizonal realism" constitutes the conceptual basis for Heelan's philosophy of science and his study of the nature of the visual space. In horizonal epistemology,

> there is no identity of reference between individual objects of a manifest image (e.g. this patch of sensed-color) and individual objects of the relevant scientific image (e.g. this spectral mix of wave lengths), only many-to-one and one-to-many mappings of perceptual objects contextually defined within mutually incompatible but complementary contexts.
>
> (Heelan 1983: 270)

Objects and events in the World are perceived through the mediacy of a multitude of "horizons"--each being "a structured domain of reality" with "a particular descriptive language and a corresponding context for its correct use" (Heelan 1983: 177-178). The contexts may be compatible and cumulative, or incompatible and non-additive, or even mutually exclusive.[49]

In particular, according to Heelan, human visual space is structured into a hyperbolic space of variable curvature (and of different near and far zones), but under the influence of modern science and the human "carpentered" environment, becomes organized in a Cartesian-Euclidean way (straight lines, uniformity, perpendicularity). The Euclidean visual space is a "cultural artifact" and represents a new horizon of reality made accessible to perception by the mediacy of science (Heelan 1983: 53). Mathematics provides a source of possible models of the structure of perception (i.e. Riemannian hyperbolic geometry) and an important influence on the content of perception itself (Euclidean geometry with the Cartesian coordinate system).[50]

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[48]According to Heelan, "all intentionality, even that operative in perception, is essentially hermeneutical, since it is concerned with making sense of our experience" (Heelan 1983: 12).

[49]This is true of writings about music; the plurality of "meta-musical" languages has been disscussed by Eggebrecht (1955, 1974), Bengtsson (1973), Nattiez (1987/1990).

[50]Heelan's hermeneutical phenomenology investigates "the way mathematical models, scientific theories, and technological instrumentation can influence, transform,

Nonetheless, Heelan claims that the hyperbolic nature of visual perception is pre-reflective and independent of the perceiver's act of choice (Heelan 1983: 158-160).

Heelan's phenomenology of vision is influenced by the writings of Husserl, Heidegger and Merleau-Ponty, and strives to incorporate or validate the first-person account in a disciplined and scholarly context. The same sources of inspiration, and a similar methodology, though with a stronger reliance on introspection, are utilized by **Don Ihde** in his *Listening and Voice: A Phenomenology of Sound* (1976).

One of Ihde's main premises is the difference between aural and visual perception, both providing different data about the spatio-temporal environment in which human beings are inescapably situated. Silence is the horizon of sound, while invisibility is the horizon of objects (Ihde 1976: 50), but "listening makes the invisible present" (p. 51). Thus, auditory and visual fields have overlapping and non-overlapping regions (p. 54); they differ, particularly in shape: sounds are omnidirectional so that the human subject is at the centre of the auditory space (and at the edge of the visual space). As Ihde writes,

> Were it to be modelled spatially, the auditory field would have to be conceived of as a sphere within which I am positioned, but whose 'extent' remains indefinite as it reaches outward towards a horizon.
>
> (Ihde 1976: 74)

Ihde points out that this spherical field is shaped and transformed by the human voluntary focus of attention on auditory events from a certain direction (p. 74). However, the most important aspects of auditory fields are, in this theory of perception, the twin dimensions of "directionality" and "surroundability." In Ihde's opinion, the essential ambiguity of auditory perception stems from the fact that

> the global encompassing surroundability of sound, which is most dramatic and fully present in overwhelming sounds and the often quite precise and definite directionality of sound presence which is noted in our daily 'location' of sounds, are both *constantly co-present*.
>
> (Ihde 1976: 76)

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and enrich the content of perception" (Heelan 1983: 8).

Ihde claims that directional hearing is a matter of everyday experience, while the awareness of the "surroundability of sound" is an attribute of a purely "musical" mode of listening:

> If I put myself in the 'musical attitude' and listen to the sound as if it were music, I may suddenly find that its ordinary and strong sense of directionality, while not disappearing, recedes to such a degree that I can concentrate upon its surrounding presence.
>
> (Ihde 1976: 76-77)

Ihde's introspective analysis of an experience of listening to a symphony in a concert hall clarifies what he means by the "surrounding presence of sound." This experience arises while the listener, immobile in his or her location, faces the orchestra on the stage and hears sounds from all directions (directly from the orchestra and reflections from all the walls). Enveloped in the spatially rich and evolving sonorities, the listeners bracket out the physical reality of sound and their own corporeality in order to perceive a disembodied music of pure temporality, a music that sounds from nowhere (cf. Chapter II). This kind of "musical" listening belongs to a particular historical and social context, i.e. it is an element of one World (in Heelan's sense). Ihde's mistake is to assume the universal validity of what is culturally circumscribed; this limitation results, partly, from his reliance on the first-person account (this is a characteristics of the phenomenological method).[51]

Whereas Don Ihde points out the difference between the aural and visual modes of spatial perception, Patrick Heelan focuses on the nature of visual perception of space, which is--in his theory--primarily hyperbolic and only secondarily (through cultural conditioning) Euclidean. Finally, in Merleau-Ponty's phenomenology of perception a particular importance is ascribed to the tactile-kinaesthetic aspects of the

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[51]Cognitive acts of perception or belief, can be studied from an objective, third-person perspective or from a subjective, first-person standpoint. The latter stance, according to Heelan, "supposes that the inquirer is also a perceiving subject, has direct access to perceptual acts of the kind that is being studied, and can use this evidence in the inquiry. A first-person study then asks the question: what is it for one like me to perceive a state of the World?" (Heelan 1983: 6). The problem, of course, is to decide what it means to be "one like me."

spatial experience.[52] This variety of modes of spatial perception indicates the richness of the human existence in space.[53]

This existence can be divided and systematized in **spatial spheres** ordered according to their increasing magnitude or growing distance from the self.[54] Therefore, starting from Merleau-Ponty's "zero degree of spatiality" that is the awareness of one's own bodily space, various personal spaces may be distinguished: a space of intuition and perception (extended through technology), a space of bodily action.[55] There are, then, the communal spaces of increasing size, from the inhabited space of the home, through various spaces and places of social life, to spaces constructed in art.[56] All these "spaces" are centred upon human corporeality and constitute various aspects of the experience of human "spatial life." In this, they differ completely from the "spaces" of physics and mathematics, spaces conceived of *in abstracto*, as ideas existing beyond the subjective experience of space (Gosztonyi 1976: 1004-1028).

One of these abstract notions of space, the timeless, "absolute space" of classical physics has become a tenet of modern culture, as the assumed scene of reality

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[52]Notions of bodily-kinaesthetic intelligence and spatial intelligence appear in Howard Gardner's theory (Gardner 1985).

[53]For an overview of the various types of spatial perception (visual, aural and tactile), as well as their dependence on time and the connection with movement, see Gosztonyi (1976: 794-823).

[54]Cf. the discussion of spatial spheres of existence in Gosztonyi (1976), or a systematization of these spheres by Whiteman (1967).

[55]Cf. Whiteman (1967). Psychological development of concepts of personal space (of increasing magnitude) in children has been outlined in an influential study by Piaget and Inhelder (1956).

[56]Cassirer (1931), Porebski (1978), and Heelan (1983) talk about the plurality of spaces in culture; Genette ((1966-1969), Bachelard (1967), Glowinski (1978), and Mitchell (1980) deal with various issues of space and literature; Norberg-Schultz (1971) focusses on existential dimensions of space in architecture; writings on issues of space in other arts (sculpture, painting) are too numerous to be quoted.

contemplated by the detached and disembodied Cartesian Minds.[57] This conceptual framework falsifies the spatio-temporal nature of the human, personal and incarnate existence--the source, medium and purpose of the spatio-temporality of arts. As Patrick Heelan reminds us, "persons, however, are not Minds: they are natural entities with a special power, that of constructing worlds and horizons to live in." (Heelan 1983: 257).

Heelan distinguishes two basic types of "Worlds" in which space is construed in a diametrically opposed manner. In modern naturalistic Worlds, "there is no part of space, no matter how distant, that is not like local space, and that is not metrically continuous with local space, and consequently, that is not in principle profane" (Heelan 1983: 256). This infinite, continuous, and homogeneous space without local irregularities bears a close resemblance to "absolute space."

On the contrary, in premodern, primitive and religious Worlds, space is discontinuous and non-homogeneous: it is divided into the spheres of the Sacred and the Profane. Both spheres are experienced in time. The reality of the non-scientific Worlds is organized by religious myths that project "the space and time of human life against the background of mythological events occurring in sacred Space and Time" (Heelan 1983: 254). The profane space is well known and well structured, it is the inhabitable space of everyday life. The sacred spaces are mysterious and unknowable; these meeting places with deities, these locations of the re-enactment of sacred rituals create discontinuities in the Profane and allow for the Sacred, the eternally present, to invade the ordinary spatiality and temporality of life.[58] The sacred Temples, Labyrinths or Mountains, the revered places of rituals and encounters with the

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[57]As Heelan writes: "Mind for the new scientific culture was the disembodied spectator of an infinite physical universe spatially integrated with the laws of classical physics and Euclidean geometry" (Heelan 1983: 257).

[58]However, in some religious cultures all life, all time and all space are considered sacred, because the transcendental Sacred is simultaneously immanent. The Deity is manifest and encountered "in and through" the world, not "over and above" the world (c.f. Pierre Teilhard de Chardin's *Le Milieu Divin,* 1957/1960).

transcendental mystery, are visited in a sacred Time which is set aside from ordinary living (cf. Cassirer 1931, Porebski 1978).[59]

Conclusion

The multitude of meanings of space presented in this Chapter, along with their historical evolution, casts light on the conceptual difficulties with defining space in music. From ordinary language we learn that space may mean an interval, distance, expanse, or, for instance, a three-dimensional infinite void. From classical philosophy we learn that the notions of space evolve and are historically limited. From modern physics we learn that there is no space independent of time, but only a space-time. However, we do not learn that with the reassuring certainty of absolute Truth: is there a space-time? What is a space-time? The philosophical-scientific debate continues. From phenomenological analysis of the human condition, we learn that "to be is to be situated" in a World (Merleau-Ponty), and that this World is a construct of the human creativity and imagination. In the spatio-temporal experience of human life, as analyzed by phenomenology, and as in modern science after the Einsteinian revolution, space and time are inseparably intertwined. This unity has important consequences for the re-definition of music as a "spatio-temporal" art.

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[59]In an analogous way, the Concert Hall is the temple of Music, a purely temporal and disembodied art (cf. Chapter II).