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“In Space” Or “As Space”: Three Dimensions Or Not?

Alfred Russel Wallace (1823 – 1913), the celebrated British naturalist and social critic, is best known for his independent discovery of the principle of natural selection, and for his key role in the development of the field of evolutionary biogeography. But his interests extended to well beyond these subjects: he was also an important anthropologist, physical geographer, land reform theorist, social critic, and early exobiologist. By the end of his life he was one of the most respected scientists in the world – and this, despite his concurrent attachment to a number of less mainstream side-infatuations including spiritualism, anti-vaccinationism, and phrenology.

Wallace was confident of his ability as a thinker, and though he had little formal schooling he often sparred with the most outstanding minds of his time. In fact, but few of his colleagues possessed his talent as a clear, lucid, writer, or his ability to think through an argument and defend his positions with arrays of evidence. And it was not just panache: many of his surmises have held their ground to the present day.

Wallace’s penchant for thinking outside the box led him to many important discoveries despite the fact that, as philosopher Charles Peirce once observed of him in a book review, “he preferred defending startling hypotheses that are not of a nature to be verified or disproved by decisive experiment.” As a result we cannot state with certainty just how high Wallace will ultimately rank among thinkers over the full trace of human endeavor. Some of his positions (for example, on phrenology) almost definitely seem doomed to the dust-bin, but others – well, their fates remain less certain.

An important example in this regard concerns Wallace’s position on the “dimensionality” of space. In the autumn of 1894 a discussion was raging in the pages of the spiritualist journal *Light* as to whether there exists a fourth dimension. Wallace contributed the following letter to the Editor to its 29 September 1894 issue:

Sir, – The discussion on this subject seems to me to be wholly founded upon fallacy and verbal quibbles. I hold, not only that the alleged fourth dimension of space cannot be proved to exist, but that it cannot exist. The whole fallacy is based upon the assumption that we do know space of one, two, and three dimensions. This I deny. The alleged space of one dimension – lines – is not space at all, but merely directions in space. So the alleged space of two dimensions – surfaces – is not space, but only the limits between two portions of space, or the surfaces of bodies in space. There is thus only one Space – that which contains everything, both actual, possible, and conceivable. This Space has no definite number of dimensions, since it is necessarily infinite, and infinite in an infinite number of directions. Because mathematicians make use of what they term “three dimensions” in order to measure certain portions of space, or to define certain positions, lines, or surfaces in it, that does not in any way affect the nature of Space itself, still less can it limit space, which it must do if any other kind of space is possible which is yet not contained in infinite Space. The whole conception of space of different dimensions is thus a pure verbal fantasy, founded on the terms and symbols of mathematicians, who have no more power to limit or modify the conception of Space itself than has the most ignorant schoolboy. The absolute unity and all-embracing character of Space may be indicated by that fine definition of it as being “a sphere whose centre is everywhere and circumference nowhere.” To anyone who thus thinks of it – and it can be rationally thought of in no other way – all the mathematicians’ quibbles, of space in which parallel lines will meet, in which two straight lines can enclose a definite portion of spaces, and in which knots can be tied upon an endless cord, will be but as empty

words without rational cohesion or intelligible meaning. (Wallace 1894, p. 467)

Wallace was so inspired by these remarks that he immediately wrote out a full essay on the subject; this he entitled “Supposed ‘Dimensions’ of Space as Possible Realities.” But it was never published. Its final paragraph reads:

I have now shown that all assertions as to the “dimensions of space” (whether two, three, four, or infinite) rest upon confusion as to the meaning of words and deriving results from such incorrect or illogical meanings. Space is said to be, actually, of one, two, or three dimensions; whereas the first two are in no sense space, or even portions of space, but only the limits or surfaces of portions of space. The third, is only a term applied to the mode of determining the shape and size of certain portions of space, and is wholly inapplicable to Space as a general term, which is by definition immeasurable. The other confusion of meaning is as to the word dimension; which, as popularly used refers to the size of any object; but, as used by mathematicians, refers to the varying lengths of one, two, or more co-ordinates as measured from imaginary rectangular axes anywhere in space. Because they can determine the position of lines, surfaces and solids by the use of one two or three such axes, they conclude (without any logical justification whatever) that this particular method of measurement of portions of space, demonstrates a quite unthinkable limitation of Space in general.¹

Seemingly this point of view would have appealed to the philosopher W.V. Quine, whose demolitions of the logical positivist views of Rudolf Carnap (as expressed in the latter’s *Die Aufbau*) began with Quine’s observation that no exact meaning can be attached to the elemental phrase “located at,” upon which Carnap built his system.

Wallace’s position on this matter was very likely in some way related to his views on spiritualism (which included a “hypernaturalistic,” or perhaps scientific, model of an aspatial spirit realm operating on the basis of natural law), but it is difficult to say whether these ideas did or did not predate his conversion to spiritualistic beliefs in late 1866. As early as 1870, in one of his first writings on spiritualism as connected to natural processes, he wrote:

But there is another class of human faculties that do not regard our fellow men, and which cannot, therefore, be thus accounted for. Such are the capacity to form ideal conceptions of space and time, of eternity and infinity – the capacity for intense artistic feelings of pleasure, in form, colour, and composition – and for those abstract notions of form and number which render geometry and arithmetic possible. How were all or any of these faculties first developed, when they could have been of no possible use to man in his early stages of barbarism? How could “natural selection,” or survival of the fittest in the struggle for existence, at all favour the development of mental powers so entirely removed from the material necessities of savage men, and which even now, with our comparatively high civilization, are, in their farthest developments, in advance of the age, and appear to have relation rather to the future of the race than to its actual status? . . . So, those faculties which enable us to transcend time and space, and to realize the wonderful conceptions of mathematics and philosophy, or which give us an intense yearning for abstract truth, (all of which were occasionally manifested at such an early period of human history as to be far in

¹ Alfred Russel Wallace collection at the Natural History Museum (London), item WP7/116(1). Online at: http://people.wku.edu/charles.smith/wallace/Supposed_Dimensions.htm .

advance of any of the few practical applications which have since grown out of them), are evidently essential to the perfect development of man as a spiritual being, but are utterly inconceivable as having been produced through the action of a law which looks only, and can look only, to the immediate material welfare of the individual or the race. (Wallace 1870, pp. 351–52, 358–59).

Some may regard this as “just history,” or the musings of an overactive imagination gone for more than a hundred years, but I am coming to a point... Suppose, just suppose, that Wallace’s assessment of the situation, while not spot-on, is fifty percent correct. That is, suppose that space in its entirety (that is, including its posed non-spatially-extended elements) is indeed infinite (though under all its conditions/manifestations still organized on the basis of natural law), but that under certain restrictive conditions *only* is manifest as three-dimensional, “extended” structures. This would imply that there are more general organizational properties involved we have not yet fathomed, but which might lend themselves to relatively conventional forms of analysis.

I have been looking into this question for some thirty years, off and on. In the early 1980s I hit upon a model for such thinking: Benedict de Spinoza’s philosophical approach to his two posed basic attributes of natural existence, thought and spatial extension. In 1986 I published a paper (Smith 1986) exploring the idea that every natural system might subsystemize internally according to a most-probable-state kind of hierarchical organization; the nature of the hierarchy was established through a simple mathematical scheme based on combinatorials. At the time I believed I was on the track of the Spinozian attribute “spatial extension”; shortly thereafter, however, I realized that this hierarchical model (which I still support) has no explicit connection with spatial extension, but might be related to the other attribute “thought” (perhaps more usefully termed “history”). I began to consider how a truly “ecological” model applicable to a natural system’s existence as a part of extended space might be organized, and came to the following model, very briefly stated.

Following Spinoza’s lead, and modern systems theory, I imagined that any natural system might be able to maintain itself as a discrete entity by sub-organizing, internally, into some small number of loci, or subsystems, *among which flow materials and information in a measurable dynamic balance*. That “balance” itself is posed to be extended space, an entropy maximization process occurring at the level of every individual system. After years of simulation, and a number of test empirical analyses of actual real world systems, the “small number” involved appears to be, specifically, four.

It would take a good deal more space than I have available here to fully explain the model, but I have created a website which runs through the philosophical underpinnings, simulations, and empirical pilot studies I have performed to this point (<http://people.wku.edu/charles.smith/once/writings.htm#2>). Over the past few years I have also been able to publish two of the best pilot studies, both of which lend support for the basic model (Smith & Derr 2012, Smith 2014), and a third summary paper (Smith 2016). These each involve geographical/geological subjects, but some other possible applications are briefly considered at the website. As the theory can be explored through fairly basic forms of pattern analysis (and probably certain kinds of flows data, expressed as input-output matrices), many further ones can be imagined: for example, the spatial autocorrelation properties of variation in pressure or wind speed within tornadoes (which through this model would be viewed as an equilibrational solution to the interplay of

four level-categories of wind/pressure).

Further applications might lie in new ways of looking into some more immediately pressing problems. A strong candidate for exploration would be monitoring for progressive disease, for example Alzheimer's disease. Deterioration of the brain expresses itself in changes in the organ's physiological functions, which in turn can be viewed through medical imaging efforts as changes in the measurable patterns of blood flow, electrical activity, etc. These patterns, interpreted as reflecting levels of efficiency of information flow among subsystems, might provide strong evidence for onset of conditions (away from a more optimally balanced "brain system"), or even a tendency toward eventually experiencing such an onset. Although the costs of running some tests along these lines would be relatively small, I unfortunately do not have access to the kinds of data that would be required for validation.

At the very least, and even should this theory fail under further rigorous investigation, it shows that one *can* envision a model of final causes that is unrelated to teleology. This provides some indication that Wallace might have been at least generally on the right track. Perhaps the universe of outcomes is not nearly so large as we think it is, yet still, after all, infinite!

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--Charles H. Smith, September 2017