of a sphere whose center is at the fixed point and whose radius is the length of the rod. Now fix one end of a second rod to another point of the plane and bring the two ends of the rods together, and fix the point on both ends; then the point can only move in a circle. Fasten it to a third point of the plane with a third rod, and it cannot move at all. But if we add a fourth dimension it could move.

The limits of space are for us simply the limits of possible motion of a material body. We can imagine a body coming from any point in three dimensional space to us, but cannot imagine one coming from outside of such space, until we add a fourth dimension.

Our conclusion is that space of four dimensions, with its resulting possibility of an infinite number of universes alongside of our own, is a perfectly legitimate mathematical hypothesis. We cannot say whether this conception does or does not correspond to any objective reality. What we can say with confidence is that if a fourth dimension exists, our universe and every known agency in it is, by some fundamental law of its being, absolutely confined to three of the dimensions. But we must not carry a conclusion of this sort beyond the limits set by experience. When we say that experience shows that not only our material universe, but all known agencies in it, are, by a law of their being, incapable of motion in more than three dimensions we must remember that the conclusion applies only to those motions which our senses can perceive, the motions of masses, in fact. There is no proof that the molecule may not vibrate in a fourth dimension. There are facts which seem to indicate at least the possibility of molecular motion or change of some sort not expressible in terms of time and three coördinates in space. If we consider those conceptions of mechanics which we derive from visible phenomena to afford a sufficient explanation of molecular action we must admit that, when the position and motion of every atom of a given substance are defined, the chemical properties of that substance are completely determined. If we take two collections of atoms of the same substance, put them together in the same way, and endow them with the same kinds of vibratory motion, we ought, on any mechanical theory of matter, to obtain substances of identical properties. Now, there seem to be reasons which I cannot stop at present to develop that might make us believe in changes of properties and attributes of substances not completely explained by molecular changes. That such is the case with vital phenomena can be demonstrated beyond doubt; that it is the case with chemical phenomena when they approach the vital character seems very probable. Certainly there is some essential difference between that form of molecular motion in which heat is commonly supposed to consist and the motion of masses. Perhaps the most remarkable of these differences consists in the relation of this motion to the ether. The motion of a mass suffers no resistance by passing through the ether with the highest astronomical velocities. Matter so rare as that of the diffuse comets may move around the sun with a speed of many miles per second without suffering the smallest resistance from the ether—in a word, without any friction between the matter and the ether. But when the molecules have the motion of heat, that motion, if motion it be, is always communicated to the ether, and is radiated away from the body, which thus becomes cool. Whatever form we attribute to the energy of heat, it is certainly a form which is constantly communicated from matter to the ether by a fundamental law of matter. Consequently, if heat be really a mode of motion, as is now generally supposed by physicists, it follows that there is some essential difference between the