

THE WORLD OF CAUSES—A STUDY OF HYPERSPACE ¹

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I.

IT IS IN keeping with the finest traditions of scientific thinking that no theory carrying momentous issues shall be offered or countenanced except after trial by every test. This is an especially wise attitude in a revolutionary epoch. The conservatism of science is its salvation and its doctors quite justly practice a high reserve in the promulgation, and even in the recognition, of new hypotheses. "Skepticism" as some one has said "is nature's armor against foolishness." Hence it is that space-concepts in four or more dimensions have found few champions in the past among our scientists of the conservative school.

Not that the thought of an upper or inner world of being apart from matter was something that could ever be cried out upon as wholly inadmissible. The limitations of our reason, as science well knows, are too evident for such headlong rashness. The human mind cannot conceive of infinity, either of space or time, yet equally impossible is it to think of space or time as less than infinite, for, in spite of ourselves, we still conceive as space or time whatever may have existed before time and whatever may lie beyond space. Again, we are helpless before the idea of a self-created material universe, existing from and to all eternity, or, if we dismiss this notion, and grope toward that of an infinite and uncreated First Cause, anterior to the universal fabric, we stand equally helpless before that idea. The mind strains in the effort to achieve either conception and fails.

¹ In the *North American Review* for October, 1922, the writer ventured upon a discussion of the changing scene in physics, as those changes bore upon the ultimate realities of life and being, and in a letter to the editors of the *Review* published in the July issue, 1923, replying to an attack in the April issue, he endeavored to defend his treatment of the subject as being fairly within the bounds of legitimate speculation. It is this paper which is referred to in the present discussion. It is necessary to add, perhaps, as explaining the silence of that paper upon the scientific utterances of the preceding decade, that the contribution was accepted by the editorial department nine years before its publication. In 1913 the overlap of the old ideas upon those newly forming gave a bizarre aspect to the essay but by the time of its publication science had become naturalized in its new element and the traditional teaching had gone completely into the limbo of forgotten things. We shall have more to say on this subject in later installments of the present series.

To the Deist, who rejects the theory of the self-existence of nature and who begins all his thinking with the idea of an intelligent Creator, the notion of a supersensuous plane of organized life is inescapable, however difficult the conception may be. If we think of the Deific nature as existing before ever the universe rose to birth, and while yet no star lit the measureless void, we are forced to conceive of intelligence as existing and potent quite apart from matter and with this difficulty gone the problem becomes a much easier one.

Nor can the position of the Deist be successfully assailed. His assumption we can neither prove nor disprove. To admit is quite as easy as to dispute his contention and much more satisfying, and with such an admission goes an acceptance of the idea that in the universal scheme of things thought and feeling are possible without a material instrument for their expression in the sense we understand. Science has always admitted that what defies our power of conception may yet be true and demonstrable, but it has relegated all these notions to the realm of philosophy and for itself has eschewed all such speculations.

II.

While our scientists have for the most part worn upon all occasions the protective armor of a dignified reserve toward the idea of an immaterial world of being, certain powerful figures, here and there, have stood forth boldly for the idea. This was true of Sir Alfred Russell Wallace, Sir William Crookes, Camille Flammarion, and others of the former day, who were unable to reconcile with any other theory the phenomena they beheld in their investigations along the borderlines of science. What these rare minds saw, or thought they saw, and were courageous enough to declare in the face of certain obloquy and derision, as in the case of Sir Oliver Lodge in our own day, may always remain the subject of controversy and curious speculation; but if the phenomena be admitted as genuine the conclusion follows at once.

We need not, however, confine to the devotees of psychical research, alive or dead, the muster-roll of scientists championing the thought of hyperspatial worlds. Among the ranks of students and thinkers in all walks of science, even before the birth of the new physics, an emphatic word upon the subject has now and again been

uttered. That this is true abundantly appears from a volume published by the *Scientific American* in 1921 under the title of *The Fourth Dimension*, made up from a collection of essays upon the subject submitted in a prize competition in 1909. While the object of the competition was to simplify the discussion of the subject, every civilized country was represented, and the auspices under which the contest was held constituted an ample warrant of its scientific character. In a preface to the work the publishers expressed the hope that the brief expositions might serve "to popularize a topic which has hitherto been unfortunately classed with such geometrical absurdities as the squaring of a circle and the tri-section of an angle."

These essays, emanating for the most part from trained mathematical and scientific minds, abound with interesting sidelights upon the problem; and while they must be read with some deductions, in view of recent discoveries, they supply an impressive commentary upon the rationality of the conception itself, even from the point of view of orthodox science, and they demonstrate that the four-dimensional idea has had its defenders in respectable and even authoritative quarters throughout the scientific era.

Perhaps the most fascinating popular treatment of this abstruse subject which has appeared was published in *McClure's Magazine* for November, 1913, under the title of *What is the Fourth Dimension?* by Waldemar Kaempffert, the present gifted science-editor of *The New York Times*. His word upon the subject is a classic of lucidity and readableness. "Curiously enough" says Kaempffert "the assumption of an actually existing fourth dimension accounts for many a phenomena which, in the present state of science, is explained by hypotheses more cumbrous. Not only the phenomena of life but the phenomena of chemical action can be explained easily by assuming the actual existence of the fourth dimension. There are two kinds of tartaric acid, one the mirror-image, as it were, of the other; for one is the reversal of the other. These two varieties change the one into the other without suffering chemical reconstitution. . . . It is easier to explain the existence of two identical but reversed varieties of tartaric acid by assuming the movement of a single variety in the fourth dimension than it is to account for the two varieties by our present theories. Dextrose and levulose, which are forms of sugar found in honey, are similar in chemical constitution but the one is the reverse of the other when examined by

polarized light. If their atoms are conceived to have movement in the fourth dimension it would be easy to explain why they differ. Certain snails present the same characteristics as these two forms of sugar. Some are coiled to the right and others to the left; and it is remarkable that, like dextrose and levulose, their juices are optically the reverse of each other when studied by polarized light."

III.

The general theory of hyperspaces has always in the case of our mathematicians carried a peculiar appeal. The mathematical mind, accustomed to subtle and elusive notions, has found it possible and even easy to deal with such conceptions. What a great mathematician can do in this department of speculation who happens to combine with high technical equipment a faculty for clear exposition is apparent from the article upon *Hyperspaces* in the *Encyclopedia Americana*, volume 14, page 602, contributed by Dr. Cassius J. Keyser, Adrian Professor of Mathematics in Columbia University, "Do hyperspaces exist?" he asks and he answers "Undoubtedly they have *logical* existence, the *concept* of hyperspace being interiorly consistent and available for thought. More mathematics does not demand. The hypothesis of their 'physical' existence 'natural' science may yet be compelled to employ."

Indeed, in his *Human Worth of Rigorous Thinking*, published in 1916, where he was freer to express his personal conviction, Dr. Keyser took firmer ground. "Hyperspaces" he observes at page 256, "have every kind of existence which we may warrantably ascribe to the space of ordinary geometry." Nor did the lapse of time dim the force of his belief. "I have myself no longer any doubt in the premises" he remarks at page 333 of that fascinating combination of learning and eloquence which he published in 1923 under the title of *Mathematical Philosophy*, and by express quotation he re-affirms the utterance we have set forth from the earlier work.

The most daring position, however, ever taken by a conservative scientist in this field was that of Professor Simon Newcomb, who was not only a mathematician of international renown but one of the most distinguished astronomers of his time, and the views he expressed were put forth in the earlier epoch of scientific speculation when the startling unfoldments of our own day were unknown and unanticipated.

"If we confine a being able to move in a fourth dimension" declared Professor Newcomb in an article contributed to *Harper's Magazine* for January, 1902, under the title of *The Fairyland of Geometry*, "within the walls of a dungeon of which the sides, the floor and ceiling were all impenetrable he would step outside of it without touching any part of the building just as easily as we could step over a circle drawn on the plane without touching it. He would simply disappear from our view like a spirit and perhaps re-appear the next moment outside the prison. To do this he would only have to make a little excursion in the fourth dimension." His concluding remarks are even more pointed and significant. "It is very curious in these mathematical speculations," he says, "that the most rigorous mathematical methods correspond to the most mystical ideas of Swedenborgian and other forms of religion. Right around us but in a direction which we can not conceive . . . there may exist not merely another universe but any number of universes."

Back of such remarkable utterances as we have quoted from distinguished mathematicians is the conviction that the axioms of Euclid are not self-evident truths, as was so long believed, and that Lobachevsky and the other non-Euclidians may claim an equally just warrant for their principles. "So far as our experience goes," remarks one of the essayists at page 168 of the book to which we have referred as published by the *Scientific American*, "all space is three-dimensional but the statement cannot be proved absolutely. It must be accepted as an axiom. If some Lobachevsky should challenge us for a proof of this axiom we could give him but little satisfaction. He might then go ahead and assume that space had four dimensions."

IV.

Such, then, was the state of thought upon this absorbing subject in the more sedate and less tumultuous day of scientific and mathematical speculation. As the implications from the new physics became plain, however, the basis widened immeasurably for the thought of a loftier world of being dissociated from the material but playing into that domain of reality. The discovery of radium was the supreme shock to the ultra-materialist. Radioactivity, with its overturn of fundamental concepts in physics, changed the material fabric from a fixed to a fluid thing. The thought of the atom

as an indivisible and indestructable unit of materiality disappeared at once and in its place came the idea of the atom merely as a center of force with visibility and other reactions to the bodily senses as incidental only and not essential. With the advent of the new physics, in fact, the ground upon which the extreme materialist had stood melted from under his feet.

The very power of the forces within the radioactive atom told against the traditional ideas. Here were particles traveling at such terrific speeds within the atomic system that by comparison all other known forces were playthings. Science, indeed, began to speak a language which the mind trained in the old ways could not understand. With the emphasis upon matter as an unfoldment from some primordial element, itself an outbirth from vacancy, a curious and unfamiliar note appeared, suggesting the utterances of the alchemists, and those schooled in the science of the older day gasped and rubbed their eyes.

The thought instantly suggested itself that these incredible forces, traveling at speeds beside which the rifle-bullet was a snail crawling on the ground, must have come into the lower-space from somewhere, and the query arose whether these new forces, and perhaps some of the old as well, like electricity and gravitation, might not have their origin in some higher, finer, more potent world within or beyond the material and whose tides, through these openings, were flowing into the lower plane.

The difficulty of such a conception, even under the new revelations from the laboratory, was the supreme obstacle to logical thinking. It seemed impossible to conjure up before the mind's eye any notion of a realm of being apart from matter. The idea of an immaterial world of reality, interpenetrating the material yet vibrant with energy, and possibly with life and consciousness, defied the power of the mind to conceive. It seemed like an effort to visualize the non-existent. Could the phenomena which appeared to necessitate such a theory have been reproduced at will this unfamiliar concept would long ago have domesticated itself in our thinking, whatever its difficulty, but with that phenomena out of the reckoning we were left to deal with the notion of a hyperspatial world merely as the probable homeland of forces and influences which work so mysteriously below and whose true nature and birthplace have defied the power of science to trace.

v.

The difficulty of the conception, it is not amiss to say, was of much less concern to the scientist than to the layman. Science had served a long and painful apprenticeship in the formulation of theories. It had just won, in its warfare on behalf of the evolutionary theory, a contest with fixed and embattled opinion, and it knew even then, as was not known nearly so well in any other department of intellectual endeavor, how vain it is to sanctify knowledge and give the stamp of finality to belief.

Science even went further and in seeking explanations for phenomena assumed, now and then, for the purpose of inquiry and experiment, ideas which were unamenable to demonstration and occasionally did violence to logic and common sense. It was a deliberate challenge to the dogmatic spirit in scientific thinking. Research in the scientific domain became a thing apart, governed by principles which in every other field would have been looked upon as wild and outlandish and which yet at unexpected moments produced astounding results. The history of scientific experimentation conducted in defiance of familiar axioms yet yielding brilliant and unanticipated discoveries would form a fascinating work not merely for the lay but for the scientific reader as well.

It is a truism that science, even of the older day, never demanded for its working theories concepts free from the contradictions of logic. In formulating hypotheses which have done yeoman service the great minds of the past have not scrupled to disregard accepted ideas, and, to thrust aside what might seem the inevitable deductions of reason, in order to account for unmistakable phenomena. The theory of a light-bearing ether, before the days of Einstein and while that theory was a universal assumption, is a classic example. The properties attributed to the ether no amount of acumen could logically reconcile. That seemingly hopeless tissue of self-contradictions appeared indispensable to explain what was going on in nature, and its logical inconsistencies science postponed and held in abeyance.

Nor has science hesitated even before the transcendental and the mystical in its quest for hypotheses which might gather into order and meaning baffling and apparently unconnected things in the realms of mind and matter. The atomic hypothesis itself, before the uprise of our present theory of the atom, was a distinctly tran-

scendental concept, incapable of logical demonstration, for an indivisible particle of finite dimensions is unthinkable nor, on the other hand, can the mind conceive of a particle infinitely divisible.

Our secondary scientists of the former day, receiving from the sources of authority and passing on to the public the groundwork of scientific thinking, were given to a somewhat dogmatic attitude in the enunciation of scientific principles, but on the highest levels of scientific thinking the tentative nature of scientific belief was thoroughly understood. Now, since the uprise of the new physics, the hesitating note sounds through all scientific teaching, and the pontifical air is absent. Indeed, the provisional nature of scientific opinion is now an accepted doctrine in all quarters.

VI.

In the book of essays making up the volume published by the *Scientific American*, and to which we have heretofore adverted, suggestions appear of a highly provocative nature and which are a distinct spur to reflection. We find the idea, for example, at page 90, attributed to Professor Karl Pearson, that an atom may be a place where ether is flowing into our space from a space of four dimensions. Again, we encounter the notion, at page 152, of four-dimensional vortices as possibly explaining the electric current. So, at page 186, the fourth dimension is offered in explanation of 'isomerism' in chemistry, applied to substances having the same composition but which yet possess different properties—a singular aspect of chemical phenomena which may be due, as suggested in these essays, to a "four-dimensional movement in the minute particles of which they are built up."

In endeavoring to solve the mystery of gravitation, magnetism and light, perhaps, we are told at page 250, we have been merely considering the three-dimensional aspects of what are really four-dimensional processes, and in the strange principle which holds an organism to its own individuality, notwithstanding the molecular changes constantly going on, there may be, as we are reminded at page 107, the hint of a four-dimensional phenomenon. The book reaches a climax, indeed, in its closing sentence with the suggestion of a four-dimensional influence spanning the whole drama of life and death. "Might not birth," we read, "be an unfolding through ether into the symmetrical life-cell, and death the reverse process of a folding-up into fourth-dimensional unity."

Technical aspects of the hyperspatial idea make heavy reading, no less since the uprise of the Einstein theories than before, and we have no thought of embarking upon an elaborate discussion of that character, even were we fitted for the task. In a world of speculation so unfamiliar it may yet be possible to orient ourselves by methods much less pretentious.

How the highest and lowest spaces interact, moreover, if they do, is not the inquiry we have set for ourselves. In a paper which appeared in 1922 we tried to establish the thesis merely that the idea of a space of more than three dimensions, affording a habitat and place of exercise for entities endowed with personality, was not an unreasonable one in the light of the new physics. In the present series of papers we propose to explore certain regions of scientific knowledge which hitherto, from their very mysterious and baffling nature, scientific speculation has avoided, but where, if a loftier space exists—a dwelling place of higher life and more potent force—we should detect the play of that inner and finer world into this outer and lower. Into those uncharted areas, where the scientific mind as yet refuses to enter, adventurous laymen, with no scientific prestige to lose, may rightfully penetrate and explore to their heart's content.

Formal science, indeed, some quarter of a century ago gave up definitely all concern with ultimate solutions. That region became to science a 'no-man's land' and a 'no-man's land' it remained until recent years, when the revelations of the laboratory and the observatory forced a restatement of scientific truth and turned the face of science once more, and against its own will, to the region of final causes.

VII.

As more and more the advance of science compels a consideration of ultimate realities the greater the note of doubt which sounds as a deep undertone through scientific discussion. The masterful voices whose accents ring out so clearly at other moments take on, as they near the subject of final causes, a timidity which paints to us graphically enough the dark vacancy into which they are peering. There are no lordlier figures in any department of thought today than the great thinkers in the scientific domain, and their hesitation before any problem is token enough of its difficulty. That these su-

perb minds should shrink from the study or statement of vital scientific truth in any field is fair warning to the rash adventurer.

With that frankness which is the badge of their greatness these sons of Anak have tried now and again to thrust aside the veil which shrouds these mysteries and the effort has disclosed to us both the grandeur of the riddle and their despair of its solution. The very candor which marks these utterances is illuminating and suggestive, and the spectacle of a proudly courageous intellect, halting before some last great generalization in the quest for finality, is an inspiring commentary upon the lofty mission of science and a revelation of the sublime humility and self-effacement of its votaries.

Sir James Jeans, here and there in his works yielded us furtive glances into that darkness, as though by long lightning-flashes, also Dr. Robert A. Millikan, one of the rare minds of our time, and Sir Arthur S. Eddington—each with varying emphasis, sounds the note of stark-futility and all end with that gesture of hopelessness which is a surrender more impressive than victory.

“It is now a full quarter of a century,” says Jeans at page 318 of his *Universe Around Us*, published by Macmillan in 1929, “since physical science, largely under the leadership of Poincaré left off trying to explain phenomena and resigned itself merely to describing them in the simplest way possible. . . . For instance, the ether has dropped out of science, not because scientists as a whole have formed a reasoned judgment that no such thing exists but because they find they can describe all the phenomena of nature quite perfectly without it. . . . If at some future time they find they need it they will put it back again. . . . This implies merely a growing conviction that the ultimate realities of the universe are at present quite beyond the reach of science, and may be—and probably are—forever beyond the comprehension of the human mind.”

The pronouncements of Dr. Millikan are equally striking. Speaking of the possibility that the hydrogen atom may be continually coming to birth in interstellar space, and thus offering a proof that the creative forces are still at work in the universe, that distinguished physicist, in his presidential address to the American Association for the Advancement of Science, as reprinted in the annual report of the Smithsonian Institution for 1931, remarks: “If Sir James Jeans prefers to hold one view and I another on this question no one can

say us nay. The one thing of which we may all be quite sure is that neither of us *knows* anything about it."

Sir Arthur Eddington is no less open in his statements and no less inconclusive. "The quest of the absolute," he says on page 206 of his *Nature of the Physical World*,² "leads into four-dimensional worlds," and he observes in an earlier passage at page 85, with that simplicity and unpretentiousness which give so much charm to his pages, "as a scientist I simply do not believe that the present order of things started off with a bang; unscientifically I am equally unwilling to accept the implied discontinuity in the divine nature. But I can make no suggestions to stay the deadlock." Sir Arthur, indeed, goes farther than his fellow Olympians in this brilliant trio. "There is something radically wrong," he declares at page 179, "with the present fundamental conceptions of physics and we do not see how to set it right."

Implicit, perhaps, in the admirably frank positions of these majestic figures in the scientific domain, and those of other great thinkers whose minds have brooded over the mystery, is an unwillingness as careful scientists to speculate upon hyperspatial worlds beyond or within the material universe. Such an unwillingness is not a denial that those worlds exist or that in those multidimensional spaces an explanation may lie, not only for the origin of the physical universe, but for many seemingly inexplicable things which happen in the physical universe now and which have happened through the aeons. The motives which close their lips against discussion of such theories are obvious enough and do honor to their solicitude for the integrity of scientific research and hypothesis.

None the less the spirit of inquiry presses and brooks no refusal and if the cherished oracles are silent or doubtful, humanity will embark unguided on the great adventure. The quest of truth for its own sake is the seal of man's kinship with the nameless something behind all being. It stamps the mind as an offshoot from the creative essence, seeking all knowledge as its just heritage. Expeditions into the unknown, therefore, are legitimate exploits of the human spirit, and if science can not sponsor and conduct the enterprise it will not withhold its blessing from any raw, untutored layman who may attempt the venture.

² *The Nature of the Physical World*. By Sir Arthur Eddington. The Macmillan Company, New York, 1929.