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(Illustrated articles are marked with an asterisk.)

IS THE ETHER MATTER?

Thanks to the spectroscope, it is now known with reasonable certainty that the elements which compose our earth exist also in other parts of the Universe. There are indications also of the existence of substances unlike anything we know; but the fact, that such extra terrestrial elements appear to act on light as our familiar elements do, has given rise to the inference that the composition of the Universe is fairly represented in kind by that of the cosmic atom which we inhabit, in other words, that the substantial unity of the material Universe is practically demonstrated. Limiting the term "material Universe" to the system of things which our senses make known to us, the inference may not be far out of the way; but there are reasons why the term should not be so limited. It would be absurd to suppose our feeble senses able to detect all the powers and properties of elements such as we know in part: it would be still more absurd to assume that our knowledge of the possible range of matter, even in the earth, is anything like exhaustive. To pronounce upon the composition of the Universe from our meager knowledge of it is consequently somewhat presumptuous.

It is easy to perceive that our range of knowledge is exceedingly limited. Relatively few aerial vibrations affect our sense of hearing; an extremely narrow range of luminous undulations are visible to us: and equally limited is our capacity to measure temperature, density, or any other accident of matter. The earth might easily contain numberless kinds and grades of matter so rare or so dense as to be entirely beyond our power of recognition.

For illustration, hydrogen passes through cast iron as water does through loose sand. The resistance which a cast iron ball would meet in its flight through an atmosphere of hydrogen would, on the other hand, be scarcely appreciable. The difference in density between cast iron and hydrogen, though very great, is far from infinite: were it infinite, the resistance which either would offer to the passage of the other would be infinitely slight: to us, *nil*. So with every other sort of matter in a medium infinitely more dense or infinitely more rare than itself. It is possible, therefore, to conceive, as Dr. Young suggests, of series of worlds of different orders, pervading each other, mutually unknown and unknowable, in the same space.

There is in this line of thought something more than purposeless speculation; and if there were not, one could hardly escape it in contemplating the theory of light now generally accepted by the scientific world, a theory involving conditionsso astounding that nothing short of a neworder of matter seems adequate to meet its requirements. Practically there could not be an hypothesis which would answer the requirements of a perfect hypothesis more completely than that which attributes the phenomena of light to undulations of a highly elastic medium pervading all space. It affords a reasonable explanation of every phenomenon in optics. More than that, it enables the investigator to anticipate effects which noeye hasseen. As Fresnel observes: "There are certain laws so complicated and so singular that observation alone, aided by analogy, could never lead to their discovery. To divine these enigmas, we must be guided by theoretical ideas founded on a *true* hypothesis. The theory of luminous vibrations presents this character and these precious advantages; for to it we owe the discovery of optical laws, the most complicated and the most difficult to divine."

It would exceed the limits set for this article even to enumerate the wonderful discoveries made by the theory of undulations, and afterwards verified by experiment, some of the predicted phenomena being so strange, exceptional, and opposed to all analogy that the validity of the theory which revealed them can scarcely be questioned. Yet this most satisfying theory is based on the assumption that interstellar space, indeed all space which we have knowledge of, whether occupied by ordinary matter or not, is pervaded by something inconceivably more solid and elastic than steel!

Attempts have been made to dispense with the assumed ethereal basis of light by substituting therefor some excessively rare form of ordinary matter. To meet the requirements of the case, such a gas would have to be very rare indeed; at the same time it would have to possess an elastic force at least a million million (1,000,000,000,000) times as great as the atmosphere at the earth's surface, conditions quite inconsistent with the main body of our knowledge concerning gases. If material, the physical basis of luminous undulations must be matter of an entirely different grade from anything else we know.

Any comparison between ordinary matter and anything so unlike it as the hypothetical ether must obviously be taken as suggestive rather than demonstrative; nevertheless the results of such comparisons give us perhaps as correct a notion of the physical basis of light as we are able to entertain. Our only clue to its possible qualities lies in the extreme rapidity with which light rays traverse it. It is understood that the velocity of wave motion depends, other things being equal, on the elasticity of the medium. Knowing the relative velocities of light and sound, Sir John Herschel calculated the necessary elasticity of the ether (in other words, the amount of force which the wave theory of light requires to be exerted at each point of space) as 1,148,000,000,000 times the elastic force of ordinary air at the surface of the earth. The atmospheric pressure is fifteen pounds to the square inch; the corresponding ethereal pressure must therefore be about seventeen million million (17,000,000,000,000) pounds, a pressure which Professor Cooke, of Harvard, translates into the weight of a cubic mile of granite. The atmosphere counterbalances a column of mercury thirty inches high. Could it be demonstrated in a similar manner, the pressure of the ether would sustain a column of mercury six times as high as the sun!

These numbers give but an approximate idea of the enormous solidity of the adamantine something which the earth sweeps through at the rate of eleven hundred miles a minute without resistance! It pervades our bodies and we move about in it with perfect indifference. As Professor Jevons justly observes, all our ordinary notions of matter must be laid aside in contemplating conclusions like these; yet "they are no more than the observed phenomena of light and heat force us to accept."

Regarded in the light of ordinary matter, the ether is impossible and incredible; as extraordinary matter, or, as we have imagined, matter of a higher grade, it is consistent and reasonable. If we admit one such higher or lower grade of matter, the door is opened for the possible existence of an infinite series of them.

The contemplation of such possibilities may at least teach us not to be hasty in limiting the scope of the Universe to elements such as we know.

THE WOODBURY PATENT.

The great interest involved in this patent, and the corresponding efforts which have been put forth, both to sustain and to defeat it, have induced inquiry on our part, some of the results of which we shall now lay before our readers. We do not propose to discuss the validity of the patent, but only to refer to some of the extraordinary circumstances connected with its history.

The application—which was for an improvement in planing machines—was filed, June 3, 1848; was rejected, February 28, 1849; was withdrawn and $20 returned to the applicant, October 4, 1852. It then lay as dead as an antediluvian fossil for more than eighteen years, when, on December 5, 1870, a new application was filed by Woodbury for the same subject matter. This was unsuccessfully pressed by different attorneys for more than two years, the applicant in one case at least having offered an attorney $5,000 as a conditional fee, which was declined on account of the hopelessness of the undertaking.

On March 27, 1873, Fisher and Duncan, late Commissioners of Patents, became Woodbury's attorneys, and on April 26 following the patent was allowed. It was issued three days later, which was just two weeks earlier than it would have gone out in the regular course of business in the Patent Office. Such an advance was, it is true, not wholly without precedent; but as it always creates inconvenience and confusion, it is only allowed in very extraordinary cases. We know of nothing in this case that should have given it such a preference.

The main decision allowing the patent to Woodbury was claimed to be justified by the ruling of Judge Fisher in the Gray case. But there, the time which had elapsed between the withdrawal of the old application and the filing of the new one was less than two thirds as great as in the Woodbury case. And as abandonment—which was the vital question in this case—is specially declared by statute to be a question of fact, to be determined by the circumstances of each particular case, this increased length of time was a proper element to be taken into the account in forming a correct conclusion here. But the Commissioner, without taking this circumstance into consideration, and without waiting till the case was legitimately before him, made a written order that it should be decided on its merits, without taking the matter of abandonment into the account at all, which order or decision was fully observed.

Let it be remembered that the statute has provided four separate tribunals for the determination of questions of patentability. These rise in grade one above another, so that three appeals lie successively from one to that which is next above it, upon the payment of the prescribed fee in each case. The next to the highest of these tribunals is the Commissioner himself; and although he may very properly give informal advice to an examiner when consulted by him, he should no more make a binding decision until the matter is brought regularly before him than should any other appellate court, in a case still pending before an inferior tribunal.

But another act, quite as indefensible, remains to be noticed. We have stated that the statute has provided that abandonment should be treated as a question of fact. That rule is made specially applicable to cases like this. Accordingly, the 41st rule of official practice provides, in these old rejected or withdrawn cases, that "Upon the hearing of such renewed applications of either class, patents will be refused if it be found that the parties have abandoned their inventions; and in order that opportunity may be given for the production of proof of abandonment, or of two years' public use, if either exists, an interference will, at the discretion of the Office, be declared between the renewed application and all applications made, or patents granted, in which the device in controversy has been claimed or described."

Now, the discretion which is thus to be exercised means a sound and just discretion, and not one that is controlled by caprice or by favoritism. And there has never been a case since the act of 1870 was passed, and probably there never will be one hereafter, where such an interference, for the purpose mentioned in the rule, was ever more imperatively required than in this. But, as we are informed, the Commissioner gave instructions that, in this case, no interference should be declared, and the patent was issued accordingly.

Now we do not intend to be unjust, or even uncharitable, towards the Commissioner; but in all candor and sincerity, we feel bound to say that these proceedings have altogether been most extraordinary, and well calculated to create a suspicion that the strict impartiality which is so necessary to secure that public confidence in the management of the Patent Office which is necessary to its ultimate success, has not been here observed. The interests of the Office require, not only uprightness in its head, but also the absence of whatever may create a suspicion of the want of it. The question naturally arises whether the same favor would have been extended to this case, and the same alacrity manifested in overstepping the line of strict official propriety, if the matter had been in the hands of other attorneys. Rightfully or wrongfully, the idea of rings within the Office, co-operating with rings ontside of the Office, is not unnaturally suggested by the facts of this case than which nothing can be more detrimental to the interests of the Office.

We have written not in malice or unkindness, but with an earnest desire to benefit the Patent Office, and through it, the great body of meritorious inventors whose welfare we believe to be in no little peril. The cheapest and most effectual way of securing uprightness and propriety of action in any public officer is, in a candid and just way, to spread his acts or those of others in like predicament fully before the public. This is well calculated to prevent those mistakes which arise through carelessness or inadvertence, as well as to correct those which may have had a different origin.

THE PHYSICAL FORCES ARE MODES OF ETHER PRESSURE

Professor Challis, of Cambridge University, after long and exhaustive researches upon galvanic and magnetic action, concludes that the hydro-dynamical theory of action is alone correct. The theoretical explanation of galvanic and magnetic phenomena is to be sought by means of mathematical deductions. The author believes that the science of theoretical physics, laid down in Newton's "Principia," is by no means confined to physical astronomy, but comprehends the principles of all departments of natural philosophy which have relation to physical force. His conclusions on galvanic and magnetic action have been reached in conformity with Newton's rules and principles. The author's main conclusions, relative to the *modus operandi* of the physical forces, to which this system of philosophy seems to point, are: That they are all modes of *pressure* of the ether; that the forces concerned in light, heat, molecular attraction and repulsion, and gravity are dynamical results of *vibrations* of the ether; and that electricity and galvanic, and magnetic forces are due to its pressure in *steady motions*.