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"Vision" and "War".

LORD RAYLEIGH'S presidential address to the British Association for the Advancement of Science, which was reproduced in *Current Science* for last month, consists of two parts. The first part is devoted to the consideration of the historical development of the auxiliary physical instruments invented by scientists for assisting their natural organs of visual perception for exploration of those phenomena in the material universe which happily lie beyond the faculty of their physiological mechanism of vision. The second part forms a brief but effective defence of scientists who are generally but unreasonably accused of being responsible for all the atrocities of modern wars.

We know that the extremely complicated and delicate human eye is the outcome of a long evolutionary process from some simple and generalised type, and that it is adapted to react to the bulk effects taking place in the environment. The sensory organs have therefore a survival value, for on their power and acuteness depends the individual and communal life. Nature never intended them to be used for the purpose of investigating the atomic structure or the passage and behaviour of electrons.

The physical scientist has had to supplement the mechanism of the eye by devices which have supplied its natural deficiency, in a way essentially identical with direct scrutiny. The concept of the universe developed by the scientific worker, equipped with the most delicate and sensitive optical instruments, must necessarily differ from the standpoint of the man, who relies upon his unaided vision and intuition for the interpretation of the phenomenal world, and it is open to the philosopher, taking a general interest in the results of modern science, to conclude that science contradicts the evidence of the senses. The growing feeling for effecting a reconciliation of such apparently contradictory views, must have led Lord Rayleigh to give a historical review of the methods and results achieved by the physicist using the technical apparatus which his inventions have placed at his disposal. In dealing with the increasing employment of optical goods for the investigation of the behaviour of matter in all states, Lord Rayleigh has emphasised that in view of the fact that we have to depend mostly upon our visual perception for the greater part of our knowledge of nature, the means at the disposal of scientists

for improving their devices to carry forward their researches need not be considered as exhausted, and that extravagant optimism about their limitless extension, while theoretically admissible, is not justified having regard to the histologically circumscribed character of the sensory surface of the natural organs. The lenses, telescopes, microscopes, cathode rays, X-rays, spectroscopy, photo-electric surfaces and television certainly promise prospects of future developments, but they form only one gateway of knowledge to obtain world experience, which cannot be complete, because our sense perceptions are extraordinarily vague and confused modes of experience. Modern physical sciences are the product of a co-ordinated effort, carried on through centuries, to investigate those phenomena of nature which produce the transitions of sense perception or awareness, and science has no explanation to offer for the necessity of these phenomena, nor has science the power to endow its formulæ for the observed phenomena with any self-consistent meaning.

In the concluding para of the first part of the address Lord Rayleigh has pointed out that the modern scientific doctrines are not based on speculations or theoretical deductions, but have been built up on the foundation of tangible facts discovered by methods not essentially different from direct scrutiny. This mode of direct scrutiny reveals nature as a vacuous pattern of electrical disturbances, and where the centres of disturbances cohere, the experience of solid state is obtained. You want the biological eye to sense the solids; you want the electric eye to perceive that "a particle can be both a particle and a wave". But is the information provided by the latter "Eye" a complete expression of our experience of the visual field of nature? It seems to us that all sense perception is merely an outcome of the dependence of our experience upon bodily functionings, and that the interpretation of the relation of our personal experience to the phenomena of material universe lies in the examination of the dependence of our personal experiences upon our bodily functionings. We may not be near a direct disclosure of the metaphysical nature of things, nevertheless scientific analysis has revealed enough knowledge to enable man to utilise his discoveries for his good as well as for his evil.

We should have been greatly impressed if Lord Rayleigh had chosen as his text for addressing the British Association the other "Vision", which the great founder of Christian Religion preached about nineteen hundred years ago, and on which the whole structure of European civilization purports to be founded. What is the attitude of the great body of British and American scientists who had gathered at Cambridge to discuss scientific papers, while the Central European powers were talking the language of war. For months extending to years the world has been witnessing stupendous developments in the two continents, threatening every nation to be involved in a general conflagration, which is already devastating two countries. Is there a science of peace? or is there only a science of war? It is true that the British Association convened its annual session at a time when the condition of public affairs in Europe was unpropitious for scientists to define their relation to international politics, but a public pronouncement of their intentions in their collective capacity might have helped to unravel the European tangle. We are aware that in the totalitarian states, scientific knowledge is under conscription for military purposes, and we know the extent of reaction which it must produce on the temper of democracies. Political ideologies are fast infecting the spirit of science. There is no recognisable symptom of the change of heart in Dictators towards the horrors and wastefulness of war in which their policies, if pressed to action, must involve their own countries which they profess to love and adore.

Lord Rayleigh has put the case for scientists thus, "It is worth while to enquire what basis there is for this indictment, and whether in fact, it is feasible for men of science to desist from labours which may have a disastrous outcome, or at any rate to help in guiding other men to use and not to abuse the fruits of those labours". His own opinion regarding the general criticism of the application of scientific discoveries in the methods of modern warfare is summarised in a brief sentence, "I believe that the whole idea that the scientific men are specially responsible is a delusion born of imperfect knowledge of the real course of the process of discovery".

Nobody quarrels with scientific discoveries. Nobody suspects the intentions of scientists. Nobody doubts the urge of scientists to explore the unknown. The world is prepared to accept Lord Rayleigh's plea that scientists are not responsible for all the atrocities of war, but it is entitled to ask "then, who is responsible?" He is perfectly right when he says, "I venture to say that it never occurred to him (Sir William Roberts Austen) or to any of his hearers (Lord Rayleigh included) that thermite had any application in war." But surely some one must have had the necessary vision to discover its application to the destruction of civil populations, and is that "some one" a scientist or a politician or a journalist? But the "world is ready to accept the gifts of science, and to use them for its own purposes. It is difficult to see any sign that it is ready to accept the advice of scientific men as to what these uses should be." The world that Lord Rayleigh has in mind is innocent of dichloroethyl sulphide and is not likely to mix aluminium powder with red oxide of iron, but they form the material on which a few gifted men work and demonstrate their application to the practical uses in peaceful industry. These scientific men are said to have no notion that the "oil, very poisonous and violently inflames the skin," and the "great amount of energy which is liberated when aluminium combines with oxygen" can have any use for military purposes. We believe that there is a wide difference regarding the degree of responsibility attached to scientists investigating theoretical problems and those dealing with explosives and poison gases, and it is untenable to maintain that the entire school of chemists are innocent of the consequences of the products of their researches to the civil populations, or of the possibilities of their employment for military purposes. Will Lord Rayleigh defend the conduct of a well-meaning educationist who in the exuberance of his enthusiasm produces a tiger from the jungle for the purpose of giving the Sunday School children a lesson in natural history and, losing control over the beast, lets it loose on the unoffending boys and girls? Would the school master be justified, were he to protest that "it never occurred to him that the cattle lifter was also a man-eater". At some stage or other in the course of their

investigations, scientists must realise the probable directions in which their discoveries might be used, and must also become aware of the consequences of such applications, because they are reputed to be endowed with far-sighted vision, and their faculty of penetration is undoubted. If scientists apprehend that the "world" is morally still in swaddling clothes, would they be justified in willingly placing that excellent and indispensable instrument, the "pen-knife" into the hands of that injudicious infant? The fact is that deep down in the unconscious part of their minds, scientists are essentially patriots and their desire to defend their homes with mustard gas is perfectly natural and honourable, because the world has not outgrown the spirit of the ancient saying "that all is fair in love and war". That the symbiosis established between science and war in pre-historic times cannot be easily dissociated is reflected in Lord Rayleigh's concluding sentence, "I think we may say that the application of fundamental discoveries in science to purposes of war is altogether too remote for it to be possible to control such discoveries at the source," and the world must for the moment be satisfied with the confession, "frankly, I doubt whether we can do much".

Dealing with the doctrine of pacificism not from the standpoint of sentimentality, but from the standpoint of the facts of human nature and human environment, Lord Raglan has discussed in his little book *The Science of Peace*, what the historical and biological sciences have to say on the origin, development and prevention of war. We confidently hope that the British Association for the Advancement of Science in collaboration with similar Associations in America and in the European countries will, by the formation of the new Division for the investigation of the social relations of science, succeed in finding a satisfactory solution for the vexed problems agitating the world. To the objective study of the social relations of science inaugurated by British scientists whose ultimate ideal must be the establishment of international peace and harmony, India is capable of making significant contributions. Is there perfect agreement among scientists regarding "results" and "methods" of study of the Social Relations of Science?