PHILOSOPHY

Because World Is Not Wholly Reliable It Has Human Meaning

Dr. A. H. Compton Suggests Uncertainty Principle Allows Choice Through Brain to Determine Future

Only because the world in a physical sense is not wholly reliable can it have any human meaning, Prof. A. H. Compton of the University of Chicago, Nobel prize laureate in physics, declared in the concluding lecture of a series at College of the City of New York last week.

This important philosophical deduction from the new principles of physics, introducing a new discussion of "free will," is expected to cause great interest.

The following is a special summary of his lecture prepared for Science Service.

By DR. A. H. COMPTON

"MAN'S greatest discovery of all time is that he can count on the world in which he lives."

This, in effect, was a statement made by Prof. R. A. Millikan only a few years ago, and rightly. For is not the reliability of nature the very bedrock on which the structure of science is built?

Yet, Prof. W. Heisenberg in his *The Physical Principles of the Quantum Theory* published in 1930, writes:

"The resolution of the paradoxes of atomic physics can be accomplished only by further renunciation of old and cherished ideas. Most important of these is the idea that natural phenomena obey exact laws—the principle of causality."

Does this mean that science, with its continual searching of fundamentals, has finally undermined its own foundations?

As one whose experiments are partly responsible for this dramatic reversal of the physicist's point of view, I have been especially interested to trace what the significance of this change may be to human life and thought. Why does Heisenberg say that nature does not obey exact laws, and how does this new doctrine affect the hoary problem of man's freedom and morality in the world of law?

It makes one pause when he finds that a flourishing science was once dealt a death blow by the philosophers because it seemed to remove the basis of morality. The early Greek science had as its main objective the finding of the purpose of life. According to the Atomists, not only stones and air, but life and thoughts as well were explained in terms of the motion of atoms. The whole world of planets and plants and people had been reduced to a vast machine.

This, Socrates clearly saw, left no room for that freedom of choice which is the basis of morality, whereas his reason told him that mind was the controlling factor in men's actions. Science thus to the Greeks lost its value. By the beginning of the Christian era the light of science had gone out. Why? It had failed to illumine man's path of life.

The modern revival of science reached its climax when Isaac Newton established the laws of motion, and showed how, by introducing the simple concept of gravitation, harmony came into the motion of the planets. As a consequence arose the so-called "scientific viewpoint," according to which the really important world is hard, cold, colorless, silent and dead; a world of quantity, a world of mathematically computable motions in mechanical regularity.

Though men were thus logically reduced once more to automata, if nature was one unbroken chain of law, scientists sought to learn that law to master nature. Let the philosophers worry about the fact that strife for mastery is meaningless to a man who is merely a link in that unbroken chain. The man of science must not pause to consider that if his own actions are "with a cause and by necessity" he cannot in truth "make a search" at all.

Now, Heisenberg tells us, science must abandon its cherished law of causality. Nature does not obey exact laws.

This statement of Heisenberg's is a consequence of the fact that any observation of the present state of a system disturbs that state, so that its future state cannot be exactly predicted. The disturbance arises because the system must effect at least one photon, or electron or proton, and in any case the reaction will disturb the system's own motion by an unknown amount.

Thus from the fact that light has the form of particles and electrons, the form of waves, it follows of necessity that experiments with light or electrons cannot reveal the future with precision. It is thus as an experimental, or physical principle that the law of causality must be abandoned.

Heisenberg has shown that if the principle of causality is replaced by his principle of uncertainty, all those paradoxes of atomic physics that have been classed as "quantum phenomena" find a ready solution. This includes such things as the photoelectric effect, the emission of light, etc. Nor has the classical dynamics as applied to large scale phenomena been in any way affected. Thus science has gained by introducing this flexibility into its cherished law of cause and effect.

Does this flexibility open any way in which the physically undetermined actions of a living organism may be determined by non-physical means, without violation of the laws of the physical world?

It is not impossible that choice might alter the statistical distribution of the motion of the particles in a brain current. Such an alteration might well determine the action of the organism, and would not violate any fundamental principle of science, as was the case when science demanded that the effect

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be the necessary consequence of the cause.

Nature is not altogether reliable. Yet if we mean by science the organized body of tested truth, such tested truths are eternally reliable. By learning these truths man can still use Nature as his servant. It is, indeed, only because the world in a physical sense is not wholly reliable that it can have any human meaning.

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CHEMISTRY

Rays, Atoms and Vitamins Discussed by Chemists

Ergosterol Made Source of Vitamin D by Radium Rays; Detection of Drunkenness by Breath Analysis is Improved

NEW DRUGS to treat diseases and new chemicals to make more comfortable lives for human beings were revealed at the meeting of the American Chemical Society in Indianapolis this week. Over 6,000 chemical workers from universities and research laboratories all over the country assembled to discuss the results of their scientific experiments during the last year.

Specialists in the chemistry of agriculture, foods, medicine, fuels, engineering, rubber, and in physical and organic chemistry reported important developments to their colleagues.

Anesthetics and other chemicals important in the workings of the human body formed the subject of one special meeting.

Leading mathematical physicists, including Dr. Saul Dushman of the General Electric Company and Prof. R. H. Fowler of Cambridge University, England, revealed to the assembled chemists the applications to chemistry of new discoveries in mathematical physics.

Radium as Source of Vitamin D

Possibility of radium playing a role in vitamin production, at least in the laboratory, appeared when Prof. Thomas DeVries of Purdue University announced to the meeting that he and his former colleague, the late Prof. Richard B. Moore, had succeeded in activating ergosterol by radium rays. Activated ergosterol is a potent source of vitamin D, it has been shown by Prof. Harry Steenbock of the University of Wisconsin. The Steenbock method, which has been patented, activates the ergosterol by ultraviolet rays.

The radium-activated ergosterol reached a degree of potency equal to one thousand times that of a good grade of cod liver oil or one-hundredth of that obtained by the Steenbock ultraviolet ray method, Prof. DeVries reported.

"Radium-activated ergosterol is not yet commercially feasible," he said in reply to a Science Service inquiry. Patents are pending on this method.

Improved Test For Drunkenness

Improvement of a chemical test which will make detection of drunkenness by breath analysis more accurate was reported by Dr. Rolla N. Harger of the Indiana University School of Medicine.

Previous attempts to estimate the concentration of alcohol in the body by analyzing the breath have given quite erratic results, Dr. Harger explained. This is probably because the breath analyzed was not always air from the alveoli or air-cells in which exchange of oxygen and carbon dioxide between the blood and the lungs takes place.

By the new method, the alcohol and carbon dioxide contents of the breath are determined simultaneously. Since the carbon dioxide content of alveolar air is constant, this gives a means of estimating the alveolar alcohol in any sample of breath.

This method was used on a number of intoxicated subjects and the alcohol figure so obtained agreed well with the concentration of the alcohol in the blood determined directly.

Study Auto Knock

Photographs of individual explosions in a gasoline engine were shown by Dr. Lloyd L. Withrow and T. A. Boyd of the General Motors Research Laboratories.

Much interest was caused by their report that "the products of combustion continue to emit light for some time" after the main burning process is over. Before this happens a narrow sheet of flame travels steadily through the charge and most of the burning takes place in this zone.

The brightness of the afterglow increases with increasing pressure of the gases during the explosion. The method has been used to identify and study "knock" in auto engines.

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A full-grown apple tree has approximately 50,000 leaves.

HOLY CITY OF ANCIENT PERU

"This town is larger than Rome" wrote one of the Spanish conquerors after seeing Pachacamac, in Peru. Now, the city has again shown its impressive size, this time from the air in a photograph taken by the Shippee-Johnson Peruvian Expedition. Pachacamac's fame goes back to pre-Incan days, when it was a shrine of the creator-god Pachacamac. A great temple in the city was the goal of throngs of Indian pilgrims who came from great distances. Then, the Incas added that part of Peru to their great empire. At Pachacamac they added a temple for the worship of the Sun to the ancient temple of the creator-god.