

1. On the Philosophical Implications of Modern Physics.

From Prof. P. W. Bridgman, "Philosophical Implications of Physics" in Bulletin of American Academy of Arts and Sciences (Quoted by James B. Conant in "Modern Science and Modern Man", P. 86 & 87

"Finally, I come to what it seems to me may well be from the long range point of view the most revolutionary of the insights to be derived from our recent experiences in physics.

.....This is the insight that it is impossible to transcend the human reference point...The new insight comes from a realization that the structure of nature may eventually be such that our processes of thought do not correspond to it sufficiently to permit us to think about it all.

.....
We are now approaching a bound beyond which we are forever estopped from pushing our inquiries, not by the construction of the world, but by the construction of ourselves. The world fades out and eludes us because it becomes meaningless. We cannot even express this in the way we would like.

.....
The very concept of existence becomes meaningless. It is literally true that the only way of reacting to this is to shut up. We are confronted with something truly ineffable. We have reached the limit of vision of the great pioneers of science, the vision namely that we live in a sympathetic world, in that it is comprehensible by our minds.

of London, (quoted by Conant, "Modern Science & Modern Man", P.89):

"We can no longer say 'The world is like this, or the world is like that'. We can only say, 'Our experience up to the present is best represented by a world of this character; I do not know what model will best represent the world of tomorrow, but I do know that it will coordinate a greater range of experience than today'".

3. Value Judgement and Scientists;--& Scientists as Humans

(D. B. Conant, P. 107, P. 114, P. 146)

- a) "The activities of scientists in their laboratories are shot through with value of judgements".
- b) "The notion that a scientist is a cool, impartial, detached, individual is, of course, absurd".
- c) "The conduct of doctors...is regulated by a set of ethical principles which in themselves are based on value judgements".
- d) "...Those who say that science and value judgements are in separate compartments have failed to examine the nature of scientific undertakings and the motivation of many scientists."
- e) "Science", July 1954 ("A New University" by Wm. Seifriz) Pp 88 & 89-90

Apparently, human nature is such that, in becoming a scientist, one makes oneself either a collator and computer of data or a visionary dreamer in the false belief that the two characters are wholly incompatible. It is the dreamer in science who has given us what we know of natural laws. From him comes the initial spark that sets a matter-of-fact experimentalist on the road to discovery. Von Laue thought that the symmetrical distribution of atoms in a crystal presents a lattice sufficiently fine to scatter the exceedingly small waves of x-rays. The idea appeared to be scientifically sound, at least to Von Laue, but to certain of his colleagues, all classicists, it was untenable. The kinetic energy, or heat movement, of the atoms would, they said, disturb the diffraction phenomena and obscure the picture. But von Laue had confidence in his hypothesis and the courage to see it through. In his laboratory, there were two assistants, both able experimenters, and they proved the truth of von Laue's speculation.

Another dreamer was Kekule. One summer evening he was returning by the last omnibus through the deserted streets of London. "I fell into a reverie," he says, "and lo, the atoms were gamboling before my eyes." Thus the structural formula of the benzene ring was born.

It is no matter of chance that the greatest scientists of all time, Copernicus, Newton, Kepler, Linnacus, Farady, Darwin, and Maxwell, were men of noble character, modest, straightforward, and full of human sympathy. The great French mathematician, Henri Poincar'e, stated that the chief end of life is contemplation, not action. George Sarton tells us that we need purer knowledge, not more knowledge, and knowledge that is less harsh.

.....

Goethe, as a philosopher, was often wrong in fact, but never in principle. His insight is well shown in the first part of the following sentence, and his good sense is revealed in the last phrase: "Your poetic sense should always accompany you but never lead you." There arises in scientific work, says Loewi, "a feeling which can only be described as religious."

.....

People expect goodness from the church, justice from the state, and enlightenment from the university. Enlightenment is more than knowledge. It is knowledge softened by understanding, and in this respect science has failed.

The stupid expression, "the scientific way of life," is meaningless. Science does, to be sure, seek the truth regardless of the consequences, and to this extent it is good, but of what did it boast during the war? Printed in red letters across its journals was, "Science is Power." If this is all it is, then the less we have of it the better. The pursuit of science is a wonderful experience, but we have degraded it by the use to which we have put it. At best it is not a way of life.

4. Science as policy, not creed

a) J. J. Thomson, 1907 "From the point of view of the physicist, a theory of matter is a policy rather than a creed....."

b) J. B. Conant, P. 91: "A mass of experimental evidence in the twentieth century has provided powerful ammunition to those who look upon a scientific theory as a policy, and has made untenable at least one theory regarded as a creed."

5. Humility from Science

J. B. Conant, P. 150

a) If I read the Book of Job correctly, its lesson is a denial of the assumption that the universe is explicable in human terms; it is a corrective to the presumption of human beings in applying their standards of value to the cosmos.

I would not repudiate the nineteenth-century optimism about the continued improvement, with the aid of science, of all the practical arts.....I would not, however,....."in principle"be certain that for the next century, under the best conditions, the areas of uncertainty.....would remain enormous. As to the Book of Job, I would subscribe to the answer that the universe is essentially inexplicable.

b) Oppenheimer Pp #33, 35, P.50

"We learned.....That more than Newtonian mechanics would have to be modified if we were to understand and describe our experiences with atomic systems. We would have to alter our ideas on very fundamental points.....even on the nature of the objectivity of parts of the physical world. We were to be reminded, in a quite unexpected way, of the nature and limitations, as well as the power, of human knowledge itself....it has recalled to us traits of old wisdom that we can well take to heart in human affairs.

....Those new features, unknown to the physics of Newton, have broadened and humanized our whole understanding of the natural world.....we will have to accept the fact that no one of us will really know very much".

We are, of course, an ignorant lot; even the best of us knows how to do only a very few things well; and of what is available in knowledge of fact, whether of science or history, only the smallest part is in any one man's knowledge"

...Humility from Science

5-c cont.

"We know that we are ignorant; we are well taught it, and the more surely and deeply we know our job the better able we are to appreciate the full measure of our pervasive ignorance. We know that these are inherent limits, compounded, no doubt, and exaggerated by that sloth and that complacency without which we would not be men at all."

6. Optimism ad absurdum-Science, the Messiah

J. B. Conant, from P. 153 to top of P. 157

The twofold answer of the Book of Job stands in sharp contradiction to the belligerent optimism of a typical nineteenth-century materialist. For such a person there was only one explanation of Job's afflictions-ignorance. Disease could be conquered if scientists kept at work and people were sensible enough to follow their advice; so, many an intelligent person maintained as early as the 1800's.

.....We have been triumphantly successful in our efforts to right the scales of apparent injustice in this vale of tears, at least as regards the illos the flesh.

.....

But it is one thing to make great progress in curing or preventing disease and another to say that all the afflictions of man can be overcome by human intelligence. Yet this almost became the creed of those who, throughout the nineteenth century and well into this, proclaimed the coming salvation of man on this earth by the good works known as science! This outlook on the world has become embodied-one might say enshrined-in the set of doctrines known as dialectical materialism.

.....

To the doctrinaire dialectical materialist, the Book of Job is worse than nonsense-...His answer to the problem of all evil, to calamities of all sorts, is essentially as follows: Through science all evils may be overcome. By "science" he means science based on the doctrine of dialectical materialism, the laws that govern not only inanimate nature but the development of society as well.

.....It presents in the most dogmatic and extravagant form the optimism of those scientists who are interested in translating their discoveries into practical effects. I would not repudiate the nineteenth-century optimism about the continued improvement

Optimism -2-

with the aid of science, of all the practical arts.....I would not however.....be certain that for the next century, under the best conditions, the areas of uncertainty....would remain enormous. As to the Book of Job, I would subscribe to the answer that the universe is essentially inexplicable.

7. From Modern Science to Ancient Judaism

a) Sir Edmund Whittaker, quoted by Conant, P. 159

.....The obstacles to reconciliation of religion and science
.....are less formidable than has sometimes been supposed, and
moreover, that the deeper understanding of the nature of the
material universe.....has opened up new prospects and possibilities
to the advocate of belief in God.

b) Pascual Jordan (Physics of the 20th century") Conant P. 160-161-162

"It might well have been expected that the great sun were a much older
inhabitant of the universe than the small earth expelled from it;
but as we see, that is not the case at all. He is referring to the
data from radioactivity as to the age of the earth.

.....If we summarize our knowledge up to the present, we must say
that we have found no body the age of which was shown to be higher
than ten billion years.....Let us look back into the past; the world
diameter, growing with the velocity of light, was formerly smaller
than it is now; if we mentally pursue the development of the universe
farther and farther back, we come to a point where everything is at
an end, or rather, everything is at the beginning...ten billion years
ago....the initially small universe arose from an original explosion.

"And certainly this picture of the universe as exploding fireworks
which went off ten billion years ago invites us to consider the remark-
able question of Miguel de Unamuno, whether the whole world-and we with
it be not possibly only a dream of God;

c)"Science" P. 90

There is another aspect of the problem that disturbs me. The
books that have sold well recently bear such titles as Peace of
Mind, Life is Worth Living, and Faith and Prayer. Each and every
one is an appeal "to return to God," just as if we had lost Him or
He us. To all this, I heartily agree. Many men and women have told

me that were it not for their Sunday School training as children they would never have acquired a real knowledge of right and wrong. But there are weaknesses in this trend back to religion of which the university man should take cognizance. The appeal is purely emotional, the reasoning often biologically unsound, and the approach too sentimental. Wholly lacking is the "righteous wrath" of which the Bible speaks. Man is half animal-I was about to say, and let us handle him accordingly, when I glanced at the well-run society of animals outdoors and wondered whether the animal half of man is not the better half.

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It is a prayer for "belief in the meaningfulness of the universe." Many will say that this is nothing more than religious faith. I have no objection to this, and perhaps it is true. But it carries with it the tragic admission that science and academic learning have failed. This failure is not necessary.

8. Skepticism of Science in its retrospective Endeavors

a) J. B. Conant, Pp 170-171

Within the general field of the natural sciences, I suggest that those inquiries that involve the assumption of the uniformity of nature over long periods of time constitute a special universe of inquiry.....To what degree the concepts used in paleontology for example, must be in principle entirely consistent or compatible with those employed in biochemistry is for me an open question.

.....Many of the so-called theories of the origin of life are not scientific theories at all in the sense of being guides to action. They are merely speculative ideas which no one now knows how to connect with new experiments or observations. On this point, by the way, the general public is apt to be much confused. People fail to distinguish between a new theory about the origin of life (or the origin of granite or of petroleum), which is merely one more speculative idea, and a theory from which flow new consequences that can be tested. Speculation in the field of cosmogony is not to be disparaged, but the wide publicity given to each new flight of fancy tends to confuse the general public and encourage credulity.

b) Jean-Paul Aron, "The Problem of Evolution" (Diogenes, summer, 1954

-"The experimental production of new species has never been accomplished...what we now call 'macro-evolution' has never been susceptible to experimental demonstration"...No one has ever succeeded in creating a species experimentally...evolution is not a fact in the strict sense in which science understands the term. It remains an idea"...

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9. Mechanism in Science, and Paradox

From J. Rob't Oppenheimer, "Science and the Common Understanding"

Pp 13-14-15

It is only this century that we have begun to come to grips with other instances of antinomy, the apparent irreconcilability between the differential description of nature, point by point, instant to instant, and the total unique law and event.

.....For the eitheenth century the world was a giant mechanism.

.....All that happened had its full, complete, immediate, efficient cause. The great machine had a determinate course. A Knowledge of its prsent and therefore its future for all time was, in principle, a man's to obtain, and perhaps in practice as well.

.....there was the belief that in the end all nature would be reduced to physics, to the giant machine. Despite all the richness of what men have learned about the world of nature, of matter and of space, of change and of life, we carry with us today an image of the giant machine as a sign of what the objective world is really like.

10. Complementary in Physics Applied to Religion and Science

a) Oppenheimer, P. 69

...Our civilizations perish; the carved stone, the written word, the heroic act fade into a memory of memory and in the end are gone. The day will come when our race is gone; this house, this earth in which we live will one day be unfit for human habitation, as the sun ages and alters.

Yet no man.....thinks wholly in these terms. His acts, his thoughts, what he sees of the world around him-the falling of a leaf or a child's joke or the rise of the moon-are part of history; but they are not only part of history; they are a part of becoming and of process but not only that: they partake also of the world outside of time; they partake of the light of eternity.

These two ways of thinking, the way of time and history and the way of eternity and of timelessness, are both part of man's effort to comprehend the world in which he lives. Neither is comprehended in the other nor reducible to it. They are, as we have learned to say in physics, complementary views, each supplementing the other, neither telling the whole story. Let us return to this.

.....complementarity of the physicists...An electron must sometimes be considered as a wave, and sometimes as a particle.

b) "Indeed, an understanding of the complementary nature of conscious life and its physical interpretation appears to me a lasting element in human understanding and a proper formulation, of the historic views called psych-physical parallelism".

"...there is the relation between the cognitive and affective sides of our lives, between knowledge or analysis and emotion or feeling...between feeling...and the ethical commitment; there is the classical relation between...the determination of one's