

WHAT IS THE MEANING OF PHYSICS?

Neville Fletcher

**Research School of Physical Sciences and Engineering
Australian National University, Canberra 0200**

To most of us the title of this short piece is itself meaningless, which was my intention! As scientists we are not used to spending long periods of time in 'soul-searching' about the purpose of science in general and of physics in particular. To us it is obvious:

*Scientists are never satisfied. It is their function always to want to know what is on the further, the hidden, side of the hill.*¹

and the joy and excitement is almost as much in the search as in the discovery.

*One never notices what has been done; one can only see what remains to be done.*²

But a great deal of enlightening comment can be found in a very wide variety of occasionally surprising sources. In this note I would like to share with you just a few of these gems.

Physics and Philosophy

Physics, of course, grew out of Philosophy, and was once called 'Natural Philosophy'. The split came when Physics started finding answers to its questions, for this was not popular with philosophers. Once Physics became a separate subject, Philosophy was left with a quite different set of objectives:

*Philosophy is to be studied, not for the sake of any definite answers to its questions,...but rather for the sake of the questions themselves.*³

though even some great philosophers, such as Ludwig Wittgenstein, had doubts about many of these questions

*Most propositions and questions, that have been written about in philosophical matters, are not false but senseless.*⁴

and proposed a reduced role for philosophy, namely

*The object of philosophy is the logical clarification of thoughts. Philosophy is not a theory but an activity.*⁵

and certainly physicists would agree with the view that

*Everything that can be thought at all can be thought clearly. Everything that can be said can be said clearly.*⁶

except for the quantum paradox that

*Truth and clarity are complementary variables, and that statement is as clear as it can be made, considering the truth it contains.*⁷

Unfortunately even philosophers must admit that no answers have been discovered to most of the questions that

have attracted their attention over the past 2,500 years, but the long discussion has clarified, at least in some cases, the meaning of the question. Some of the wisest statements come, not from the Western schools of Philosophy, but rather from Eastern philosophical traditions such as Buddhism

*It can be said that things are like illusions; they can be said neither to be existent nor non-existent. Yet it cannot be said that, apart from this world of change and appearance there is another world of permanence and truth. It is a mistake to regard this world as either a temporal world or as a real one.*⁸

Perhaps this does not get us very far, but Buddha did suggest a useful consequence:

*A wise man, recognising that the world is but an illusion, does not act as if it were real, so he escapes the suffering.*⁹

The World of Physics

Physics differs from philosophy in seeking answers, sometimes without worrying too much about the precise meaning of the questions. Mathematics, of course, helps immensely in formalising the assumptions underlying a physical question and in leading to an answer based upon those assumptions:

*Physicists...make up equations which are partly works of art and partly coded instructions, like Chinese calligraphy, having meaning only for the initiates.*¹

but those equations keep us honest and allow others to follow our reasoning. Of the models that are built in physical theories, it is appropriate to say that

*All models are wrong...some are useful.*⁷

Indeed, much of Physics is practically useful, and indeed an essential underpinning to our modern industrial society. An example is the Metric System of weights and measures adopted by the International Standards Organisation (and implemented everywhere except in the USA), though this over to standardisation is certainly something like 3,000 years old:

*Divers weights, and divers measures, both of them are alike abomination to the Lord.*⁹

The Australian National Measurement Laboratory is the final reference for these standards in Australia, and has wide influence over many countries of South-East Asia in this field. This is of considerable national importance:

*A false balance is abomination to the Lord; but a just weight is His delight.*¹⁰

But Physics is concerned with ‘fundamental’ questions too — the origin and early history of the universe, the nature of time, the ultimate fundamental particles, and the unified ‘Theory of Everything’. Perhaps we have aimed collectively

*To have squeezed the universe into a ball
To roll it towards some overwhelming question.*¹¹

Immense progress has been made over the centuries, and particularly in our own lifetimes, but perhaps it is true to say that, with the apparently necessary introduction of ‘dark matter’ and ‘dark energy’ and the picture of everything being made from ‘strings’ and ‘branes’ in multi-dimensional spaces,

*All our knowledge brings us nearer to our ignorance,
All our ignorance brings us nearer to death.*¹²

The Future of Physics?

These days scientists generally, and physicists particularly, worry about the future of their subject, not just in Australia but across the world. To some this may seem a recent concern, but a lament by the 15th century Duke of Burgundy has a surprisingly modern ring:

*Even so our houses and ourselves and children
Have lost, or do not learn for want of time,
The sciences that should become our country.*¹³

Young people seem to have lost interest in anything but commerce, and Physics seems just ‘too hard’. But again this is not new, as indicated by this passage from *Ecclesiastes*, written some 2,500 years ago:

*And further, by these, my son, be admonished: of the
making of many books there is no end; and much
study is a weariness of the flesh.*¹⁴

after which follows the fatherly advice

*Be not righteous over much; neither make thyself over
wise; why shouldst thou destroy thyself?*¹⁵

Besides, there are other things that interest the young, and even the not-so-young, hence the very practical advice

*A feast is made for laughter, and wine maketh merry;
but money answereth all things.*¹⁶

But we should not be too disheartened. Remember that the great expansion and flowering of science took place despite these gloomy sentiments. Part of the problem, of course, is that, just as Physics appropriated all the really interesting and potentially useful bits of Philosophy, leaving the philosophers with intractable problems such as ‘the meaning of life’ and ‘the nature of reality’, so Engineering has appropriated much of what used to be Physics, leaving us with questions such as ‘the nature of dark energy’ and ‘the ultimate constituents of matter’, both of which may be equally unanswerable. Perhaps the philosophers would say that it serves us right!

Is New Technology the Answer?

There are those who advocate the extended use of modern information technology in education as a replacement for personal instruction. Certainly computers make life easy and, for the Vice-Chancellor who has to operate the university as a profitable business in order to satisfy the criteria of Government Quality Assurance, this represents a simple way out. But is computer technology really the path to understanding? A perceptive comment is the following:

*Anyone can have knowledge without knowing a thing,
except how to switch on a machine that supplies it.
You can buy brains in a box. You have access to all
knowledge and remain in a state of total stupidity.
Switch on, log in. That is all you'll ever need to
know.*¹⁷

More poetically, the same view has been expressed in the words

*Where is the life we have lost in living?
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?*¹²

to which we might add a final line ‘Where is the information we have lost in data?’

Certainly there is great convenience to be found in the modern information revolution, but we have seen the same thing many times before. Those ancient civilisations that recorded their history and philosophy on clay tablets that were immune from the ravages of fire doubtless deplored the introduction of fragile media such as velum and papyrus; centuries of scribes who recorded and decorated the illuminated manuscripts of the middle ages were surely concerned at the introduction of the new technology of printing, and now we are similarly concerned at the introduction of digital media. But perhaps there is a difference — all the earlier written records could be read by an intelligent and adequately trained human, but digital media can be read only by a machine.

This mention of machines, specifically computers, reminds us of other questions. Can a machine be intelligent and self-aware? What is the distinction between the mind of such an intelligent machine and that of a human? These problems have been with us for thousands of years, and intelligent thinkers not blinkered by the myths of religion have realised that there is only a quantitative distinction between humans and other animals:

*I said in mine heart concerning the state of the sons
of man, that God might manifest them, and that they
might see that they themselves are beasts. For that
which befalleth the sons of man befalleth beasts; even
one thing befalleth them: as one dieth, so dieth the
other; yea, they have all one breath; so that a man
hath no preeminence above a beast: for all is vanity.*¹⁸

While this view conflicts seriously with the teachings of modern Christian and Islamic religions, a little reflection shows that it is the only reasonable conclusion to which one can come. But this discussion takes us too far from the original point. My own view is that there is nothing essential about a human awareness and intelligence that distinguishes us from ‘lower’ animals, which are clearly self-aware to a degree approaching our own.

New technology, particularly that associated with digital computation, is clearly here to stay, and its contribution to human mental capacities is immense. Physics and the other sciences are clearly using it to the full and this use will extend. Computers could, I imagine, take over the world completely, but then we are back to the basic problem of Philosophy, ‘What is the meaning of Life?’ to which no answer has yet been found.

Conclusions

I must admit that all this discussion and quoting of sources does not lead us to any clear conclusions about anything. My purpose in writing this piece, however, was simply to point out that many of the problems that perplex us today have perplexed the thinking members of the human race for thousands of years. We may not find any solutions, but at least it helps to be aware of the problems and questions.

From my own point of view, having done research in physics for more than fifty years, I still find it a subject of unrivalled interest. Whatever practical question is asked, from the freezing of water to the vision of honeybees, a real understanding necessarily involves the sort of analysis carried out by physicists, and of course this is even more obviously true of questions such as the stability of plasmas or the entanglement of photons, which derive directly from physics.

So what about the future of physics in practical terms? Have we, perhaps, provoked our own undoing by discovering too much? Where would medicine be without X-rays, computed tomography, magnetic resonance imaging, and all the rest? Where would molecular biology be without knowledge of the structure of DNA? Where would communications and commerce be without computers and the internet? But crucial questions still remain. Can industrial civilisation continue without solar power generation, whether from semiconductor cells or biological molecules, or is some modified form of nuclear power the answer? What about global climate change? The number of such pressing questions, for answering which new physics is essential, is immense. Whatever we mean exactly by ‘Physics’, I don’t think we need worry too much about its future — I hope I am right!

References

1. S.T. (Sylvia) Hamon *A Very Particular Murder* (Constable, London 1989)
2. Marie Curie (1867–1934)
3. Bertrand Russell *The Problems of Philosophy* (Oxford University Press 1912) chap. 15.
4. Ludwig Wittgenstein *Tractatus Logico-Philosophicus* (1918) prop. 4.003.
5. *ibid.* prop. 4.112.
6. *ibid.* prop. 4.116.
7. Source unknown.
8. *The Teachings of Buddha* (Bukkyo Dendo Kyokai, Tokyo)
9. *Proverbs* **20**, 10. (King James Bible)
10. *ibid.* **11**, 1.
11. T.S. Eliot *The Love Song of J. Alfred Prufrock*
12. T.S. Eliot *The Rock*, Chorus I.
13. William Shakespeare *Henry V*, Act V Scene 2.
14. *Ecclesiastes* **12**, 12. (King James Bible)
15. *ibid.* **7**, 16.
16. *ibid.* **10**, 19.
17. Malcolm Bradbury *To the Hermitage* (2000)
18. *Ecclesiastes* **3**, 18–19.