

Quantum Mechanics And The True Culture of Modern Times

1. Quantum behavior

"Quantum mechanics" is the description of the behavior of matter and light in all its details and of the happenings on an atomic scale. Things on a very small scale behave nothing like that you have any direct experience about. Because atomic behavior is so unlike ordinary experience, it is very difficult to get used to, and it appears peculiar and mysterious to everyone—both to the novice and to the experienced physicist. So we have to learn about them in as sort of abstract or imaginative fashion and not by connection with our direct experience.

2. Philosophical implications

Let us consider briefly some philosophical implications of quantum mechanics. As always, there are two aspects of the problem: one is the philosophical implications for physics, and the other is the extrapolation of philosophical matters to other fields. When philosophical ideas associated with science are dragged into another field, they are usually completely distorted. Therefore we shall confine our remarks as much as possible to physics itself.

The most interesting aspect is the idea of the uncertainty principle; making an observation affects the phenomenon. When we look for a certain physics phenomenon we cannot help but disturb it in a certain minimum way, and the disturbance is necessary for the consistency of quantum mechanics

Another thing that people have emphasized since quantum mechanics was developed is the idea that we should not speak about those things which we cannot measure. Actually relativity theory also said this. Unless a thing can be defined by measurement, it has no place in a theory. However, ideas which cannot be measured directly may still be useful in physics theory. It is always good to know which ideas cannot be checked directly, but it is not necessary to remove them all. It is not true that we can pursue science completely by using only those concepts which are directly subject to experiment.

In quantum mechanics itself there is a probability amplitude, there is a potential, and there are many constructs that we cannot measure directly. The basis of a science is its ability to predict. To predict means to tell what will happen in an experiment that has never been done. We must extrapolate the experiments to a region where they must not have been done. We must take our concepts and extend them to places where they have not yet been checked. If we do not do that, we have no prediction. And the only way to find out what we are wrong is to find out what our predictions are. It is absolutely necessary to make constructs.

Because of the indeterminacy of quantum mechanics, we are unable to predict what will happen in physics in a given physical circumstance which is arranged as carefully as pos-

sible. This has given rise to all kinds of nonsense and questions on the meaning of the freedom of will, and of the idea that the world is uncertain. Classical physics is also indeterminate, in a sense. Speaking more precisely, given an arbitrary accuracy, no matter how precise, one can find a time long enough that we cannot make predictions valid for that long a time.

3. Feynman's epilogue

For most of the students, if I have made you hate the subject of quantum mechanics, I'm sorry. I just hope I haven't caused a serious trouble to you and that you do not leave this exciting business. I hope that someone else can teach it to you in a way that doesn't give you indigestion.

May I add that the main purpose of my teaching quantum mechanics has not been to prepare you for some examination—it was not even to prepare you to serve industry or the military. I wanted most to give you some appreciation of the wonderful world and the physicist's way of looking at it, which I believe is a major part of the true culture of modern times. There are probably professors of other subjects who would object, but I believe that they are completely wrong. Perhaps you will not only have some appreciation of this culture, it is even possible that you may want to join in the greatest adventure that the human mind has ever begun.

(Adapted from R. Feynman's *Quantum Mechanics* by T. Lai)



YOU KNOW IT'S A BAD PUB WHEN:

- there's a line up to leave
- the B & M's sell faster than the beer
- the beer drinkers stack the beer cups for you
- the C.P.'s give the most tips to the bartenders
- the coatcheck man doesn't receive any coats or need any hangers
- you can take a head count without using all your fingers and toes
- when the phone rings more than the cash register does
- Bob Stanley leaves early
- the floor is cleaner at the end of the night than at the beginning
- the owner of Jim's comes in and laughs in your face about the turnout
- one cab takes **everyone** home
- there is more staff and band members than students at the event

THIS IS YOUR STUDENT UNION —
THANKS FOR YOUR SUPPORT

C.P. #1 Bar Staff

RUPURT

BY S. WHEATON

SO ABE, WHAT'S THE LATEST FROM 'NEWMAN AND THE MORONS'?"



WHAT DIFFERENCE DOES IT MAKE? YOU'RE TOO INCOMPETENT TO APPRECIATE THE MUSICAL VALUE!



POW!

AND ON THE FLIP SIDE ...

