Biology as Dogma

WOULD YOU BE INTERESTED in reading a book entitled *Letter to Students of Biology of the 21st Century*? Normally I wouldn't have been. Biology isn't my field. The last time I formally studied it was in the second year of high school.

The reason I decided to read the book is that I have been corresponding with the author, Harold Hillman. Hillman is director of the Unity Laboratory of Applied Neurobiology, University of Surrey, England. We have common interests in opposing the suppression of dissenting views in science. I looked forward to learning more about the difficulties he had encountered over the years.

As I expected, the book is not easy reading. Sentences like this come fast and furious: "Virtually all the information about the alleged subcellular localisation of proteins, enzymes, lipids, receptors and transmitters has been derived from experiments involving homogenisation and centrifugation." But even for a biology tyro, it's not too hard to obtain a general idea of Hillman's argument.

Since the 1960s, Hillman and his collaborator Peter Sartory (now deceased) have been examining the basic assumptions underlying biological procedures. One such procedure is electron microscopy, which is the use of high-energy electrons in place of light (which is used in ordinary microscopes) to obtain high-resolution pictures. Using an electron microscope, a scientist can obtain close-ups of many features of cells.

Hillman questions whether the electron microscope really shows what cells are like, because of what is done to the cells beforehand. The electron microscope can't be used to look directly at living cells in the human brain, for example. The cells have to be *prepared*. That means they are cut from the organism, treated with powerful chemicals, subjected to a very low pressure and bombarded with electrons, thereby heating the cells to several hundred degrees.

According to Hillman, the electron microscopist is looking at an unnatural "mask", usually composed of osmic acid. He argues that some of the things seen through the electron microscope could not really exist in living cells. In other words they are artefacts of the process for preparing cells for the electron microscope. Among the structures which Hillman says do not exist in life include the endoplasmic reticulum, the Golgi body, ribosomes and synaptic vesicles (and lots of other complicated-sounding objects).

As well as electron microscopy, Hillman has examined other methods used by biochemists and pharmacologists all over the world, such as histochemistry, subcellular fractionation and electrophoresis. In each case he has questioned the assumptions underlying the process of observation. In each case he argues that some of the structures observed are artefacts of the method used. There isn't space here for the full argument, but it relies on some basic concepts including the geometry of three-dimensional objects (structures of cells) seen in two dimensions (through a microscope) and compatibility with observations of *living* cells.

Hillman is not out to tear down biology. What he would really like is for biologists to do the control experiments necessary to determine the effect of their methods of preparation.

Where the story gets really interesting to the non-biologist is in the response of the biological community to the work by Hillman and Sartory. In the many years since first raising these issues they have undertaken numerous experiments, published numerous papers and given numerous talks at scientific conferences. The response has been cold and antagonistic, to say the least.

When Hillman gave talks before learned societies, he was told his views were out of date and that he was tilting against windmills. He then challenged anyone to name a single textbook which did not contain the views he was questioning. He was told that people should not be so naive as to believe what they read in textbooks.

The implications of this are rather startling. So in a letter to the prestigious scientific journal *Nature* he challenged the people who made these comments to defend them in print. No one took up the challenge.

Hillman and Sartory had enormous difficulty in publishing their work. As well as comments on biological matters, the reviewers used methods such as rudeness in correspondence and meetings, not replying to letters, refusal to discuss the issues in public or private, ridiculing their views in social situations and accusing them of being "controversial".

Why this hostile response? It is important to realise that the methods and technologies questioned by Hillman and Sartory are used by many thousands of biologists. Their careers depend on others trusting their results. Electron microscopes are very expensive; a single instrument can cost $500,000 not to mention running costs. Therefore, singlehandedly, they can account for a sizeable fraction of a medical-research budget. Vested interests in reputations, careers and grants are involved, as well as commitments to ideas long held sacred.

Hillman presents an entire shopping list of techniques which can be used to attack academics who question current views. He seems to have experienced them all. But his book is not intended to be an exposé. He pulls punches he could easily deliver, not wanting to embarrass particular individuals or to discredit science as an enterprise. (British science feels itself under threat from the Thatcher Government, after all.) He really believes in the scientific method, and deplores the unscientific response to his own ideas.

The incredible intolerance towards Hillman and his views was hard for me to believe. Although I have studied many similar instances in different fields of science, each new story comes as a shock. In one case, Hillman gave a talk to a large audience at what he calls "a well-known Welsh university". The many undergraduates in the audience seemed sympathetic to his case. A lecturer stood up and claimed to have pictures from an electron microscope which showed that Hillman was wrong. After the talk Hillman asked the lecturer to see the pictures. " 'I have not got any,' he said, laughing. 'Why did you say you had in front of that large audience?' 'Because I did not want the students to be misled by you.' "

Hillman's *Letter to Students of Biology of the Twenty First Century* is intended to convey the message that biology, like all sciences, should not be treated as dogma. But what it shows most of all is that biology *is* both taught and treated as dogma by biologists. In saying this, what matters is less whether Hillman's biology is right or wrong, but the nasty and intolerant way in which the biological community has responded to it.

I'm sorry if I have raised your hopes of reading this book — it hasn't been published. Hillman has tried many publishers. They say it is well written, but too personal. To my mind, the personal parts are the most important. Perhaps that is why establishment biologists would not like to see it appear.

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