



THE NATURE OF THINGS

COLLEAGUES HAVE DESCRIBED HIM AS 'THE PERFECT MARRIAGE BETWEEN A SCIENTIST AND A JOURNALIST.' DURING HIS TENURE AS THE EDITOR OF *NATURE*, JOHN MADDOX HAS DONE MUCH TO MAKE IT ONE OF THE MOST FREQUENTLY CITED SCIENTIFIC JOURNALS IN THE WORLD. MR. MADDOX DISCUSSES SCIENCE, RESEARCH AND THE NATURE OF THINGS IN A CONVERSATION WITH JAMES GEARY.

INTERVIEW

FROM ITS FOUNDATION IN 1869 BY AMATEUR astronomer Norman Lockyer, *Nature* has been dedicated to the dissemination and popularization of science. According to an editorial policy statement from 1870, the magazine's goals were to publish the most important results of scientific research and discovery, and to gain more recognition for science both in education and in daily life. These goals remain valid to this day. *Nature* has been the first to publish a number of landmark research studies, including papers describing the discovery of the neutron and the positron and the elucidation of DNA's double helix structure. John Maddox was appointed editor of the journal in 1966. He left the position in 1973 after a disagreement with the magazine's owners, and resumed the post again in 1980.

'What was your original motivation to become interested in science?'

'I remember being very excited as a small boy by reading H.G. Wells' *History of Mankind*. This was an attempt

to provide a rationalist explanation of how the world evolved. I found that really quite fascinating and kept an interest in science ever afterwards.'

'You originally studied chemistry, but switched to physics. You then spent some time as an academic, and after that became a journalist.'

'I really became a journalist by accident. My first job was teaching theoretical

physics at the University of Manchester, but I realized that I couldn't possibly support a wife and two children on a university salary. So I decided to take the first job that paid twice as much. *The Manchester Guardian* was looking for a science writer at the time and asked me to take the job. At first I thought it was a joke, because all I had written up until that point had been academic papers. Nevertheless, I took the job and enjoyed it, and they seemed to like what I wrote. It took a great deal of difficulty, however, to persuade them to pay me twice my university salary.'

'Since you've studied physics and also been a teacher, do you regret having moved away from academic life?'

'Of course the luxury of academic life, being able to decide for yourself what you work on, that's a luxury that I don't have in my present job. On the other hand, I think my present job is useful and, in fact, exceedingly interesting. My regrets about having given up academic life are no more than the regrets that everyone has that it might have been possible to be a football player or something like that.' ➤

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'WE VALUE THE FREEDOM OF BEING ABLE TO TAKE A HETERODOX VIEW.'

'As a former teacher, do you feel that Nature has a role to play in the scientific education of the public?'

'Not so much the public as the scientific profession. I think it's quite remarkable how, as the research community becomes more and more specialized, it's become more and more necessary that specialists be educated in what's happening in other fields. One of the most interesting things that we do in *Nature* is to provide what you might call high-level popularization of science for researchers. I'm thinking, for example, of how often it is that we will write something in our 'News and Views' section which will stimulate people to take on particular research projects. For example, a short time ago I wrote an article on an attempt by some chemists to devise a self-replicating system, a matter of great concern to those working on the origins of life. One result of that article was that a very well-known researcher in the field decided to write a paper about the subject in which he tried to make a better bridge between chemistry and biology. This illustrates how the scientific community can be stimulated by the right kind of popularization.'

'Publication in Nature can not only stimulate the scientific community, it can also make or break a scientist's career. To what extent does the journal determine the course of scientific research instead of simply responding to it?'

I don't think our influence on the long-term pattern of research is great. Taking a long view over many decades, I think the research community tackles the interesting and the soluble problems. But in the short-term, there's no doubt that we help to determine the current fashions in research. For example, we have taken an editorial line about AIDS research. I think it's now plain that HIV is the prime cause of AIDS. Recent theories that HIV is not the cause of AIDS are not widely recognized. On the other hand, it's also clear that HIV doesn't act like an ordinary virus. Therefore we've argued that the best way to look for a more effective treatment for AIDS is

by seeking ways in which the activity of the immune system can be modulated with drugs. I personally believe that the search for a vaccine against HIV is going to be fruitless. We have expressed this view as an opinion, but I know from correspondence that this opinion is quite influential. So one worries, of course, a great deal about sounding off irresponsibly.'

UNCONVENTIONAL WISDOM

'This is, in fact, one of the criticisms leveled at Nature by scientists; namely, that the journal has no scientific advisory board to evaluate which articles should be published and which research should be encouraged. That judgement is in your hands.'

'Well, we're strongly against it. At present, we have a network of some 14,000 advisers scattered all over the world who act as referees. So we're not short of advisers. The trouble with an advisory board is that it would make us much more conventional. It's well known that it's exceedingly difficult to change a received opinion in the scientific community. When you look back over some development, the emergence of relativity at the beginning of this century for example, it's plain that at any time during the previous 30 years relativity would have made sense. People tried to resolve the inconsistencies in physics by inventing the ether, which doesn't really exist, as an attempt to preserve an old-fashioned view of what the world was like. There are many other illustrations of how conventional wisdom tends to become established and very hard to change. We value the freedom of being able to take a heterodox view, and an advisory board would make that harder.'

'Having said that, can you suggest some areas of science in which received opinions might have to change in the next 25 years or so?'

'I think the application of biomedical research is going to be quite, quite staggering in the next 25 years. I'm sure that, given the astonishing speed with which genes are now being identified, there are going to be all kinds of possibilities for detecting, avoiding

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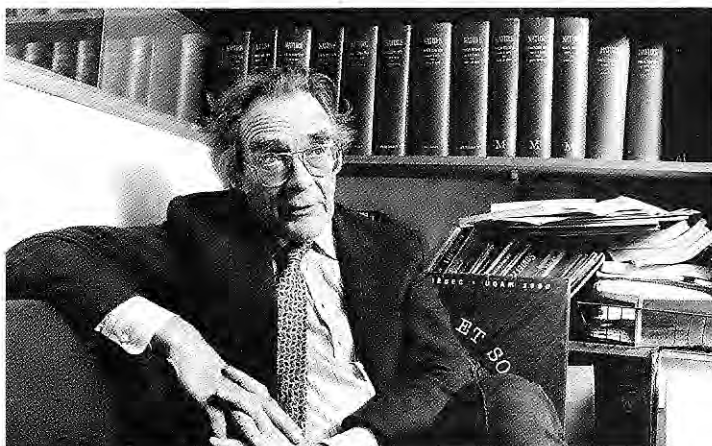
and correcting genetic defects by means of drugs. The other thing that comes out of biotechnology is the way in which plants and other organisms are going to be manipulated to produce not simply food more efficiently, but chemicals as well. The starting material for the AIDS drug AZT, for example, comes from the sperm of herring. It's ridiculous that such an important drug should be obtainable only from such an exotic natural material. It's only a matter of a few years, I'm sure, before someone figures out how to incorporate the genes that make the starting material for AZT into plants. There are some other developments in medicine which are, in my opinion, regarded with too much enthusiasm at present. For my money, I don't believe that gene therapy as such is going to be widely practiced. Except for one or two diseases, such as Parkinson's and diabetes, gene therapy will not be very relevant. It's not going to cure cancer or heart disease, for example. Other techniques will turn out to be more interesting there, I think.

In other fields of science, it seems to me clear that we are only at the very beginning of the computer revolution. We're all fond of saying how the brain is a kind of computer. I think it's probable that at some stage people will figure out how to transfer the information stored in one's brain to some kind of computer. And if that's possible, one can even think of doing the reverse: taking the information stored in a computer and feeding it back into the human brain. It sounds like science fiction, but it's actually of tremendous importance for anyone who wishes the learning process to become more efficient. The other big field of science is going to be the manipulation of atoms and molecules in new materials. The strength of carbon fibre, one of the strongest materials now known, is about 1/1000 of the strength of a chemical bond. One can imagine making materials synthetically that just happen to be one thousand times stronger than the strongest we have now. One can also think of manipulating atoms and molecules so that bits of biological activity are tagged on to inanimate things. For

example, one could imagine making a replica of human muscle and have some muscle proteins attached to a computer chip which would allow the computer chip to move wherever the computer required it to be. This sort of micro-manipulation offers the possibility of creating tiny machines that mimic the way in which living things work.

'My own personal interest is in the much more academic question of how the universe began. People are becoming, I believe, more and more unhappy with the conventional explanation of the Big Bang. In my view, there is quite a bit of exaggerated hype surrounding the recent discovery of ripples in the microwave background. The new information is still consistent with the idea that there have been several episodes of the appearance of matter. When the full data is seen, I think the discovery will support the heterodox view of how the universe began just as much as it supports the Big Bang. If there is going to be a new theory about how the universe began, it's likely to be one in which we discover that what we call our universe turns out to be just a part of some much bigger structure. By definition, it will not be possible to see what's beyond our present universe, but we'll be able to make inferences about what's out there. Philosophically, the only admissible view in my opinion is that the universe is a continuing structure. It didn't begin at a finite point and it's not going to come to an end either. In many ways, this will be comforting for people. Since relativity came along, people have always been concerned with the idea that the universe is running down. But I think that's just an illusion we have because we're only able to see a small part of a much larger structure.'

Do you share the concerns of some about the possible abuses of technology in the future? For exam- ➤



'THE SCIENTIFIC COMMUNITY SHOULD BE AWARE OF THE MUCH WIDER CONTEXT IN WHICH WE ALL LIVE.'

ple, the controversy surrounding the Human Genome Project perhaps?'

'An important issue there, I believe, is the question of whether the Human Genome Project will be as open and free as it should be. If it isn't, then there will be a tremendous kind of national competition between countries. The ethical question that arises from that is, that when so much is known about the human genome and it's possible to make very accurate predictions about which people are likely to inherit which diseases, there will be a lot of pressure to adjust people's insurance. I think that's a problem that hasn't been sorted out. In that sense, while I believe that these technologies will make us all happier and more prosperous, I don't for a minute suggest that there are no difficulties.

'But imagine that we were a thousand years back in 992 A.D. You and I would actually be very depressed just now. If we knew our history, we'd know that the millenium began with a tremendous sense of optimism. But during the first thousand years of the modern era, all kinds of things went wrong and people were really very fearful for the future. But look what's happened. We find a thousand years later that we are prosperous to a degree that no one could have predicted, and we have this enormous sense that the whole world is our village. My own belief is that there are two big problems that have to be solved in the next 50 years in order to make a successful transition to another prosperous millenium. One is the greenhouse problem, and the other is the problem of ensuring that national governments do sensible things. Some people say: But what about population growth. Isn't that serious? Well, I don't think it is. If the population grows too fast in particular countries, those countries are going to be less prosperous than they could have been. That will eventually be a lesson that will sink in. I think also that the danger concealed in that is not mass starvation or other horrors that people talk about, but that we may end up at the

end of this millenium with a small group of very prosperous countries and a much larger group of impoverished countries. And the tension between them will be hard to live with.'

THE PROCESS OF NATURE

'How does the editorial process at Nature work?'

'We receive about 200 unsolicited manuscripts and one hundred pieces of scientific correspondence each week. So you can see why we need 14,000 referees. We finish up publishing about 20 manuscripts each week. This means that we select only about 10% of what we're sent. One third of what we're sent is rejected in the office without being sent to the referees. Approximately half of what the referees see, or 30% of the total, is approved. We are then faced with the difficult process of deciding which of that 30% will eventually be published. That is done with the help of two or three informal advisers and by discussion among ourselves. My role is much more that of monitoring the process to see that it's fair and dealing with all the complaints that come from authors, of which there are a great many. Sometimes I say: No, we're not going to publish that article, because I have some objection, even though the referees and my senior colleagues want it. I may also decide to publish something even though the referees are against it. Maybe once or twice a month we have occasions like that.'

'As science continues to unfold, how do you see your role as the editor of Nature?'

'I think our role is, first of all, to act very responsibly. We musn't suggest things that will lead nowhere. Another important job is to remind the scientific community, and the world at large, of the public issues that are raised by science and technical progress. For example, there are unresolved problems in the use that's going to be made of the Human Genome Project. I think it's our job, our duty, to persuade governments as well as scientists

to take these problems seriously. There are other matters, like the way in which sci-

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ular results are true. But no one is surprised if occasionally people pull a rabbit out of their hat and discover that it's a dead rabbit.'

'Do you have any personal scientific causes about which you feel particularly strongly?'

'The spread of nuclear weapons has been a concern of mine for many years. I think there is almost certain to be a nuclear war of some kind in the next happy millenium. If Iraq, for example, had gotten five more years down the road with its nuclear programme before the Gulf War, I think it very likely that there would have been a nuclear war in the Middle East. That would have been a small nuclear war. It would have killed many millions of people. But it would not have been the end of the world. I think nuclear wars of that kind are becoming increasingly probable, and there's everything to be said for doing our best to stop them.'

'In one of your recent editorials, you implied that 'the reputation of science and the esteem of its practitioners' needed a boost. What did you mean by that?'

'There seems to be a sense in the scientific community now that nothing much is happening, that all the big discoveries have been made: continental drift, reverse transcriptase, the whole technology of biotechnology. It's something that's so familiar that people tend to feel that everything exciting is behind us; it's simply a matter of applying new techniques. I think that the scientific community needs something to lift its spirits. It needs some big success. It seems to me that a more effective AIDS treatment would indeed be just that success. I think it would be much better if the scientific community really set about developing a strategy for treating AIDS that would lead more quickly to the kind of practical treatment that people need. It's a bit like cancer treatment really. It's now common to meet people who say: I had liver cancer ten years ago but now I'm cured. What they mean is that they're still at risk for cancer, but death has been postponed. And I think that's the kind of strategy we should be pursuing for the treatment of AIDS. It would be enormously good for science to be able to say: We've spent \$3 billion a year for ten years and now we can promise every AIDS patient that we will be able to look after him or her sensibly.'

ence itself is run and scientific fraud. We have a duty to tell the scientific community that it must behave better. We've done a lot of that in the past 10 years and will continue to do so, because we are a professional magazine and therefore have a right as well as a responsibility to monitor the conduct of the scientific profession. There are other issues which are much more general: the spread of nuclear weapons, the organization of the world's finances, the problem of international security. All these questions we also discuss, not because we have any special expertise in those fields, but because it's important that the scientific community should be aware of the much wider context in which we all live.'

'As you just mentioned, there has been a spate of scientific frauds over the past few years. To what do you attribute this?'

'Well, I think that it's no accident that most of these cases have involved biomedical research and most have taken place in America. I think there are three contributing factors. Firstly, the biomedical research grant system in America, which has produced three quarters of the world's research in the field, is too competitive. The cost of failing to get a grant can be enormous. So people will do anything, even make up data, to get a grant. Secondly, in medicine in particular, the senior people are usually qualified as clinicians and not as researchers. They will often hire researchers with backgrounds in molecular biology, and the people they hire tend to produce too many papers too quickly. The third factor is the rapidity of modern biomedical research. The techniques are so good that, with just a few weeks of work, you can achieve a spectacular result. Sometimes, of course, these spectac-

BY JAMES GEARY.
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