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A SENSE OF THE FUTURE

One hundred years ago, if you had walked on a summer evening into the country just beyond Bromley in Kent, you might have come on a remarkable sight. In the greenhouse of one of the larger and uglier houses of the neighborhood, a tall man in his sixties was stooping over potted plants. Beside him sat a younger man, just as absorbed; and the younger man was playing the bassoon. This earnest pair was Charles Darwin and his son Frank; and they were making a scientific experiment. Darwin wanted to know exactly what tells an insect-eating plant like the common sundew to close its leaves when a fly settles on it. So he was going through the possible causes methodically one by one. Noise was not a likely cause; but it might just have worked; and Darwin was not the man to rule out anything. He had tried sand and water and bits of hard-boiled egg, and now he was trying Frank's bassoon. Darwin never did get to the bottom of what makes the sundew close. But he almost did, and the next generation finished his work. He was well content with that. Darwin at sixty was a famous scientist who had changed our whole understanding of nature; yet he remained content to do tidy experiments that would bear fruit somewhere, sometime in the future.

This is the sense of the future I want to talk about, at first hand, as a scientist. I am distressed to see how many people today are afraid of the future and of science together. I believe that these fears are mistaken. They seem to me to misunderstand the methods of science and spring from a gloom about what it has done, which has simply forgotten the facts. We sit under the shadow of the nine o'clock news, nursing our sense of doom, and we think ourselves worse off than our forefathers a hundred and seventy years ago, who were at war with Napoleon for a generation. But a hundred and seventy years ago, the working week was eighty hours for children. Cholera was more common in England than flu. The country could barely support ten million people, and not a million of them could read. You know how all this has been changed; and don't let anyone tell you that nothing has been gained but comfort. Think of the gain in life and health alone: a population which has topped fifty millions, the infant death rate cut by 80 or 90 percent, and the span of life enlarged by at least

twenty-five years. The sewer and the fertilizer have done that, and the linotype and the X-ray tube and the statistician puzzling over inheritance. They have been real liberators. Every machine has been a liberator. They have freed us from drudgery and disease and ignorance and from the misery Hogarth painted that could forget itself only in the stupor of drink.

We owe that miracle to science; and it is a miracle. But the scientists who have worked it have been neither gods nor witch doctors. They have been men: men who had faith in the future; and they have used no magic. What they have used is at bottom only Darwin's method, because that method is science. Science is experiment; science is trying things. It is trying each possible alternative in turn, intelligently and systematically; and throwing away what won't work, and accepting what will, no matter how it goes against our prejudices. And what works adds one more piece to the slow, laborious, but triumphant understanding of our world.

This is not a secret or a mysterious progress. If it sometimes seems so, that is just because the day-to-day work of science is so unspectacular. You hear nothing from the research worker for years, and then, suddenly, there is the result in the headlines: penicillin or the jet engine or nuclear fission. No one tells the layman about the years of experiment and failure. How is he to know what has not been done, or to guess the labor of what has? What is he to think but to marvel at the skill of science, and to fear its power?

I believe that both these feelings do equal harm: the feeling of marvel as much as the fear. Because they have this in common, that they both want to persuade the layman that there is nothing he can do for himself. Science is the new magic, they whisper; it is out of your hands; for good or ill, your salvation or your doom is the business of others.

That is why I have attacked the magic before the fear: because the marvel lies below the fear. In the minds of most people today, the fear is plainly uppermost. They are afraid of the future; and if

you ask them why, they conveniently blame the atomic bomb. But the atomic bomb is only the scapegoat for our fears. We are not afraid of the future because of a bomb. We are afraid of bombs because we have no faith in the future. We no longer have faith in our ability, as individuals or as nations, to control our own future. That loss of confidence has not sprung overnight from the invention of a weapon. The atomic bomb has merely brought home to us, harshly, as a matter of life and death, what has long been growing: our failure to face, our refusal to face, as individuals and as nations, the place of science in our world.

There is the taproot of our fears. In our hearts, of course, we know that the future belongs to science; we do not deceive ourselves about that. But we do not want to have to think like scientists. We want to cling to the doctrines and prejudices which we imagine, quite wrongly, made the world snug seventy years ago. We do not care about the future; we just want that world to last our time. Because we do not feel equal to the new ideas; we have been told that science is mysterious and difficult. And so we let the exciting new knowledge slip from us, a little further every day, and our confidence with it; and then, face to face with the sense of our helplessness, we pretend that it is all a conspiracy among nuclear physicists.

It is in our power to change that in our own generation. As nations, we can apply to affairs of state the realism of science: holding to what works and discarding what does not. As individuals, we can grasp the commonsense ideas of science. And there is the most important lesson we must learn: it is the *ideas* of science that are remaking the world, not its mechanical achievements. When we have learned that, we will see the achievements too in their proper place. The atomic bomb is not a great achievement of science. But science has made a great discovery: the fundamental discovery that we can tap atomic energy. That is an achievement not of bickering nations but of man. And we have the whole history of science to tell us that every fundamental discovery has in the end brought men more good than harm. I said "has in the end" almost by habit: has, if we are willing to look forward. Every scientist looks forward; what else is research

but to begin what others will finish and enjoy? And what other incentive can satisfy any of us but that sense of the future?

Disaster threatens us only if we perpetuate the division between science and our own everyday living and thinking. Let no one tell you again that science is only for specialists; it is not. It is no different from history or good talk or reading a novel; some people do it better and some worse; some make a life's work of it; but it is within the reach of everybody.

Science is as human as Darwin and his bassoon, and no harder to understand. Its values are the human values: honesty, tolerance, independence, commonsense, and singleness of mind. Its achievements are among the great achievements of man: the Greeks ranked Pythagoras with Homer. And it has made its way not secretly but by sticking to the plain facts and only the facts—never mind who discovered them or who challenges them. Science listened equally to Newton and his friend Christopher Wren, to Darwin and his critic Samuel Butler: and listens today to every bright lad with an idea as patiently as to the professors.

If you want to know what happens to science when it allows itself to be dominated by authority, political or scientific, let me take you to a field of which I have some special knowledge: German research during the war. We went into the war very much afraid of German science: it had once had a great reputation. Yet the Germans all through the war never took a fundamental step, whether in U-boat research, in radar bombing, or in nuclear physics. Why were they, the professional warmakers, outclassed by us? One example will tell you. About the time that we had our first atomic pile working, Himmler's director of war research was sending an investigator to Denmark to discover—believe it or not—how the Vikings knitted. By one of those exquisite strokes of irony which dogged the Nazis, the name of his investigator—believe it or not—was Miss Piffl.

To listen to everyone; to silence no one; to honor and promote those who are right—these have given science its power in our world, and its humanity. Don't be deceived by those who say

that science is narrow; a narrow, bigoted power is as brittle as Himmler's. Have you been told that science is dogmatic? There is not a field of science which has not been made over from top to bottom in the last fifty years. Science has filled our world because it has been tolerant and flexible and endlessly open to new ideas. In the best sense of that difficult word, science is a democratic method. That has been its strength: that and its confidence that nothing can be more important than what is true.

Does that seem to you after all a very ordinary tradition? Of course it is. It is the tradition for which Europe has hankered ever since the Renaissance: free inquiry and personal action. It is the climate of the arts as much as of science. England led the world in both, because from Elizabethan times she made that tradition of independence her actual way of living. That is why the Authorized Version of the Bible, the first table of logarithms, and Shakespeare's First Folio all came out in England within twelve years. It is our inheritance of freedom, which has liberated the mind with the body. The sense of the future and that tradition are one, if we are willing to unite them. The ideas of science are not special ideas; we can all get at the heart of them—that is, all of us who are willing to find Darwin's sundew more stirring than the Vikings. What we need is to stop shutting our minds to these ideas; to stop being afraid of them. We stand on the threshold of a great age of science; we are already over the threshold; it is for us to make that future our own.