CURRENT SCIENCE

Volume 77 Number 5 10 September 1999

EDITORIAL

A century of science

In a provocative 'millennium essay', Vaclav Smil (*Nature*, 1999, **400**, 415) picked out the Haber–Bosch process for producing ammonia as the most important scientific advance of the century. Indeed, as the end of the year approaches, the number of essays looking back on the century and indeed the millennium will increase. Why was the ammonia synthesis so honoured? The author's argument is compelling. After all we can indeed live without computers, lasers, spacecraft and will probably live better without atomic bombs. We might have even muddled through the century if the structure of the atom and that of DNA were not understood. But would we have reached our present level of subsistence if food production has not kept pace with the demands of a burgeoning population? Indeed, the Malthusian disasters anticipated in the last century have been avoided. To a large measure, the credit for the enhanced yields of twentieth century agriculture must be ascribed to the use of fertilizers; ammonia of course is the key chemical in the fertilizer industry. The celebrated success of the green revolution has overshadowed the unobtrusive role of ammonia. While biological nitrogen fixation is accomplished by a few organisms in a subtle and sophisticated fashion, man only has the Haber–Bosch process available to convert the abundantly available and splendidly inert molecule of dinitrogen to ammonia, opening the route to urea synthesis. For most of us, the Haber–Bosch process, the conversion of nitrogen to ammonia at high temperature and pressure in the presence of catalysts, is a nightmare of forgotten chemistry. To most students, the Law of Mass Action and Le Chateliers Principle, which accompany the ammonia synthesis in textbooks, are associated with the most unattractive aspects of chemistry. To be told at the end of the century that the ammonia synthesis has transformed our existence may indeed come as a surprise. A moment's reflection will however convince most readers that Vaclav Smil has a point. For us in India, the fact that our population has now reached a billion people and that we will reach a billion and a half by the middle of the next century should be alarming. As the number of mouths to feed increases inexorably we may as well hope that the early years of the coming century will yield scientific advances that will match the impact of the ammonia synthesis on agricultural production.

In making the case for ammonia the author has no doubt exaggerated his case. Science, unlike armies, does not march on its stomach alone. Is it easy to list the dozen most important scientific events of the century? Undoubtedly, not. Even sportswriters would have difficulty in naming the hypothetical 'all time great' cricket team of the century. Such lists are often more distinguished by their omissions, rather than their compositions. Nevertheless, looking back on a century of scientific achievement may be instructive and even entertaining. In some fields the cast of characters is too well known to enumerate. Who after all does not know the names of the immortals who transformed 20th century physics. The consequences of the development of modern physics are common knowledge, but I suspect that in assessing the impact of each individual's contribution, opinions will differ and sharply so. While nuclear fission may be the event that has most dramatically transformed the public perception of science in this century, few general readers may recall the names of Otto Hahn and Lise Meitner; the latter, of course, was even forgotten or deliberately ignored by the Nobel committee. The history of science is difficult to recount and we would do well to remember the old dictum that 'time blots out small merit and fattens big glory'. In fields which are far from the public eye the names associated with fundamental advances are often obscure. Even as biology slowly moves to centre stage, it is clear that in the public perception no single event will be as indelibly etched in our memories of this century, as the discovery of the structure of DNA by James Watson and Francis Crick. What will undoubtedly be forgotten will be the enormous amount of painstaking, careful and quite often, remarkably original work that has brought modern biology to its present state. Like the Taj Mahal, the Pyramids and other monuments of yore, the edifice of modern science has been built by hundreds and thousands of dedicated individuals. Looking back on the contributions of 20th century science may indeed be a good way of recognizing our debt of gratitude.

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