

ings, it becomes clear why Heisenberg failed during the war. He was happy to see that the technical difficulties were enormous and he concentrated on peaceful reactors. He only hoped that the American scientists, including the refugees from Europe, would come to the same conclusion. In 1941 he visited Bohr to give him this message. But Bohr's ears were closed and Heisenberg knew that he must continue to live in a small island surrounded by the Nazi horror; the greater world was too far away; even his best friend had turned his back. Bohr later escaped to the US, but Heisenberg's message was never delivered.

I shall not forget one of Heisenberg's recollections. With a colleague, he is hurrying through burning Berlin, trying to get back to two of his sons when his shoe catches fire. And while he puts out the fire, he discusses with his friend how science will be rebuilt in Germany when the catastrophe has run its course.

Shortly after the defeat of Germany, he hears of Hiroshima. He can hardly believe it. He is convinced that a political movement, or country, must be judged by its methods, not by its professed aims. (Heisenberg never men-

tions a nightmare which must have occurred to him: what would have happened if atomic bombs had been used against Germany. Hitler, unlike Hirohito, would not have had the fortitude to surrender. Hitler wanted Germany destroyed if the war was lost.)

But at last peace came and the reconstruction started. Heisenberg returned to the land he loved most, Bavaria. He continued to work on the hardest and most exciting problems of physics. The same basic philosophy that had led him to his formulation of quantum mechanics took him to the S-matrix approach to particle physics (1946). He later devoted himself to a bold attempt to understand particle physics through non-linear field theories with an inherent 'length' scale—continuing, in fact, pre-war ideas. This expressed his opposition to the idea that there are never-ending hierarchies of successively more fundamental particles—the 'big fleas—lesser fleas' syndrome. He also initiated the German programme for the production of nuclear energy.

In a long, magnificent and difficult life he never lost his sense of purpose, nor a sense of humour. On the 800th anniversary of the Bavarian state, he appeared on television and said: "The

Bavarian unites the discipline of the Austrian with the charm of the Prussian." Most particularly, he retained a sense of balance. To each serious argument, he attached its opposite. He understood, from his own physics that between 'yes' and 'no' there are possible answers, less abrupt and more fruitful.

I am one of the relatively few who had a teacher like Heisenberg. From his life there remain for me two lessons. One is that the cataclysm of yet another world war must be avoided. Next time, though man will surely survive, it will be even more difficult to imagine how the spirit can be resurrected. The other is that the path of peace is not only difficult but also uncertain. No simple proposal, neither power nor appeasement, will suffice.

The title of Heisenberg's memoirs *Der Teil und das Ganze* means literally the part and the whole: the world cannot be divided into science and politics, nor into any other components. It is strange and wonderful that this lesson of unity should have been taught by a physicist who worked on a subject that most consider remote from the common understanding.

Edward Teller

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