

Heisenberg and the Scientist's Responsibility

Reimar Lüst

1 Introduction

On a day in early March 1949 I rung the bell at the Max Planck Institute for Physics in the Böttingerstrasse in Göttingen. Two days previously I had passed my diploma exam in theoretical physics at the University of Frankfurt, and was now hoping to become a doctoral student of Carl-Friedrich von Weizsäcker. The porter, Herr Cierpka, asked me whether I had an appointment. I did not; so he called von Weizsäcker to ask if I might speak to him. I was told to come immediately and made my way to the second floor, where I received a very friendly greeting from Herr von Weizsäcker. He listened to my request, but then explained that we would have to continue our conversation later, since the institute colloquium was about to begin. I should come along too. The small seminar room, which could hold an audience of no more than 25, was directly next to the office of Werner Heisenberg. I sat down in the back row. A man of very youthful appearance then entered, and took his place, quite unpretentiously, in the front row. He asked "Who is giving the talk today?". It was to be Arnold Schlüter, who was presenting his first work on plasma physics. Now and then Schlüter was interrupted by Heisenberg, but not in a professorial or know-all manner, simply to help achieve clarity on a topic that was new to Heisenberg too.

This seminar was my first experience of Werner Heisenberg. I have outlined my arrival at his institute because my reception as a newcomer was typical of the atmosphere there, an atmosphere that owed so much to his influence. If I had to describe it with a single word, I would say that it was the simplicity that was so characteristic of him. In his institute there was no bureaucracy. What dominated was a great freedom, in which the individuality of every single scientist was valued. Nonetheless, one could always feel the guiding and formative influence of Werner Heisenberg.

Here I shall try to sketch out something of what I learned at this institute and from him, in discussions, lectures, and seminars. In his institute I was able to grow as a scientist. With the exception of a number of stays in the United States, I have spent my entire scientific career in one or another of his institutes: first as a doctoral student; then as a staff scientist at the Institute for Physics; later as a scientific member at the Institute for Astrophysics under the leadership of Ludwig Biermann; and, finally, I was privileged to

establish a new institute, the Institute for Extraterrestrial Physics, but, in each case, under the auspices of Werner Heisenberg.

But my purpose here is not simply to enthuse about the wonderful times spent doing science in his institute; rather, I would like to try to describe how Werner Heisenberg perceived and carried out his responsibility as a research scientist. He was very aware of this responsibility. And it was a matter that motivated him in many conversations, in particular in discussions with Carl-Friedrich von Weizsäcker. In his autobiography, Chap. 16 bears the title ‘On the Responsibility of the Researcher’.

I would like to consider three particular realms of responsibility: 1. Heisenberg, the Citizen and Patriot; 2. Heisenberg, the Promoter of Science in Germany; and 3. Heisenberg, the Proponent of International Cooperation in Science.

But first, to better explain this division, I should quote from the preface of the book ‘Das politische Leben eines Unpolitischen’ (The Political Life of an Apolitical Person) by Elisabeth Heisenberg. There she reproduces Carl-Friedrich von Weizsäcker’s characterization of Werner Heisenberg: “He was, first and foremost, a spontaneous person, thereafter a brilliant scientist, next a highly talented artist, and only in the fourth place, from a sense of duty, ‘homo politicus’.”

2 Citizen and Patriot

Heisenberg was not a nationalist, but a patriot. In nothing is Heisenberg more misunderstood than in his activities as citizen and patriot. On this account friendships were destroyed and later, on occasion, he even experienced open animosity.

His political stance was certainly influenced very strongly by the events of the revolutionary period in Munich in the years 1918 and 1919, and also by his encounter with the youth movement, the *Wandervogel*, which was inextricably linked with romanticism. His love of nature, and also of Germany, did much to determine his patriotic awareness. But it would certainly never have occurred to him to describe himself as a political person.

In 1926 he was offered appointments at the Universities of Zurich and Leipzig. He chose to go to Leipzig. When asked later why he had not favored the much more beautiful Zurich, he answered, quite spontaneously, “I preferred to stay in Germany”. Germany was, for him, the country in which he had spent a fulfilled and exciting youth. It was where he felt he belonged.

Seven years later, in 1933/1934, he once again had to decide whether he should leave Germany. At that time he was offered positions at both the Institute for Advanced Studies in Princeton and at Harvard University. In a letter of March 9th 1934 to Heisenberg, Frederic Saunders, Chairman of the Physics Department, wrote: “I realize that it is in some ways unlikely

that you would care to leave your own country. If you felt willing to come for a year without minding yourself for the future, we should gladly accept that in place of not getting you at all. We should be greatly honoured if you feel that you can accept permanently and we can assure you that you would receive the warmest kind of welcome from our entire university."

This letter reached him at a time when the infamous Law on the Restoration of the Permanent Civil Service was forcing Jewish academics to emigrate. On 13th October 1933, Max von Laue wrote to Niels Bohr: "In total, about 70 physicists, including a few physical chemists, have lost their posts."

Heisenberg, like many other colleagues, immediately took action to help those affected find positions abroad. He did this as a matter of course and with no hesitation. What was much more problematic was to decide, on principle, what stand one should take in the light of all the evident injustice that was happening in the name of the state.

On this subject Heisenberg wrote "The outrage among the younger faculty members – I am thinking in particular of Friedrich Hund, Karl Friedrich Bonhoffer and the mathematician Bartel Lehnhard van der Warden – was so great that we considered resigning from our positions at the university and encouraging as many colleagues as possible to take the same step."

Max Planck, to whom Heisenberg turned for advice, counselled against such a move. He believed that their leaving would change nothing. Resigning from their teaching posts – and of this Heisenberg was well aware – would necessitate emigration. Planck advised them to stick it out: "You should hold out until everything is over; create islands of continuity, and by doing so you will preserve values until the catastrophe is over."

Heisenberg and others followed this advice. At the same time, he fully understood that the decision to stay in Germany would mean making certain concessions. It was precisely this attitude of Heisenberg that was hard for many of those abroad to understand. And for many younger people here in Germany, who did not live through this period themselves, it is virtually impossible to make it understandable.

Shortly before the outbreak of war in summer 1939, he was once again confronted with an opportunity to go to the USA. This time the offer, a very attractive one, came from Columbia University in New York. In fact, it had first reached him in 1937. During the summer months of 1939 Heisenberg held lectures at the universities of Ann Arbor and Chicago. On this occasion he also met Fermi. He was eager to explain, both to Fermi and others, the reasons for his staying in Germany. To Fermi he said, "I have decided to gather around me in Germany a group of young people who wish to actively contribute to that which is new in science. Later, after the war, these same people, together with others, will be there to ensure that good science can again be found in Germany. I would feel myself a traitor if I were to abandon these young people now."

Before his departure from New York, he had another similar conversation with the physicist George Pegram from the physics department of Columbia University. But Heisenberg was not able to convince him. Pegram found it impossible to understand how anyone could wish to return to a country that was going to be defeated, as he strongly believed it would, in the war that was about to begin. But Heisenberg remained adamant and travelled back to Germany in the almost empty ship ‘Europa’ at the beginning of August 1939.

After the war, Heisenberg was asked yet again whether he wouldn’t like to emigrate to America. But even then he declined without hesitation. He described his standpoint in the following words: “It is clear to me that, in the coming decades, America will be the centre of scientific life, and that the conditions for my work will be much worse in Germany than they would be there. Nonetheless, I want to be here in the coming years to help with the post-war reconstruction. That in many respects it would be much nicer and more comfortable to live in America is a fact that one has to accept.”

On the 14th February 1946 Werner Heisenberg once more took up his work in the Böttingerstrasse in Göttingen, and therewith began his contribution to the reconstruction of German science.

3 Promoter of Science in Postwar Germany

After his return to Germany, Heisenberg was a promoter of science in that country in two ways. On the one hand, he was director of the Max Planck Institute for Physics, the name given to the institute following the dissolution of the Kaiser Wilhelm Society on the order of the Allied Control Council and after the inaugural meeting of the new Max Planck Society in the British zone.

Alongside his activities in the institute, he joined forces with the physiologist Hermann Rein from the University of Göttingen to try to found a ‘*Forschungsrat*’ (Research Council), whose task it should be to promote close contact between the administration of the newly founded Federal Republic and scientific research.

In establishing the institute Heisenberg was helped by Karl Wirtz and Carl Friedrich von Weizsäcker, whilst Max von Laue once more became vice-director of the institute, as he had been in Einstein’s time. Karl Wirtz was responsible for the experimental side; Carl Friedrich von Weizsäcker, however, had been pursuing astrophysics since the war, and this area was strengthened by the appointment to the institute of Ludwig Biermann. This did much to promote the development of electronic computing machines at the institute, which was started in 1950 by Heinz Billing.

The topic that united the whole institute at the internal colloquia was cosmic radiation. For two years, this subject was treated at each of the colloquia, which took place weekly on Saturday mornings. Nearly every member of the

scientific staff was expected to contribute, and also to prepare a manuscript for the second edition of the book on cosmic radiation, edited by Heisenberg and published in 1953 by Springer-Verlag. Gerhard Lüders, and later I myself, were faced with the job of solving the practical editorial problems.

The observation of cosmic radiation was part of the experimental program of the institute. The radiation was detected with the help of photographic plates that were carried by balloons at great heights. The expeditions to follow the balloons, either by car in, among others, Heisenberg's Mercedes, or in Italian warships were always a special attraction to Heisenberg, since they reminded him of his *Wandervogel* time at the beginning of the 1920s.

This was a wonderful time in Göttingen for all of us, enormously productive scientifically, but also characterized by a very close personal living and working environment. Shortly before his death Heisenberg said, "That time in Göttingen – it was the happiest time of my life."

When restrictions on nuclear research in Germany were lifted in 1954, the institute, under Karl Wirtz, began once more to work on the development of nuclear reactors. In 1956, research into nuclear fusion was begun, with Biermann and Schlüter responsible for the theory. To develop the experimental side, they were joined, in 1957, by Gerhard von Giercke.

At this time, the relocation of the institute from Göttingen to Munich was already planned. Senior politicians, however, decided that the reactor development work must be pursued at a new nuclear research centre in Karlsruhe. Heisenberg stuck to his decision to erect new buildings for the institute in Munich, whilst the department of Wirtz moved to Karlsruhe.

In the autumn of 1958 the new buildings, designed by Heisenberg's friend since youth, Sepp Ruf, were ready for occupation. And in June 1960 the official opening took place. In the meanwhile, however, the institute had already become inadequate for the huge experiments of fusion research. It was Heisenberg who argued vehemently that such large-scale research facilities should also have their place within the Max Planck Society. But the new big institute was to be the Institute for Plasma Physics, founded initially not within the Max Planck Society but as a limited company, with Heisenberg as one of the directors. Only in 1971 was this institute incorporated into the society as a proper Max Planck Institute. In the interim, Arnulf Schlüter had taken over from Heisenberg as the scientific director.

In 1963 the institute, which, since its move to Munich, had been a double institute for physics and astrophysics, gave rise to a third institute, the Institute for Extraterrestrial Physics in Garching. But until his retirement Heisenberg remained the managing director of the entire institute.

Also worthy of mention is the founding of the Starnberger Institute, the Max Planck Institute for the Study of Science and Technology, under the leadership of Carl-Friedrich von Weizsäcker. He had not moved to Munich, but had accepted a professorship of philosophy at the university of Hamburg, although he remained a scientific member of Heisenberg's institute.

After the plasma physics had moved out, the Institute for Physics concentrated, increasingly, on high-energy physics, with experiments at CERN and DESY and also theoretical work.

In Göttingen, however, Heisenberg had not devoted all his attention to establishing the Max Planck Institute for Physics, but was also interested in the new directions that would be taken by science politics in Germany. Based on his conception, and due to his efforts, the *Deutsche Forschungsrat* (German Research Council) was established in March 1949 by the existing Academies in Munich, Heidelberg and Göttingen, together with the Max Planck Society. Heisenberg was its president and Rein its vice-president. Heisenberg took up this new challenge with great hope and enthusiasm.

Two months previously, in January 1949, the old *Notgemeinschaft der deutschen Wissenschaft* (Emergency Association of German Science) had been re-established. The *Notgemeinschaft* and the *Forschungsrat* had one thing in common: By working together with the State and with industry, they aimed to achieve the material and intellectual reconstruction of German science.

But the two organizations took different paths. The *Notgemeinschaft* pleaded strongly for science to be screened from political influences, whereas Heisenberg was convinced that science and the State needed to tackle their task in close cooperation. He thus wanted the *Forschungsrat* to be strongly linked to the Federal Chancellery. In this he received the wholehearted support of Adenauer, to whom he had developed an immensely trusting relationship. The *Notgemeinschaft* backed the universities and the federal structure of the states and wanted to rely on these for support. This was a cause of concern to Heisenberg, because he thought he could detect therein a strongly reactionary element.

In the end, it was the *Notgemeinschaft* that prevailed; and it reverted to its old name of *Deutsche Forschungsgemeinschaft* (DFG; German Research Foundation). Weizsäcker, referring to these events, once said: "The argument that pertains in science – that it is the better reasoning and not the tactics that will lead to success – puts Heisenberg in the weaker position in a political dispute."

But, finally, with their Göttingen Declaration, the scientists demonstrated anything other than weakness. This declaration, issued on 13th April 1957 and signed by 18 scientists, was an appeal against arming the German military with nuclear weapons. It received a positive response worldwide. Heisenberg was unable to take part in the big discussion in the Federal Chancellery on 17th April 1957 since he was just recuperating from a serious illness. Shortly before, Adenauer had called Heisenberg to try to persuade him to change his mind. This conversation helped to reduce the tension in what had been a long political dispute; but Adenauer did not succeed in changing Heisenberg's opinion. However, this was not the last conversation between Adenauer and Heisenberg.

4 Proponent of International Cooperation in Science

In June 1946, only a few months after beginning anew in Göttingen, Heisenberg gave a speech to the Göttingen students on 'Science as a tool for reaching understanding among peoples'. This aim is one to which Heisenberg actively contributed in a great many ways.

Here I would like to describe two of these activities: Namely, the founding of CERN, the European nuclear research facility in Geneva, and, secondly, of the Alexander von Humboldt Foundation.

In a letter to Heisenberg dated 8th December 1951, the Secretary of State for the Foreign Office, Prof. Hallstein, wrote: "Dear Colleague, It has been reported to me that you have agreed to serve as the representative of the Federal Republic at the UNESCO conference, to begin in Paris on 17th December, on the setting up of a European laboratory for nuclear physics. In expressing my delight and offering my thanks for this decision, I appoint you by means of the enclosed document as the delegate of the Federal Republic of Germany."

Even we at the institute could detect the great energy and enthusiasm with which Heisenberg took on this task; indeed, he frequently told us about it at the institute colloquia. For him, of course, the prospect of gaining new knowledge about the physics of elementary particles was an important part of the attraction. But he was also fascinated by the technical challenges of building a large particle accelerator. In the USA a radically new method of focussing had just been developed. In order to demonstrate this in the big physics colloquium of the University of Göttingen, he got the workshop at the institute to build a wooden model as an analogy, on which a wooden ball rolled down a hill. He let it roll down time and time again, showing how it remained stable on its wooden path with convex and concave sections. Even in his relatively sober report to the Secretary of State, Hallstein, one could not mistake his enthusiasm. But, in addition to the physics, the prospect of a European cooperation was, for Heisenberg, a decisive incentive for the founding of CERN.

After a little less than one-and-a-half years' intensive preparation, the time had come: On 1st July 1953, Heisenberg was authorized to sign the convention establishing CERN.

Heisenberg was asked whether he would agree to be the scientific director of CERN in Geneva for a period of five years. He remained undecided for a long time. The international task concerned attracted him greatly. But finally he declined. He felt that there were still many tasks that he should tackle within Germany. However, he became the chairman of the 'Science Policy Committee', which was responsible for determining the scientific programme at CERN.

In Germany, on 10th December 1953, Heisenberg took on an important new duty. On this day the Alexander von Humboldt Foundation was established. In a small ceremony he accepted from Konrad Adenauer the certifi-

cate appointing him as president of the foundation. This foundation gave Heisenberg the ideal opportunity to realize and experience the ideas he had advocated in 1946 to the students in Göttingen.

From 1956 onwards he had at his side a magnificent General Secretary, Heinrich Pfeiffer. Upon his own initiative, Pfeiffer did a great deal to put Heisenberg's ideas into practice, and became a trusted friend and discussion partner. Heisenberg believed strongly that no restrictions – whether of national, racial, or religious nature – should be imposed on scientific discussion. He himself had often felt the need for the scientist to be free, and to be able to freely choose his partners in discussion, wherever they may be found. Furthermore, he was convinced that science, despite the great differences between nations in language, culture and social structures, can build strong bridges between peoples. This he had experienced directly in the international atmosphere at the institute of Niels Bohr in Copenhagen, which had left its mark on him. He wrote about it:

“There I found myself in a circle of young people of the most diverse nationalities: Englishmen, Americans, Swedes, Norwegians, Dutch, Japanese; lots of people all wanting to work on the same problem, the Bohr theory of the atom. Outside work we were also like a big family, coming together for outings, games, social events and sport. Within this circle of atomic physicists I had the opportunity to become really familiar with members of other races and their ways of thinking. Being forced to learn and speak foreign languages was the best way of learning to feel at home in other areas of life, and in foreign literature and art. Through this, one also learned to better judge the circumstances in one's home country. It became ever clearer to me that the differences between peoples and races are of little or no significance when all are working jointly to solve a difficult scientific problem. Even the differences in ways of thinking, which express themselves particularly in art, seemed to enhance rather than restrict my own opportunities.”

The Alexander von Humboldt Foundation was, in a certain sense, the fulfilment of Heisenberg's old dream, in which he had believed for so long, of an international family of scientists the world over. The excellent response of the scholars made him very happy. One could observe this afresh every year on the occasion of the reception held for the scholars by the German President in the garden of the Villa Hammerschmidt in Bonn.

During Heisenberg's presidency of the foundation, 550 Humboldt scholars from 78 nations received grants. Only a few months before his death he gave up the presidency to Feodor Lynnen. But even as Honorary President, and despite his severe illness, he continued to contribute, through discussions, to the work of the foundation. I myself was greatly honoured, in 1989, to be appointed to this office as Wolfgang Pauli's successor.

But I would not be here today, and would not have been invited to make this contribution, were it not for the fact that Heisenberg led me onto a path that I would not have ventured onto alone.

This occurred at the 1971 annual general meeting of the Max Planck Society in Berlin. Within the Max Planck Society there was quite a dispute going on. The staff members were demonstrating for the right to take part in decision-making. For the Max Planck Society, such an idea was completely unheard of. The Scientific Council of the society held heated discussions about the matter. After the meeting Werner Heisenberg took me to one side and suggested that we go for a walk. He had heard that I had received an attractive job offer from industry, but, in his opinion, I should stay at the Max Planck Society. At the election, in the autumn of that year, of the new president of the society, he felt that I should be available as a candidate.

Heisenberg ended our long walk with the further advice that, in the new task which he hoped I would take on, I should try to give up the habit of saying “er, . . . er” when speaking. I hope that, today, I have managed, to some extent at least, to follow this well-meaning advice.

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