MAX-PLANCK-GESELLSCHAFT

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Under the watchful gaze of Minerva

Traditions, symbols and dealing with the past

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»Many questions went far too long unasked, many circumstances went far too long uninvestigated or addressed only by outsiders, many documents remained far too long under lock and key or were all too willingly ignored in the archives. For far too long, too, closed ranks stood in the way of honest inquiry. Too many had cooperated actively or passively with the Nazi dictatorship, and were thus all too willing for their own share of responsibility, their own complicity to remain hidden, so that they might merge undisturbed and apparently unencumbered into the new post-War democratic society.« Max Planck President Hubert Markl made this clear admission in 2001 at a symposium in Berlin in the presence of some of the surviving victims, as he formally apologized for the Max Planck Society's long silence. Some of those attending the symposium had been abused in Auschwitz during World War II in the experiments on twins conducted by concentration camp doctor Josef Mengele who, as a pupil of Otmar von Verschuer, enjoyed close contact with the Kaiser Wilhelm Institute for Anthropology, Human Heredity and Eugenics.

In fact, the study of twins is just one example of the involvement of individual KWS scientists in the »Third Reich«. It was in the mid-1980s that the Max Planck Society began to critically examine the past history of its predecessor organization. In 1997, the Society became the first German research organization to appoint an independent commission of historians who were given both access to all archives and legacy collections, as well as financial support. The results were openly published, in19 volumes of research and 28 pre-prints, as well as in workshops, international conferences and reports. The findings were debated above all by historians and by the public media. The traditions in part adopted by the Max Planck Society, its open-minded liberalism and its excellent world-class research continue to form a pattern that can only be explained from a historical perspective.

An imperial inception

For some time now, Administrative Headquarters in Munich has been home to the President's Imperial chain of office which came to light at an auction in 2004 and was purchased by the Max Planck Society. The Director of the Kunstgewerbemuseum (Museum of Decorative Arts) in Berlin, Otto Rohloff, had the chain made in 1910 at the personal request of Kaiser Wilhelm II. It was the Kaiser's express intention to have a hand in shaping the rites and symbols of the non-university research organization he had initiated. The members of the hierarchically structured Society, comprised on the one hand of renowned scientists and on the other of leading representatives of industry, banking, administration and the nobility, were to feel the distinction bestowed upon them, their self-assurance bolstered and given new strength.

On ceremonial occasions, the President of the new Society would wear a chain of office composed of thirteen oval shields, of the kind typically worn by the presidents of universities. A black enamel Imperial eagle with the Hohenzollern arms upon its breast holds on three slender chains a medallion with a likeness of Wilhelm II, surrounded by a laurel wreath. The expert on heraldry, Willi Geile, has postulated that the Imperial medallion derives from the Gnadenpfennig coined by Prince-Elector Georg Wilhelm of Brandenburg: In the 16th and 17th centuries, princes were wont to

give Gnadenpfennige – memorial medals – to persons whom they particularly wished to favour.

»In order to furnish the Society under My protection, the ›Kaiser-Wilhelm- Gesellschaft zur Förderung der Wissenschaften‹, with a visible sign of My recognition and My good will, I hereby grant the Members of the Society the right to wear an insignia decorated with My likeness on an orange ribbon worked with green in their buttonhole«, Wilhelm II informed the Prussian Minister of Culture on 16 January 1911. At least the colours of the Imperial decree endured, even if the orange soon paled into yellow: For many long years lasting into the era of the Max Planck Society, yellow and green remained the semi-official colours. To this day, publications released by the archives are still bound in yellow-green.

The Kaiser chose the colours

The rich green was also chosen for the velvet gowns of the Senators of the KWS whose ceremonial regalia saw them clothed in flowing green robes with red collars, gold buttons and insignia. Writing in the magazine »Zukunft« in 1911, Maximilian Harden poked fun at the Society's vanity: »If we don't make it dear enough, there's no attraction in it […]. So, very nearly twelve million was plundered from the merchants coffers to found the Kaiser Wilhelm Society. Even the ordinary members may wear a badge of honour bearing the Kaiser's head in a garland of forget-me-nots (whereby the wearer, too, should not forget to put his hand in his pocket for science in the years to come). Whereas on high days and holidays, those who coughed up a hundred thousand or more and were made Senators are entitled to a gown of green with a red collar.«

Soon after World War I began, the Kaiser permitted »his« Institutes to hoist the Imperial flag, a device of green diagonals on an orange ground, bearing the Imperial arms – an honour that the majority of Institutes were proud to comply with. On 11 September 1914, the first President of the Kaiser Wilhelm Society, Adolf von Harnack, expressed his gratitude: »The Society will never forget, and indeed will remember with pride, how in the time of the victorious World War it received its banner from the hands of its dearly beloved and admired Kaiser and Protector«. Until well into the 1950s, it was customary at the annual meetings of the Max Planck Society to fly the KWS flag dating from the 1920s, until it was replaced by an imitation in yellow-green.

As its emblem, the by nature humanistic Society chose the Roman goddess Minerva who stands for wisdom, fortitude and perseverance, and who was worshipped both in Rome and, as Athena, in Athens as the goddess of knowledge. Already in 1911 an elliptical vignette of Jupiter's warrior daughter with helmet, shield and downward-pointing spear adorned brochures and notepaper from the palace in Berlin, which on the letterhead was described as the »Palace of Minerva«. After the end of the monarchy, the Director of the Gewerbeschule München (Munich School of Art), Carl Sattler, drew a more feminine image of the goddess: Her locks are longer, the folds of her gown softer. But it was not until the 1950s that Minerva threw aside her warrior heritage, as her translucent robe showed off the contours of her body, her shirt of mail discarded to reveal her breast and her hand now holding not a spear but a staff. The Max Planck Institute for Chemistry even has her grasping a pen.

To this day, the Max Planck Society portrays the goddess, standing and gently modernized, on its Members' insignia. The head of Minerva has been the Society's trademark since 1926. Since the Weimar Republic, busts of Minerva in many variations have adorned the majority of Institutes, and, like the busts of Max Planck, have become a symbol of unity. For the entrance to Administrative Headquarters in Munich, the Peruvian artist Fernando de la Jara sculpted the goddess in dark green granite.

The six-meter high profile of Minerva symbolizes the world of the intellect, of thoughts and ideas. While opposite on the right stands its counterpart, symbolizing the material world.

The tradition continues to this day

In order to attract sufficiently influential sponsors, from the very beginning the Kaiser Wilhelm Society relied on modern marketing, with great success. Public lectures on popular topics regularly attracted a wide audience in Berlin, just as the Max Planck Forum do today. In the years before World War I, the Kaiser was a welcome guest at the Society's annual meetings and took a keen interest – rather like today's politicians – in the inauguration of the first Institutes. Within a matter of three years, the cosmopolitan Society, besides engaging in world-class research, had established habits and traditions that in large part persist to this day.

Despite losing its protector in 1918 when the monarchy gave way to a republic, the leadership of the Kaiser Wilhelm Society still felt a debt of loyalty to the Kaiser. The long-standing President, Adolf von Harnack, triumphed over the left-leaning parties who would have preferred to abolish the name of this internationally respected Society. It was not until 1926 that the Executive Committee of the Kaiser Wilhelm Society resolved to replace the Kaiser's image on chains of office and members' insignia with that of Minerva – but not before seeking reassurance from Wilhelm II. The Institutes removed the Imperial arms from their orange-green banners and stitched them back together with orange-green stripes.

Although the Society had let things lie for eight years, the Managing Director of the KWS, Max Lucas von Cranach, now urged the designer Carl Sattler to deliver the chain of office and insignia with all haste. Quality was of lesser importance to the Society, as Cranach wrote to Sattler:

»I must once again point out that we desire a simple chain of no very great value«. Members were expressly permitted to continue wearing their Imperial insignia. Some used this as a means of protest. Otto Warburg, for example, Director of the Institute for Cell Physiology, continued even after World War II to wear the Kaiser's badge in silent dissent against the change of name to the Max Planck Society.

During the National Socialist era, even the Kaiser Wilhelm Society was required to fly the swastika flag; letters were signed with the obligatory Nazi salute, and busts of Hitler were installed at the Institutes. Nevertheless, the scientists and members of the Society retained their feeling of solidarity, their special esprit de corps. Many academics were willing »to labour in the service of a National Socialist fatherland« and tailor their scientific research to the needs of the war. Some of them far exceeded the limits of what was ethically responsible.

With the end of World War II, the end of the Kaiser Wilhelm Society too seemed nigh. In the turmoil of the war, most of the Institutes in Berlin were closed and relocated to temporary homes, mainly in southern Germany. Buildings were damaged and staff were lost. The Secretary General Ernst Telschow rescued a part of the administrative records from headquarters in Berlin and fled to Göttingen, the same destination to which, in 1945, the British Colonel Blount brought the 87 year-old Max Planck, who had been bombed out of house and home. The Americans in particular made efforts to dissolve the »Kaiser Wilhelm Society«. In the end, after complex negotiations, the Allies agreed in its place to found a new society, the Max Planck Society, which assumed the material and intellectual legacy of its predecessor organization.

Max Planck the bridge builder

Despite his advanced age, Max Planck agreed in 1945 to act as interim President and thus through his personal integrity assured the Society's continuity. Planck became a builder of bridges between the old Kaiser Wilhelm Society and the new Max Planck Society. He was succeeded by Otto Hahn, Director of the Kaiser Wilhelm Institute for Chemistry, who had by then been released from the Farm Hall internment camp in England and had been awarded the 1945 Nobel Prize for Chemistry. During the National Socialist era, Hahn had been compelled to make concessions to the regime in order to preserve the KWI for Chemistry, but he had

remained critical of the Nazis and in the post-war years he came to epitomize the »good German scientist«.

The change of name of the Society insisted upon by the Allies met with strong resistance from both Otto Hahn and Ernst Telschow. Hahn briefly even considered resigning from the office of President in protest against the dissolution of the Kaiser Wilhelm Society. It was not until the last attempt to persuade émigrés to support the retention of the old name failed that Otto Hahn finally relented. Lise Meitner, for one, had written to him from exile in Stockholm, saying: »What the best among the English and Americans desire is that the best Germans should see a final break being made with this unfortunate tradition that has brought the world and Germany itself the greatest misfortune. And as a small sign of German understanding, the name K.W.S. requires to be changed. What does the name signify, when the existence of Germany and thus of Europe is at stake?«

The fact that Hahn submitted did not, however, make him an active supporter of coming to terms with history. In common with other members of the new Society, Hahn too was highly assertive in his dealings with the Allies and, as MPS President, he accepted no moral responsibility for the KWS. His intention was to secure the continued existence of the Society and re-establish its position in the international world of science. To this end, it seemed necessary to gloss over the participation of KWS scientists in war work that failed to meet ethical standards. In the early years of the MPS a myth was born of a Kaiser Wilhelm Society devoted purely to unfettered basic research and peopled by scientists who had successfully resisted National Socialist influences. The fact that a series of Institutes had worked for the German war industry – Hahn's own Institute among them – was skilfully concealed, or denied. In this regard, 1945 did not represent a true break, either for science or for scientists: While those who had been driven out generally did not rejoin the Max Planck Society and initially received no compensation either, those scientists who had remained in Germany provided one another with what became known as »Persil notes«, denazification certificates that enabled former Nazis among them to keep working. The KWS/MPS, described later by subsequent MPS President Adolf Butenandt as a »sworn brotherhood« continued to function and old-boy networks in government and science remained intact.

Collective denial

As a result, the Max Planck Society shared in the then pervasive state of »collective denial«, a situation aided and abetted by the developing conflict between the Western Allies and the Eastern Bloc, and the resulting rapidity with which research and industry were urged back onto their feet. Within a few years, the Max Planck Society was able to regain its pre-1945 standard of achievement and rejoin the international scientific community. In the fledgling Federal Republic of Germany, the Society established itself as a respected scientific institution with a momentous history, whose elitism derived not least from the Nobel laureates of the KWS days.

In his speech at the annual meeting of the Max Planck Society in 1950, Otto Hahn expressly invoked »the tradition of the Kaiser Wilhelm Society«, which the MPS should build on. The fourth annual meeting took place in 1953 in Berlin, as an »expression of our old allegiance to the former home of the KWS«. It was testimony to the high repute of the Max Planck Society that German Federal President Theodor Heuss regularly attended its annual meetings along with other prominent politicians.

With this in mind, it is understandable that in the early years the Max Planck Society should endeavour to retain the manners and symbolism of the Kaiser Wilhelm Society while dispensing where possible with symbols of its own. Administrative Headquarters opted either for slightly modified copies, or continued to use old insignia such as the rarely awarded Harnack Medal. The second Presidential chain of office having been lost in the confusion of the war, a jeweller in Ulm made a new one that echoed previous designs, and is still used today by the

President. The head of Minerva now supersedes the Imperial medallion, the forget-me-nots are replaced by petals and, instead of the radiant golden emblems, the chain is now adorned with gold medals commemorating past Presidents from the first KWS President Adolf von Harnack through to MPS President Hubert Markl. Similarly, the members' and anniversary insignia portraying Minerva that are still used today – while no longer distinguishing between classes of members – are fashioned after the Kaiser Wilhelm Society members' insignia. A new addition adopted in 1978 is the Otto Hahn Medal created by the artist Hans von Miller, which is presented to junior scientists. While the Max Planck Society's Minerva logo has been modernized over time, this has not been the case with other emblems.

Anniversaries in the service of tradition

The close alliance between the maintenance of traditions and a self-image delineated by the past persisted at the Society until the 1980s. The celebration of anniversaries presents a good example. Prior to 1998 it seemed natural enough for the Max Planck Society, itself founded in Göttingen in 1948, to celebrate not its own anniversaries, but the milestones since the foundation of the KWS in 1911. Both the 50th and 75th anniversaries of the KWS were duly marked under the title of respectively »50 years of the Kaiser Wilhelm Society and Max Planck Society« and »75 years of the Kaiser Wilhelm Society and Max Planck Society«.

For the 50th anniversary, President Butenandt consciously chose to hold the Society's annual meeting in Berlin, the city in which the Kaiser Wilhelm Society was founded. Since that time, an as yet unbroken tradition has persisted at the MPS of returning to Berlin every ten years for the annual meeting. While Butenandt was loud in his praise of the excellent work of the KWS, he had few words to spare for the Nazi era. Butenandt once again condemned the dissolution of the KWS as a mistake on the part of the Allies. »We recorded many successes in our scientific research, until the year 1945, the year of total collapse, brought both an end and a new beginning. The Kaiser Wilhelm Society was incapacitated and was dissolved – by a resolution that was fortunately not promulgated – by the Allied Control Council. False interpretations of the work done by the Institutes, combined with a resentment against the name of the Society, impeded both the continuation of the old and the commencement of the new«.

In parallel with these remarks, Butenandt emphasized how painful the liquidation of the Kaiser Wilhelm Society in 1960 had been. As if reluctant to address the vagaries of its past, the Society distanced itself from penning its own comprehensive history. Instead, a volume of interesting archive material was published, a useful collection in its own right, but devoid of all comment.

It was not until the 1980s, against the background of a changing political, scientific and media climate, that the Max Planck Society began to rethink its approach to remembering the past. Both historians and the media, as well as a new breed of historical societies and community associations increasingly began to question the kind of blanket assessments that cast the majority of Germans as victims rather than perpetrators. Benno Müller-Hill and Ernst Klee sparked a broad discussion on the issue of German science and the victims of racial fanaticism. Biochemist Adolf Butenandt was one of those who incurred massive criticism. As it turned out, the serious allegations and suspicions raised by Müller-Hill and Klee did not hold water and Butenandt was not actively involved in ethically questionable research. He was, however, aware that his colleagues had gone beyond the bounds of what was ethically permissible. Butenandt never seriously addressed the excessively sharp allegations of his critics. His tactic of silence and concealment only served to arouse speculation about his conduct in the »Third Reich« and prolonged the agony far more than a clear statement would have done.

In this climate, the new President, Heinz Staab, chose not to celebrate the 75th anniversary of the KWS on 11 January 1986 with a gala ceremony. The Society, it was maintained, wished to concentrate on the future. However, a full history of the KWS/MPS was promptly com-

missioned, though the intended publication date of 1986 was eventually extended until 1990. At the same time, the first, still only mildly, critical voices began to be heard in the press, disparaging the lack of a sense of responsibility. On 11 January 1986, for example, Martin Urban wrote in the Süddeutsche Zeitung: »An examination of Germany's past does not feature among the particular research topics addressed by the Max Planck Society, despite the fact that certain questions here remain to be answered regarding for example the long-term harm suffered by concentration camp inmates. One would wish that in the next quarter century the Max Planck Society might have a little more stomach for the unpalatable, given that it can be rightly proud of its freedom, guaranteed by its founder Wilhelm II, from state tutelage.««

The chemist and medical expert Heinz Staab, a pupil of Butenandt, took up the challenge. On the occasion of the annual meeting of the Max Planck Society in Aachen in 1986 – he notably did not choose Berlin – Staab distanced himself somewhat from the KWS, preferring to emphasize the foundation of the MPS in the British and US zones 40 years previously. In fact, this »first« progenitor of the MPS was dissolved in 1948 in order to make way on 26 February of that year for the MPS proper. Staab also broke with the dogma established in the early days of the MPS, as he stressed in a long section of his speech: »We cannot look back on this era without being aware that even in the Kaiser Wilhelm Society there were scientists who misused their skills and knowledge for political purposes, to the detriment of mankind […] The fact that scientists in our Society evidently infringed upon the ethical rules of science, is a burden that we all bear. We must accept this burden without extenuation or bias, just as the Federal President in the wider context has called for an acknowledgement of the truths of our past«. It was thanks to the efforts of Staab and his predecessor Hans Zacher that in May 1990 brain samples taken from concentration camp inmates and victims of »euthanasia« were buried after a service of remembrance at the Waldfriedhof Cemetery in Munich. In the same year the almost 1000-page history commissioned for the 75th anniversary, edited by historians Rudolf Vierhaus and Bernhard vom Brocke, highlighted the continuities between the KWS and MPS in terms of both structure and staff.

By 1990, then, the way was clear for an open and uncompromising examination of the past, one that would not shy away from unpleasant results. In 1997, MPS President Hubert Markl appointed an independent Presidential Committee to investigate the history of the KWS under the Nazi regime. The Committee laid the results of its research open for discussion at an international conference in March 2005. The series of publications concluded in 2008 with the »Memorial to the scientists, men and women, expelled from the Kaiser Wilhelm Society by the National Socialists«.

However, the Max Planck Society was not content with – albeit belatedly – merely addressing its history. Of at least as much significance was the decision to accept historical responsibility, which culminated in a very moving admission of guilt, voiced by Hubert Markl in the presence of surviving victims: »The most honest form of apology lies in the disclosure of guilt«, Markl explained at a symposium on »Biosciences and human experimentation at the Kaiser Wilhelm Institutes«. He went on: »For scientists, this ought perhaps also to be the most appropriate form of apology. The truth is, only those who are guilty can beg for pardon. Nevertheless, I ask you, the surviving victims, most sincerely to forgive those who for whatever reason have themselves failed to beg your pardon«. By not only continuing the legacy of an organization rich in Nobel Prizes but also accepting moral responsibility for what happened during the Nazi era, the Max Planck Society succeeded in taking due account of both sides of the Kaiser Wilhelm Society and reappraising the close links between the two societies. Today, only a quarter of Max Planck Institutes have roots that stretch back to the days of Imperial Germany. One in three Directors originates from outside of Germany. It would appear time now for the Society to take the same approach to its symbolism as it has already courageously taken in reviewing its history

Space for scientific reflection

MAX-PLANCK-GESELLSCHAFT

Building for science

DIETER GRÖMLING • SUSANNE KIEWITZ

In 1912, the Prussian Minister of Culture convened a committee of high-ranking experts to take part in a wide-ranging discussion about the future of the Kaiser Wilhelm Society, which had just celebrated its first anniversary. The purpose of the meeting was to plan for the institutes of biology. The young Society was gaining its initial experience with the construction of laboratory buildings for basic scientific research with the Institute for Chemistry and the Institute of Physical Chemistry and Electrochemistry, both of which were under construction at the time. In contrast to university environments, there was little need for classrooms in these buildings as the scientists' remit was to concentrate solely on research. Another unusual feature was the lack of urban reference points. On the showpiece boulevard of Unter den Linden, the University of Berlin and the Royal Library constituted highlights of an architectural chain which also served to enhance the image of the imperial state. The KWS buildings, on the other hand, were constructed in Dahlem, surrounded by windmills and corn fields and outside the gates of the growing metropolis.

Emil Fischer, the chemist and Nobel Prize winner, was accordingly free to formulate the building programme for the new biology institutes that were also to be established in Dahlem: 'Follow […] the example of our factory owners and build them in barracks style. […] based purely on a utilitarian principle, without any consideration of architectural aesthetics.' His appeal met with broad agreement because it was based on a concept of maximum flexibility, which was ultimately grounded in Adolf von Harnack's concept of driving research forwards by promoting outstanding individuals. The end result is that research buildings should be as open and flexible as possible for these scientists. Fischer argued that 'We must always remember that requirements will constantly be changing with each new individual and each new branch of research; we therefore cannot build for the future but […] for the present.'

However, Fischer was unable to implement his building programme. The Institute for Biology that was built in Dahlem in 1914 – featuring recessed balconies and a stair tower – resembled a bourgeois Berlin apartment building, the Institute for Cell Physiology built for Otto Warburg in 1930 even resembled an 18th century country estate. Warburg was probably not aware that he was contradicting the stipulations made by Fischer in 1912. Fischer, in whose memory Warburg had a statue erected in the institute garden in 1952, had been Warburg's PhD supervisor. Warburg justified his exquisite taste by stating that he did not want to work in a factory. Carl Sattler subsequently modified the initial simple design for the institute and incorporated an adaptation of the Mark Brandenburg manor in Gross-Kreutz. Warburg, a passionate equestrian from an upper-class family, remained true to his preference for all that was English and feudal when it came to architecture. He did not see himself as a factory or barracks worker and made it clear that a creative spirit needed an appropriate environment.

Warburg's institute is certainly the most striking example of edifices that went against the 1912 building programme. But the Institute for Experimental Therapy, built in 1913, is also reminiscent of a rural castle, even though, like the other institutes, it housed modern ventilation systems and laboratory technology. It was not until the 1920s, the era of functionalism and expressionism, that factory-like brick buildings also found acceptance among the scientists. Since then, modern research buildings have themselves set architectural standards. Temporary buildings were used only in emergencies, in wartime or

during the pioneering stages of technical equipment development, as in the case of Ludwig Prandtl's first wind tunnel in Göttingen in 1909. Only in field research have stopgap solutions always been the norm.

These days, architecture for science covers a very diverse range of building types for institutes working in the natural and human sciences. They house laboratories and libraries but also include astronomy monitoring stations, animal facilities, greenhouses and special buildings for large equipment, needed for the highly specialised basic research that often depends on the buildings' technical facilities. They provide scientists with a stable environment in which they can reflect, experiment, debate, observe and research. They are places of science. Some of them took on an intangible value as the findings acquired within their walls confronted society with new opportunities for power and with the issue of how these new findings could be dealt with responsibly.

Buildings and places

Over the last hundred years, the Max Planck Society and the Kaiser Wilhelm Society have established numerous science buildings and also relinquished many of them. There has been considerable momentum in this area, intensified by the Second World War and its aftermath. In accordance with its statutory mandate to 'establish and maintain scientific research institutes', the KWS managed to acquire an impressive portfolio of properties within a few short years of its inception. In line with its policy of increasing decentralisation, these buildings were located not only in Berlin but also in the Rhine and Ruhr areas and, following the First World War, in Heidelberg, Göttingen, Munich, Breslau (now Wrocław) and Dresden. The KWS also maintained a small stock of buildings abroad, namely the Institute for Art History in Rome and the Institute for Marine Biology in Rovigno (modern-day Rovinj). In 1918, the Society had 12 institutes. By 1932, a further 21 had been added to this figure.

Empty plots of land on the outskirts of cities, which already had the necessary infrastructure in the form of clinics or other research institutions, proved to be suitable locations. In 1912, the KWS and the state jointly began to establish a loosely structured campus of individual buildings in the green fields of Dahlem near Berlin, out of which a new scientific and residential quarter developed. The natural environment, such as the Great Plön Lake in the case of the Institute of Hydrobiology, rarely played a critical role in the choice of location. This approach was not to change fundamentally in the Max Planck Society either. The promotion of science under the Third Reich benefited the Kaiser Wilhelm Society even more than the regime's building mania: weapons-related research work and biomedical projects found particular favour within the ideological agenda of the racist state and received generous funding. New buildings were added, albeit often for existing institutes. As the war dragged on, the state reduced the extent of its science-related building activity. The onset of the German Armed Forces' retreat in 1943 and the growing number of air raids on major cities had a direct impact on the Society – from the summer of 1943, almost all of the Berlin-based Kaiser Wilhelm Institutes were moved from the capital to temporary accommodation in schools, factories, universities and villas in southern and western Germany.

When the dissolution of the Kaiser Wilhelm Society was decreed at the end of the war and the Max Planck Society was established in 1948 as the Society's 'rescue organisation' and successor, the portfolio of properties in the western occupation zones constituted its material basis. Safeguarding what was left of the building stock after the war and amalgamating departments to form functioning institutes were the Max Planck Society's first and most urgent tasks in the young Federal Republic. While the Dresden-based Institute for Leather Research went up in flames during an air raid in February 1945, the Institute for Coal Research in Mülheim survived the bombing of the Ruhr area largely unscathed. Institutes were frequently surprisingly productive in their temporary 'homes'. According to an activity report produced by the MPG in 1951 and referring to the relocation of the KWI for Biology at the end of the war: 'The move to

Hechingen went smoothly in April 1945. The institute's work was only interrupted for one day'.

In the post-war years, the MPG focused its building activities on renovating war-damaged buildings and extending suitable stopgap solutions in West Germany. Starting in 1960, the first new build projects heralded the beginning of an intense period of expansion. The establishment of a separate building department within the Max Planck Society's Administrative Headquarters in 1963 was a response to the ever more complex and growing requirements on the construction side. The economic upturn, population growth and increased demand for education and training also led to significant growth at the MPG and to a variety of new and bigger research institutes, with the result that the organisation was soon able to span a network of facilities across all the federal states in West Germany. The main challenge facing the Society during this period was meeting a disproportionately high demand for buildings in a relatively short space of time. In the 1970s, the MPG constructed seven large new buildings for institutes and institute centres in a variety of locations including Göttingen, Munich and Stuttgart. Despite serious financial constraints, the MPG continued to grow in the 1980s and institutes were designed and constructed in Mainz, Marburg, Bremen and Saarbrücken, among other locations.

The fall of the Berlin Wall in the autumn of 1989 also marked a radical turning point for the MPS: the Society wanted 20 per cent of its potential to be located in the 'new' German states, the former East Germany, by 2000. This was achieved by establishing 18 Max Planck institutes in the larger cities. Inevitably, there was then a certain amount of catching up to do in the 'old' German states of the former West Germany from 2000 onwards.

Since the 1960s, the MPG had returned to its original practice of situating experimental institutes operating in the natural sciences away from city centres. As was the case during the KWS era, such locations offered the necessary space for future expansion. However, this principle rarely applied to the institutes in the former East Germany, where proximity to urban centres was preferred. This was made possible by the improvement in anti-pollution measures resulting from sophisticated measurement methods, reduced consumption of substances and reagents and the replacement of practical lab work by digital models. However, clustering institutes on greenfield sites is still a good idea, in that it facilitates on-site cooperation and the cost-effective use of a shared infrastructure. The model established in Dahlem in 1912 has thus proved to be a modern and pioneering concept.

The Max Planck Society's current building activities are broadly diversified in terms of discipline and geography. Some 80 large construction projects for roughly 40 institutes, of which 10 are new builds, are now at planning, construction or settlement stage. Approximately eight per cent of the buildings currently owned by the MPG were inherited from the Kaiser Wilhelm Society. They are, however, frequently integrated into structures that were built at a later stage to form specific developments.

This diverse KWS/MPG portfolio can be described in greater detail by examining first of all the external form and then the interior layout. While the façade and style can provide an indication of who it was that wanted to identify with the buildings or see themselves expressed in them, it is the interior that points to the specific needs of the researchers. The way in which building layouts have changed is an expression of the transformation that has taken place in the scientific work itself, as well as in its internal organisation and its methods. The relationship between the external form and the internal structure of various buildings from different eras is indicative of the differences and similarities between the KWS and the MPS.

From prestige to functionality

Cost effectiveness, operational reliability and usefulness have always been the main criteria in designing construction projects and having them accepted by financiers. The KWS was under obligation mainly to charitable foundations, private individuals and supporting municipalities, which, along with the state, provided the bulk of its funding. The KWS was established under

the personal patronage of Kaiser Wilhelm II, and Ernst Eberhard von Ihne was consequently commissioned to design the first of the science buildings. As court architect since 1888, he was responsible for a number of major prestigious projects for the state and his institute buildings bear all the hallmarks – albeit somewhat moderated – of the Wilhelmine style. However, a preference for objectivity, pragmatism and functionality could be discerned among the scientists themselves from the very beginning, as the 1912 debate surrounding the biology institutes shows. The fact that Ihne's designs were nevertheless implemented is an indication of the young KWS's dependency on its imperial patron, who, with the help of 'his' architect, was also able to shape something of a 'German Empire brand' – ultimately with success, as Wilhelm's style gave an entire era its name. The KWS was just one aspect of this ambitious architectural programme. Only Carl Sattler's buildings, constructed during the Weimar Republic and adorned with the bust of Minerva, began tentatively to unify the KWS research buildings, creating a certain recognition value for them and attempting to meet the needs of research in their structure. This had been Emil Fischer's wish in 1912. He saw the KWS buildings as a means of defining and establishing new internal and external models for science as a whole: 'If we succeeded just once in constructing a building based solely on the principle of usefulness […] that would be a great asset for the future construction of all other science institutes in Germany'.

Fischer thus created a new relationship between internal function and external façade. Research needs should determine the type of research facility that is built, which can, in turn, influence the development of future buildings. Looking at how things developed, we can see that this aspiration was ultimately realised, even if, in the final analysis, it came to fruition only after the Second World War when the MPG was established: the towers in the Ernst Ruska building constructed at the Fritz Haber Institute in 1974 served as an experiment room for the electron microscopes. The buildings at the Institute for Human Development in Berlin and the Institute for Astrophysics in Garching (both designed in 1978 by the architects Fehling and Gogel) were based on an attempt to meet the needs of the research work conducted within the two institutes. In both cases, the identity of the buildings concerned is unmistakable. Their level of individuality has truly made them models for the whole concept of research buildings. These edifices are particularly significant in the light of the current trend towards ever-increasing visual diversity. The question that is currently being considered is whether architecture should support the Max Planck Society's efforts to build its profile. This evokes the aspect of corporate communication that Sattler originally introduced.

Close cooperation between architects and scientists, an aspect which the MPG put on a professional footing in these projects, was actually initiated by the KWS. Before the First World War, the KWS concentrated mainly on the interior, which in Dahlem was the responsibility of Max Guth, who had experience of fitting out laboratories. He worked closely with the designated Directors. With the end of the monarchy, the scientists also got a say in the design of the façade. However, that still did not lead to a consistent interior justification of the external form. Carl Sattler, who was the contract architect for the KWS from 1925, defined the identity of the Society's research buildings, either through his own designs or in an advisory capacity, and in this way influenced their style. Functional forms with or without sparse decoration prevailed; in the elegant residential suburb of Dahlem, the style was based on rural elements, incorporating aspects of the more traditional Heimatstil (Domestic Revival) as well. Sattler also tried to suit the taste of the buildings' users, as he explained apologetically to his peers at the opening of Harnack House: 'We had to take into consideration the psyche of very different, […], very sensitive visitors […]. You will see much that you will perhaps consider old fashioned but which meets certain dormant needs in the residents' subconscious'.

The scientists were not the only people to have a say in the design of the buildings. The industrialists and private donors also made their voices heard. The German

Iron and Steel Institute was very influential in the choice of architect for the KWI for Iron Research. At the KWI for Occupational Physiology in Dortmund, the head of the municipal planning and building control office, Wilhelm Delfs, designed the new institute building, which reflected typical modern forms within the industrial region as defined by urban municipal concepts. The donors' interest in the external form is particularly evident in the conversion of a machine hall into temporary accommodation for the KWI for Iron Research. In this case, the design of the façade caused some upset when financier Gustav Krupp von Bohlen und Halbach questioned at a meeting of the Board of Trustees the need to add a classical portico to the completed building.

Following on from the establishment of the Max Planck Society in 1948, the financial framework and thus the factors influencing construction also changed. The institutional assistance provided to the MPG by the federal government and the individual states obliged the Society to operate within generally accepted planning and financing boundaries. Since then, investment projects are always presented to the Max Planck Society's Executive Committee and the national/regional governing bodies and are subject to inspection by the relevant audit offices. Transparency in the allocation of funds, cost effectiveness, the need for equity and equality and the reference to European standards for the realisation of publicly funded construction projects are new criteria that affect these decision-making procedures in accordance with the trends in society as a whole. The difference between this approach and that of the KWS is striking.

This reduction of the customer's influence and the decline in support from foundations after the Second World War favoured a function-based style of construction planning, an approach that gained further currency following the rise in academic liberalism in the 1960s. This allowed for the establishment of Boards of Directors to manage institutes and the installation of regularly rotating Managing Directors. Nevertheless, the principle of cooperation between architects and scientists was retained in this changing framework, as it was only by working closely with a building's users that the relevant needs could be met and the required functionality achieved. Now, as then, scientists are involved as early as possible in the planning process. However, the demands placed on a building's interior changed somewhat between 1950 and 2010.

It was under these conditions that Sep Ruf designed the MPI for Physics in a post-war functional style in the Munich suburb of Freimann in 1958. He developed an independent structure for each specific function, with the result that the institute building, workshop, service building, experiment hall and lecture theatre are all separate entities. This pioneering idea had already been applied at the KWI for Physics in Dahlem. Werner Heisenberg, who, as Director of both institutes embodied a sense of continuity between the Kaiser Wilhelm Society and the Max Planck Society and helped to choose the architect, may also have shared his own experiences from the KWI in Berlin and thus helped to refine existing, tried-and-tested structures. The façade in Munich is, however, quite different to the one in Dahlem: the Munich building conveys a sense of transparency and lightness through the dispersal of solid structural elements, the multi-layered façade design, the extensive use of glass and the inviting courtyard arrangement. The dominant style element of the 1937 institute, on the other hand, is an unnecessary onion-domed tower positioned over the front entrance, which was probably placed there at the request of the first Director, Peter Debye.

This example demonstrates the increasing importance in the MPG of more objective parameters within which to frame requirements with the aim of creating buildings that can be adapted over the long term to meet the changing needs of new generations of researchers. In contrast to the KWS, the MPG generally selects a different architect for each construction project in a competitive procedure. Focusing on functional and objectifiable criteria became the Society's guiding principle in the 1960s and 70s. Construction as a whole was characterised by keywords like standard, grid, module and prefabrication in systems of measurement ('Marburg system').

The Max Planck institutes built during this period clearly comply with this ethos in terms of form and materiality but still constitute independent designs whose interiors are laid out with the specific research requirements in mind. From a current perspective, the buildings are very usable. The only things missing are communications structures; work is ongoing in this area to improve the situation.

Since the 1960s, the principle of developing the structural form of science buildings from the inside out has prevailed. The need for sustainability and energy efficiency has become an important parameter for contemporary buildings and this will affect the external form of future buildings. The MPI for Biology of Ageing, currently under construction in Cologne, integrates all of the current challenges in a compact and light-filled construction. This will be a model building in terms of its typology and structure and the perfect embodiment of the autonomy conducive to science.

Networked spaces for people and technology

Technical and social requirements are the two key aspects around which the interior structure of research buildings is based. With regard to technology, the call for maximum flexibility in science institutes steered the debate from the very beginning, a debate that still rages today. The background to this is the mandate exercised by MPG and KWS to promote fields of research that are not yet established because the development of new methods entails extensive use of variable technology that has the potential for refinement. No other sphere has changed so much in the last hundred years. The results can be seen both in the construction of research institutes as a whole and in the planning of their layouts. Both aim at the growing separation of functional units. The physical separation of buildings for different functions was already signalled in some Kaiser Wilhelm institutes. In particular, the need to keep sensitive measurements in a vibration-free environment necessitated the physical separation of laboratories from machine halls and workshops and sometimes even involved splitting up individual buildings. The advance of science into nano-dimensions has accentuated this need. It has led today to a generation of scientific instruments whose sensitivity to electromagnetic, seismic and acoustic factors must be analysed in each individual case and integrated in the planning considerations. These instruments often need their own areas in institutes or must be located in separate buildings.

Separation is also a priority inside the buildings, where efficient construction planning groups together functionally similar areas. Large and costly facilities such as ventilation and cooling systems are commonplace in research environments and entire floors or even buildings dedicated to a particular technology, such as combined heat and power plants, are no longer rarities in modern institutes. Accordingly, the investment costs for the technical infrastructure, depending on how much equipment is installed, currently account for 40 to 50 per cent of total construction costs. In addition to the demands placed on the technology, a much greater emphasis is now also placed on safety requirements, increasing the amount of technology used in the interest of both the environment and employees. Before the Second World War, scientists were relatively nonchalant in their handling of highly toxic substances. Using all of the sensory organs to check substances was an important method for chemists, even at the turn of the 20th century, and up until the 1960s the open-air veranda was part of every building in which chemical experiments were performed. Since the 1960s, scientists know more about the potential risks involved. The issue is taken much more seriously now and more stringent environmental legislation has been enacted. Greater sensitivity with regard to health issues is a relatively new phenomenon. The research sector has responded to this by adapting operational workflows. The amount of space allocated to ventilation and waste disposal systems has increased accordingly.

Ihne's old buildings, whose layouts do not allow for this separation of functional areas, can therefore no longer be used for experimental scientific research.

Since the 1980s, these buildings have been converted to spaces requiring less sophisticated technology such as libraries, archives, offices and meeting rooms, depending on actual needs. The three old buildings from the Neue Sachlichkeit (New Objectivity) period that were inherited from the KWS, on the other hand, are sectioned, zoned and separated in a modern manner – and are therefore fundamentally fit for use with today's technology. These include the buildings used by the MPI for Iron Research in Düsseldorf, the MPI for Medical Research in Heidelberg and the old KWI for Occupational Physiology in Dortmund which became the MPI for Molecular Physiology in 1999. Their structure proved to be usable in the long term. After several decades, the adaptability of these buildings is limited due to their general structural condition and their layout, which is being pushed to its limits given the significant increase in the amount of technology deployed. The old building in Dortmund was consequently vacated in 1999. The words of Edgar Atzler, Director of the institute in 1928, nevertheless proved to be fundamentally true: 'The new construction method has proved itself to be extremely suitable for a science institute. We have no doubt that many will emulate us.'

Yet research settings must not only impress in terms of technology, they must also motivate. The most important word in this regard is communication. Starting with the ancient Greek and Roman academies, through the colleges of the Middle Ages, to the universities of the 19th and 20th centuries, communication has always been an important factor in the acquisition of knowledge. The most radical change in the last 20 years has been the speed of information flow and the need for interdisciplinary exchange, as closer integration of the European market and globalisation in general have made the information and communication society a reality. On the research side, specialisation within the scientific disciplines and the complexity of research activities call for a greater focus on teamwork and increased interdisciplinary cooperation. Training is multidisciplinary, teams are comprised of an international mix of different professional groups and must therefore work harder to overcome obstacles to communication. Buildings and parts of buildings – including the labs and offices of the smallest teams of scientists – which are conducive to discussions and meetings will be needed more than ever in the future.

As part of an interconnected world, the Max Planck institutes also communicate in an increasingly virtual environment. It remains to be seen what physical anchor points they will still need in the future and how these will look architecturally.

Added to this are the higher expectations regarding quality of life. The US campus universities are frequently cited as models in this regard; the campus is considered to be a place for living and working and therefore also includes space for shopping, sport and leisure. This model has not worked in Europe because science is financed differently here and because completely different lifestyles and structures have evolved in cities in the 'old' and the 'new' world. Nevertheless, a perceived deficit remains.

The MPG buildings must respond to this much more effectively than the KWS institutes did. After all, the KWS fulfilled the need for communication which existed at that time through enhanced construction planning: in addition to the institute buildings, homes were also built, right from the beginning. The Director's house was mandatory and was often designed to reflect his personal preferences. These villas played an important role in communication. Atzler, who came into conflict with the city of Dortmund (which delayed the building of his villa for financial reasons) when his Institute for Occupational Physiology was established there in 1929, pointed out that it was particularly difficult to 'attract scientific visitors' to the industrial city and only by receiving fellow scientists in his own home could 'those connections that link the institute with the scientific world be made'.

Arrangements were also made for staff accommodation. Before the First World War, rooms were usually provided for staff in the institutes themselves. However, they were located right next to workshops and machine

rooms, as in the case of Fritz Haber's Institute. Progress was made to ensure greater comfort for employees from the late 1920s onwards, when apartment blocks were planned in a number of areas, including Buch in Berlin. Such developments were presumably an expression of the increased value placed on scientific staff. From 1929, Harnack House performed a social and communication function for the Kaiser Wilhelm institutes in Berlin. In addition to a restaurant and a clubroom, which provided scope for conversation, a gym, tennis courts and a swimming pool also encouraged active interaction and the development of personal friendships. The relaxed atmosphere ultimately fostered scientific exchange among colleagues as well. We can see how modern this concept was by the fact that, since 2000, Harnack House has once again performed a similar role as the Max Planck Society's conference centre and guesthouse.

However, the KWS architects did not focus on building structures that fostered communication when they designed research buildings. The garden, office and library acted as social meeting places. Times have changed: in modern research facilities, even paths of travel are planned specifically as meeting points to encourage joint activities. Seating areas with Internet access, along with terraces and leafy courtyards are now just as likely to be areas of communication as the traditional canteen. The need for greater communication density also affects workplace design. In an example of the general trend in the development of laboratory structures, the MPI of Molecular Cell Biology and Genetics in Dresden (2001) consistently deviated from the standard 40 m2 laboratory, instead establishing larger lab units with integrated desks – each of them a communication zone for a research team.

Summary.
Contemporary buildings for the future

A look back at the buildings and building projects of the last hundred years shows, on the one hand, that there were then, as now, specific requirements, whose technical and social aspects posed particular challenges for architects. The mandate has remained unchanged throughout: to promote research by providing spaces equipped with cost-effective, state-of-the-art technology for distinguished researchers. On the other hand, the details of these requirements have changed considerably. There is discontinuity in this sense between the KWS and the MPS. Specifically, this relates to the increased use of costly, sensitive technology and the increasing importance of intangible factors and democratisation in the staff structure since the 1960s. In particular, the current theory that the acquisition of knowledge is based on communication, that a research institute is more than just a collection of suitable workplaces and is namely a place of residence and life, has radically changed the type of buildings built for science in the last 20 years. While the KWS also met people's social needs by building residential units and defined the institute primarily as a technical entity with a more or less high level of prestige, we could define the contemporary institute building as 'a large home for researchers'.

This has given many buildings an unmistakable character, offering scientists a special opportunity to identify with their particular institute. The modern, technically sophisticated 'place for scientific reflection' that is an institute can thus also be an everyday place of remembrance: a place in which personal and professional experiences are linked in a scientist's academic career, especially in the case of junior scientists. Together with the priorities of flexibility and functionality in the building substance, this also sets the tone for the Max Planck Society's relationship with the Kaiser Wilhelm Society: where the MPG inherits its buildings and continues to manage them, it does so productively and with an eye to the future. Historic locations are integrated into current plans or, in cases where they can no longer be adapted for the required technology, relinquished. The Society is not in the business of maintaining locations and buildings as museum pieces, purely for the purposes of conservation.

Great minds of science

Presidents, Secretaries General, Directors and other scientists

REINHARD RÜRUP

Until very recently, the explanation used most readily for the striking success and the resulting national and international renown of the Kaiser Wilhelm Society and later the Max Planck Society was always the 'Harnack principle'. At the 1928 General Meeting, Adolf von Harnack, President of the Society for many years, summed up the status and the importance of the Institute Directors in the following words: 'The Director is the leading figure – to such an extent that you could also say the Society chooses a Director and builds an institute around him.' Two years later, Friedrich Glum, then Director General of the KWS, formulated the principle: 'The Kaiser Wilhelm Society should not establish institutes and look for the right men to head them; rather, we must first find the man and then build the institute around him.' In 1961, on the occasion of the 50th anniversary of the founding of the KWS, the President of the MPS, Adolf Butenandt, also spoke of the 'guiding structural principle' according to which the institutes are 'established around the prominent scientist'. However, he qualified that this is an 'ideal which is sometimes difficult to achieve'. As recently as 1993, MPS President Hans F. Zacher reasoned that 'according to the Harnack principle, by virtue of which leading scientists make up the core of our system, the Max Planck Society's responsibility for essential innovative steps concentrates on the sequence of retirement and appointment of successors among its Scientific Members.'

Nowadays, however, it is clear that the 'Harnack principle' in its strictest sense belongs to the realm of legend [Vierhaus 1996]. Admittedly, there have always been cases in which an institute was created for a prominent scientist, both in the Kaiser Wilhelm Society and in the Max Planck Society. Very often, though, institutes were established for entirely different reasons: to tie in with general research strategy or to satisfy economic or occasionally political interests and the associated funding possibilities. Still, it is true that the great personalities in the history of the KWS/MPS from the earliest beginnings until the present day have always played an important role, often even a decisive one. In the more recent literature, the reference to a 'research organisation centred on strong personalities' [Laitko 1996] is therefore justified. It mainly refers to the Scientific Members of the Society, above all the Directors, but the same applies to the Presidents, the Secretaries General or the leading figures in the Management Board and in the Senate. In order to enable extraordinary achievements, major research institutions like the Kaiser Wilhelm and Max Planck Societies always need both stability and dynamism, they need conservation and renewal, continuity and change. They must have respect for their historical heritage and the accomplishments of their predecessors, and they must be fundamentally open to new things and have the courage to take risks and face the unknown. Organisations also need to nurture their traditions while maintaining a critical stance. This applies both to the people who work in such research establishments and to the organisational structures there. Factors such as precipitous change, an all-too-keen alignment to the current zeitgeist or a frenzy of activity are no less detrimental to sustainably productive scientific work than rigid institutional forms that are set in stone. From the very beginning, it was therefore agreed in the KWS that permanent posts must be offered to the Institute Directors and the Scientific Members in order to compete with the civil servant status afforded to full professors. In con-

trast, all other scientists would be given only fixed-term contracts to ensure mobility in the institutes and to promote a continuous exchange of staff with the universities and other research establishments. Administrative staff, secretaries, laboratory assistants and technicians, on the other hand, were offered long-term employment as far as possible.

Presidents

If we look at the Presidents of the KWS/MPS from the perspective of continuity or disruption among the leading staff, there is a clear tendency towards stability. In the hundred years since 1911, there have only been eleven Presidents, each serving for an average of nine years. The largest differences in term of office occurred before 1945 in the KWS: the founding President, Adolf von Harnack, held office for 19 years and his successor, Max Planck, for seven years; Carl Bosch and Albert Vögler were only able to serve three and four years, respectively. Three of these Presidents passed away while in office and Planck retired at 79 on the grounds of age (although he agreed to serve as interim President in 1945–46). Following that period, a fixed rhythm was established in the Max Planck Society from 1948 onwards, with Presidents serving for six or (in the event of re-election) twelve years. The first three Presidents (Otto Hahn, Adolf Butenandt and Reimar Lüst) held office for twelve years each. Their successors from 1984 to 2002 (Heinz A. Staab, Hans F. Zacher and Hubert Markl) served for six years each and the President in office in the anniversary year, Peter Gruss, is serving his second consecutive term, having been re-elected in 2008.

Until 1945, only persons with a close connection to the KWS as members of the Senate or the Management Board, but who were not Institute Directors, were elected to be President. They were usually held in high esteem due to their professional activities and accomplishments in other areas of science or industry. The founding President, Adolf von Harnack (1851–1930), was Full Professor of Evangelical Theology and Ecclesiastical History at Berlin University, Director General of the Royal Library (later the Prussian State Library) and a leading member of the Berlin Academy of Sciences. He was also a brilliant orator and author, and a highly acclaimed scientific organiser who had a large part to play in the foundation of the KWS. Physicist Max Planck (1858–1947), who took office after him in 1930, was professor emeritus at Berlin University for four years. As the founder of quantum theory and a 1918 Nobel Laureate, he was one of the most internationally prominent scholars of his time. As a permanent secretary to the Academy of Sciences, he also possessed experience of scientific organisation. Furthermore, he was an unusually well educated man and a figure who was celebrated far beyond the close circle of his peers.

The ‘big name in science’ was succeeded by the ‘industrial president’ in 1937, although Carl Bosch (1874–1940) was also an outstanding natural scientist, who had been awarded the Nobel Prize in 1931 for the ‘development of chemical high pressure methods’. But it was his status in the chemical industry that was crucial to his election. He was Chairman of the Board at BASF from 1919, Chairman of the Board at IG Farben from 1925 and Supervisory Board Chairman of the latter from 1935. After Bosch passed away having served only scant years in office, the KWS managed to attract one of the most influential industrialists, both economically and politically, to replace him in 1941: Albert Vögler (1877–1945). Vögler had been a Director General since 1926 and held the post of Supervisory Board Chairman at Vereinigte Stahlwerke AG from 1936 until his death. He was politically active for the German People’s Party in the National Assembly and in the Reichstag (German parliament) in the early years of the Weimar Republic. Later he supported the German National People’s Party and from 1933 he became a member of the Reichstag again via the Nazi Party’s single list of candidates, though he was not a party member. During the war, he was one of the closest advisers of the minister for armaments and war production, Albert Speer.

If we look at the great political crises and upheav-

als between 1911 and 1945, the KWS seems hardly to have been affected on the presidential level. Neither the beginning nor the end of World War I represented obvious turning points and the fall of the monarchy and the revolutionary transition to a parliamentary democracy did not impact the staff of the Society either. Even against the backdrop of the National Socialists' 'seizure of power' in 1933 and the outbreak of war in 1939, the organisation determinedly sought continuity. The first far-reaching effect was felt, in fact, with the military defeat and the collapse of the 'Third Reich' in spring 1945. Vögler, who had resolutely put the KWS in the service of the war and therefore of the Nazi system, ended his own life in April 1945. It seemed very uncertain whether or not the Society would have a future, given its strong involvement in the armament efforts and in the wartime economy. Also, the institutes had been scattered across the country in the wake of evacuations from 1943 onwards and many of them had only temporary facilities to work in.

When it became obvious in the immediate post-war period that the occupying powers would no longer accept a 'Kaiser Wilhelm Society', it was decided that a new Society would formally be founded on the basis of the existing institutes, in order to preserve human and material resources. The choice of the name 'Max Planck Society' made it clear that what was sought was not to break with the organisation's own history, but rather to ensure continuity in the midst of an existential crisis. This was also expressed in the choice of President, who headed the MPS temporarily from 1946 and then took up ordinary office from 1948. Otto Hahn (1879–1968), who was awarded the Nobel Prize in autumn 1945 for the discovery of the fission of heavy nuclei, had been a Scientific Member of the KWS since 1912 and a Director of the KWI for Chemistry since 1928. During the era of National Socialism, unlike many of his colleagues, he had made no concessions to the zeitgeist. In the summer of 1933, he renounced his teaching post at Berlin University and he always defended his 'non-Aryan' colleagues whenever possible. He was invaluable to the organisation in the post-war period, in that he embodied the positive elements of the KWS tradition, just like Planck. His name represented not only scientific but also moral capital for the MPS. Although he had been reluctant to assume the responsibility, his term of office turned out to be very successful.

Looking back, we can clearly see that the appointment of Hahn as President created a new pattern for selecting the men – no woman has yet served in this office – at the helm of the MPS. The organisation ceased to recruit great names from outside the Society and, with one exception, elected an Institute Director from within its own ranks, a primus inter pares. Biochemist Adolf Butenandt (1903–95), Director since 1936, was another Nobel Laureate (chemistry, 1939). He was a member of the Nazi Party, but was otherwise not politically active in the National Socialist era. His appointment as President in 1960 marked the start of the relocation of the MPS headquarters, which had resided in Göttingen since 1945, to Munich. Butenandt was an uncommonly successful scientific organiser: during his term in office, the MPS experienced a phase of continuous expansion. At the end of his presidency, Butenandt was made Honorary President, just like his predecessor.

His successors were astrophysicist Reimar Lüst (born in 1923) from 1972 to 1984, chemist Heinz A. Staab (born in 1926) from 1984 to 1990, jurist Hans F. Zacher (born in 1928) from 1990 to 1996 and molecular biologist Peter Gruss (born in 1949) from 2002 onwards. It was only in 1996 that a President would once again be appointed from outside the organisation. Biologist Hubert Markl (born in 1938) had previously served as President of the German Research Foundation and as founding President of the Berlin-Brandenburg Academy of Sciences and Humanities (formerly the Prussian Academy of Sciences) and was considered one of the country's leading intellectuals. These Presidents of course distinguished themselves greatly with regard to their personality and style of administration, but they all had one fundamental interest in common: safeguarding what had already been accomplished while refining

the profile of the MPS by setting new priorities in the research it conducted. All Presidents could rely on the political attention and financial support of the federal government and the states, as well as on a highly qualified and increasingly distinctive academic administrative structure.

Secretaries General

The Presidents of the KWS from Harnack to Vögler worked in an honorary capacity, just like the other members of the Management Board, and the first Secretaries General (Ernst von Simson 1911–12 and Ernst Trendelenburg 1912–20) also served in their posts alongside their official duties. Friedrich Glum, made an 'Executive Member of the Management Board' in 1922, was the first full-time head of the still very small Administrative Headquarters, which he developed in the following years into an effective management tool for the scientific organisation. Despite being relatively young – he was born in 1891 – Glum quickly became the actual driving force behind the KWS. In 1927 he was given the title of Director General and the great appreciation for his work was not least apparent in the fact that he was granted a salary which, in 1930, far exceeded the top salaries of the KWI Directors and even surpassed the earnings of the Prussian Prime Minister. Glum was one of the first modern scientific managers who, besides administrating, knew how to plan and make decisions. As such, he successfully managed to implement the policy of 'self-imposed Gleichschaltung' (forcible coordination – a Nazi concept of control) in the KWS during the first years of National Socialism. However, when Planck left the office of President in 1937, his term as Director General came to an end.

His successor, a Secretary General once more, was his more or less coeval Ernst Telschow (born in 1889), who had completed his PhD in chemistry under Otto Hahn and started working for the Administrative Headquarters in 1930. A member of the Nazi Party since May 1933, he cooperated smoothly and effectively with the leading promoters of National Socialist science policy during the 'Third Reich'. When the 'Führer principle' was introduced in the KWS, as elsewhere, in 1937 and the thus-far strong Executive Committee (the Management Board) was turned into an Advisory Committee, the post of Secretary General became much more important in view of the frequent absence of Presidents until 1945. Telschow, who was a very talented administrator, took every opportunity to make himself ever more indispensable the longer he stayed in office. This meant that, with the emphatic support of Planck and Hahn, he was able to stay on in his function beyond 1945 and considerably influence the composition of the Max Planck Society until 1960.

The Secretaries General and the leading staff of the Administrative Headquarters represent a key element of continuity in the history of the KWS/MPS, as evidenced in the long-standing service of Glum and Telschow, above all. What is more, they were both strong, distinctive personalities who were widely admired but, at the same time, not completely free of conflict. In the case of Telschow, this applies particularly to the period of transition between the Kaiser Wilhelm Society and the Max Planck Society, when a minority of the Institute Directors were of the opinion that an 'old Nazi' who had administrated the KWS in the era of National Socialism would not be suitable for a central role in the new scientific organisation in a society which sought to become more democratic. There was also substantial criticism of the continuity that Telschow's presence after 1945 represented from the prominent KWS scientists who had been driven out of Germany. Still, Telschow remained in office because Planck, Hahn and many others thought that they could not do without his experience. He did, however, have to accept that a further Executive Member of the Management Board, the politically unencumbered Otto Benecke from the German Association of Cities (Deutscher Städtetag), was instated beside him in 1951.

Once Telschow and Benecke left office in 1960 and 1961, respectively, the Administrative Headquarters was first headed by Hans Ballreich in Munich (1961–67)

and by Hans Seeliger in Göttingen (1961–63). Since the appointment of Friedrich Schneider (1966–76), all Secretaries General – Dietrich Ranft (1974–87), Wolfgang Hasenclever (1987–95), Barbara Bludau (1995–2010) and Ludwig Kronthaler (since 2010) – have been working out of Munich, as has the Administrative Headquarters. Aside from the transitional arrangements that immediately followed Telschow and Benecke, the Secretaries General have each served at least eight years, but often more than twelve, thus ensuring considerable continuity on this level of the MPS too.

Scientific Members and other researchers

When it comes to the scientists working in the Kaiser Wilhelm Institutes, the issue of continuity and change is a priori different, since tenure, as previously explained, was only offered to Scientific Members, in other words the Directors and certain outstanding heads of department. All other types of employment were generally fixed term, although contracts could be extended over longer periods if there was a sustained interest in the research being carried out. Whereas the Institute Directors by and large stayed on in their posts until retirement, the turnover among the other scientists was great. Especially for junior scientists, the chance of conducting research at one of the institutes was a great opportunity. Indeed, in many institutes the number of often unpaid visiting scientists, fellowship holders and foreign guests significantly exceeded the number of scientists on the payroll. Many members of staff, including a considerable number of PhD students, later returned to universities as assistants, readers or professors, or assumed important posts in the research departments of major companies. Even among the Scientific Members who were not Directors, it was not uncommon to transfer to a university chair. When a new Director took over the management of an institute, he or she was even entitled to let all members of the scientific staff go – to allow for the recruitment of specific experts to advance new research foci.

The transformation of the Kaiser Wilhelm Society into the Max Planck Society did little or nothing to change this constellation. The Directors and department heads remained in office with few exceptions and the principles of structural and staff policy formulated when the KWS was founded met with approval even under the new circumstances. In practice, however, considerable and even fundamental changes were introduced over the course of time. For example, the number of department heads and scientific officers who were offered permanent posts gradually increased. In the 1970s, many institutes began to convert fixed-term scientific posts into permanent posts. However, since this very much limited the scope of a new Director to hire staff with qualifications specifically required for the respective research programme, it was later decided to halt this development and promote a greater degree of flexibility and mobility again.

On the directorial level, the introduction of the institutional Board of Directors in 1964 brought far-reaching changes. It redefined the role of the Directors and augmented their number significantly. By the mid-1980s, most institutes were managed by a Board of two or more Directors, who took turns to hold the post of Managing Director. Similar constellations had existed as far back as the days of the KWS, notably in the KWI for Medical Research (inaugurated in Heidelberg in 1929), which had four to five separate sections; but they remained exceptions to the rule. In contrast, it was now time to replace the old and fundamentally authoritarian principle of management by a single Director with new structures that better reflected the basic liberal and democratic order of the Federal Republic of Germany.

Nobel Prize winners and other great names

Whereas the standing of the Kaiser Wilhelm Society rested in the early days on its founders, the imperial patron, the President, the prominent members of the Senate and the Management Board, as well as the munificent patrons, as time passed it was upheld by the scientific personalities, genius discoverers and in-

ventors who worked in the institutes which were being established in rapid succession. By 1945, no less than 13 Scientific Members of Kaiser Wilhelm Institutes had been awarded the Nobel Prize: Albert Einstein and Fritz Haber, James Franck and Richard Willstätter, Max von Laue and Otto Meyerhof, Otto Heinrich Warburg and Werner Heisenberg, Richard Kuhn and Adolf Butenandt, Hans Spemann, Peter Debye and Otto Hahn, as well as the Presidents Planck and Bosch. Other Nobel Laureates were active in the KWS governing bodies and in the Boards of Trustees of the different institutes, or were associated with the institutes as External Scientific Members (even the founding Senate contained three Nobel Laureates: Paul Ehrlich, Emil Fischer and Jakobus Hendricus van't Hoff). The Society could also boast a large number of other scientists of no lesser prestige, such as Lise Meitner and Cécile Vogt, Max Bergmann, Herbert F. Freundlich, Richard B. Goldschmidt, Reginald O. Herzog, Ludolf von Krehl, Carl Neuberg, Michael Polanyi, Ludwig Prandtl, Ernst Rabel, Oskar Vogt and Martin Wolff.

The Scientific Members of the Max Planck Society and its institutes also include many who have been awarded the Nobel Prize. Butenandt, Hahn, Heisenberg, Kuhn, von Laue and Warburg originally came from the KWS. In the new Society's first 25 years they were followed by Walther Bothe (1954), Karl Ziegler (1963), Feodor Lynen (1964), Manfred Eigen (1967) and Konrad Lorenz (1973). The period from the mid-1980s to mid-1990s brought another ten Laureates: Georges Köhler (1984), Klaus von Klitzing (1985), Ernst Ruska (1986), Johann Deisenhofer (1988), Robert Huber (1988), Hartmut Michel (1988), Erwin Neher (1991), Bert Sakmann (1991), Paul J. Crutzen (1995) and Christiane Nüsslein-Volhard (1995). After the turn of the century it was the turn of Theodor W. Hänsch (2005) and Gerhard Ertl (2007). The list of 'great names' could again be much longer – consider, for instance, Karl Friedrich Bonhoeffer and Wolfgang Gentner, Carl Friedrich von Weizsäcker and Reimar Lüst, Heinz Maier-Leibnitz and Helmut Coing, Jürgen Habermas and Paul Baltes, to name but a few. The MPS has won particular recognition for the fact that its institutes continuously foster the younger generations of scientists, allowing them to mature into independent research personalities of world-wide renown.

Scientists expelled in the National Socialist era

The only crisis which would have a radical impact on the staff structure and would leave unmistakable marks in the history of both the Kaiser Wilhelm Society and the Max Planck Society began with the Nazis' 'seizure of power' in 1933. In total, more than a hundred scientists were expelled from the KWS for reasons which had nothing to do with their scientific qualifications. Most of them had to leave as early as 1933/34 and the last ones were forced out in 1938. Among them were no less than ten of the 35 Institute Directors and 21 of the 65 Scientific Members working in the institutes at the time. They were joined by five further department heads, four academic officers (from the law institutes), 58 academic staff and assistants, eight visiting scientists who had enjoyed lengthy stays at the institutes and a number of PhD students who were able to make brilliant careers for themselves in science after emigrating. More than one on five of the scientists who were forced to leave the KWS for political reasons – racism in over 90 per cent of cases – were women, of whom only a fraction (Lise Meitner and Cécile Vogt) were Scientific Members. The institutes that took the hardest blow to their staff were the KWIs for Physical Chemistry and Electrochemistry, Medical Research and Biology, which lost 24, 19 and 12 people, respectively. The KWIs for Biochemistry, Brain Research and Fiber Research also lost a considerable number of scientists (7, 7 and 6, respectively).

The Scientific Members among them who were also Institute Directors were Max Bergmann (Leather Research), Albert Einstein (Physics), Richard B. Goldschmidt (Biology), Fritz Haber (Physical Chemistry), Reginald O. Herzog (Fiber Research), Otto Meyerhof (Medical Research: Physiology), Carl Neuberg (Bio-

chemistry), Ernst Rabel (Comparative and International Private Law), Hans Sachs (Medical Research: Serology) and Oskar Vogt (Brain Research). The other eleven Scientific Members were scholars of similarly high standing: Max Bielschowsky (Brain Research), Fritz Epstein (Physical Chemistry), Herbert F. Freundlich (Physical Chemistry), Erich Kaufmann (Comparative Public Law and International Law), Lise Meitner (Chemistry: Physics), Felix Plaut (German Institute for Psychiatric Research), Michael Polanyi (Physical Chemistry), Count Berthold Schenk von Stauffenberg (Public Law and International Law), Cécile Vogt (Brain Research), Karl Weissenberg (Physics) and Martin Wolff (Comparative and International Private Law).

The younger scientists who made a remarkable career in their new countries cannot all be listed here due to their great number. We must content ourselves with a few examples: geneticist Charlotte Auerbach was one of the first women to be accepted into the Royal Society in London. Physicist and communications scientist Hans Jakob von Baeyer made a place for himself in the telecommunications hall of fame in Canada. Neurologist Fritz Buchthal, who worked in Copenhagen and later in Santa Barbara, received the 'Lifetime Achievement Award' of the World Association of Neurology. Max Delbrück at the California Institute of Technology was awarded the Nobel Prize as one of the founders of molecular biology. Despite his premature death in a plane crash in 1948, Ladislaus (László) W. Farkas is considered the founder of physical chemistry in Palestine/Israel. Kurt Paul Jacobsohn made a decisive contribution to the development of biochemistry in Portugal. Chemist Edgar Lederer became one of the most respected and influential French natural scientists. Hermann Lehmann in Cambridge was considered the world's leading haematologist and was honorary member of ten haematological societies in Europe and further afield. Curt Stern in Berkeley was one of the pioneers of human genetics and was successively appointed President of three major scientific societies in the US. Marthe Vogt in Cambridge was one of the founders of neuropharmacology. All these names show beyond contention how much scientific substance and potential the KWS lost in the era of National Socialism. They also highlight how and to what extent the host countries benefited from the forced migration. However, notwithstanding the later achievements of the migrating scientists, there can be no doubt that the displacement was a severe blow of fate to everyone involved. In most cases, it took a long time for the foreign country with its unfamiliar language, customs and often alien scientific culture to really feel like a new home. Some took their own lives after emigrating (Reginald O. Herzog, Felix Plaut); others, like Mathilde Hertz in Cambridge suffered a permanent interruption of their research activities. Many others endured long periods of insecurity and hardship. Two of the expelled scientists (Fritz Epstein, Friedrich Duschinsky) were deported from France and murdered in Auschwitz. Marie Wreschner avoided imminent deportation from Berlin by committing suicide. Count Berthold Schenk von Stauffenberg was the only Scientific Member of the KWS who lost his life as a result of active resistance to the Nazi system. Following his participation in the attempted overthrow on 20 July, he was sentenced to death by the 'People's Court' in August 1944 and executed in Plötzensee, Berlin.

Once the last remaining Jewish scientists (Meitner, Meyerhof and Wolff) had left in 1938, the KWS was practically a 'Jew-free' Society in line with Nazi ideology. In May 1937 the President had already announced to the responsible minister that there were 'no longer any Jews in the Senate of the Kaiser Wilhelm Society for the Advancement of Science'. In the same letter he also specified that 'of the 800 ordinary members, approximately two per cent are Jews'. At this point, it is worth noting that people of Jewish descent had played an extraordinarily important part in the founding and, above all, the funding of the KWS. On the list of members dating from 1911, 23 per cent were Jews; in the first Senate they represented 25 per cent and they had contributed 39 per cent of all donations made by 1914. This compares with a Jewish population of no

more than one per cent in Germany as a whole. The KWS could not have prevented the politically motivated expulsion of the scientists, but there was never any strong opposition in the Administrative Headquarters or expressed by individual Directors; there was no public protest against the manifest injustice. People may have sincerely regretted the forced removal of their fellow scientists, but they continued their work as if nothing had happened. From then on, research was conducted in the KWS and in Germany at large with the exclusion of Jews and people of 'non-Aryan' descent.

'Denazification' and staff continuity following World War II

In view of the vast scale of the KWS's involvement in the armament efforts and in the wartime economy under the Nazi system (25 of the 36 research institutes had been declared defence, armament or SS facilities by 1941) and its participation in the theory and practice of racial hygiene in the 'Third Reich', including the murdering of the infirm, experiments by certain scientists on concentration camp prisoners and prisoners of war, as well as research using 'material' collected from the victims of Nazi crimes, it was expected that the occupying powers' 'clean-up measures' and the process of denazification from 1945 onwards would have a similarly huge impact on the workforce of the KWS as the period from 1933 had had. The reality, however, was starkly different.

Certainly, there is still a lack of complete data for the KWS, but a new study of the 'denazification' trials of 87 members and employees, 67 of whom were scientists (25 Directors, 18 other Scientific Members or department heads and 24 academic staff), shows that almost a third were prohibited from working in their profession; however, most of these bans were not upheld in the later 'Spruchkammer' (civilian court) trials. In the end, it was confirmed that none of the 43 leading KWS scientists could be considered an 'offender', or even a 'lesser offender'; 15 were only designated 'followers' and 28 were completely exonerated. This was above all possible because the scientists issued so-called Persil notes for each other: they mutually certified each other as having conducted only 'basic research' and having maintained a strictly apolitical stance. That way, the fact that more than half of the investigated scientists had been members of the Nazi Party was considered unimportant.

Some of the Directors who were clearly offenders on the basis of their political stance and their activities during the Nazi era, like Peter Adolf Thiessen (Physical Chemistry) and Wilhelm Eitel (Silicate Research), were among the scientists who soon emigrated to the Soviet Union or the US to continue their work, which meant that the question of whether they could still be allowed to belong to the KWS/MPS never had to be settled. 'Race hygienists' like Ernst Rüdin, Fritz Lenz and Baron Otmar von Verschuer could not be kept on (although Lenz and Verschuer soon found employment at West German universities), but the KWI/MPI for Breeding Research under Wilhelm Rudorf was largely unaffected, for example, even though it was considered an institution in which former Nazis set the tone. On the whole, those who were responsible for the KWS in the transitional period were of the opinion that as much continuity as possible in the staff was an indispensible condition for any future institutional stability. That is why the Senate took the following decision two days after the founding of the MPS on 26 February 1948: 'The Scientific Members of the Kaiser Wilhelm Institutes shall be recognised as Scientific Members of the Max Planck Society.'

Of the scientists that were expelled during the 'Third Reich', almost no one has returned. Some of the prominent former colleagues accepted the status they were offered of External Scientific Member of the MPS. The problems associated with the uninterrupted staff continuity were mostly ignored; criticism from people like Lise Meitner and James Franck met with incomprehension or direct rejection among the majority of their colleagues. When Institute Directors, particularly from the MPI for Biology, protested against colleagues with

a Nazi past being entrusted with MPS management posts so soon, absolutely no action was taken. For decades, the Max Planck Society showed no interest in examining the Nazi aspects of the institution's past in any great detail.

Staff movements in recent times

Since it was founded over sixty years ago, the Max Planck Society has seen no major changes to its staff structure except for the procedures already mentioned (the introduction of the Board of Directors in the institutes and the increase in permanent posts offered to scientists). Fluctuations in the workforce have been mainly due to the Society's uneven but generally sustained growth. When Hahn handed over the presidency to Butenandt in 1960, the MPS had 2,965 employees, of whom 113 were Scientific Members and a further 727 were academic staff. In the next twelve years, these numbers augmented dramatically to 8,158 employees (176 Scientific Members and 1,900 other scientists), before a phase of relative stagnation began, which meant that at the end of Lüst's presidency in 1984, the figures had hardly changed: 8,404 employees with 193 Scientific Members and 1,989 academic staff. This trend continued in the years to follow: in 1990, the Society had 8,724 employees with 200 Scientific Members and 2,089 academic staff. In the wake of German reunification and the expansion of the MPS into the former East, the numbers rose considerably, with 11,036 employees recorded in 1996: 220 Scientific Members and 2,686 academic staff. The total number of employees increased to 12,049 by 2002 and to 13,384 by 2008. The number of Scientific Members (269 in 2002 and 267 in 2008) stabilised at a high level, as did that of academic staff (3,240 in 2002 and 3,153 in 2008). In the entire period from 1960 to 2008, the number of Scientific Members thereby rose 236 per cent; the increase amounted to 434 per cent for academic staff and 451 per cent for employees overall.

Given that the number of institutes only doubled in the same period, these figures demonstrate that in addition to a mere quantitative expansion, the research facilities were able to bolster their resources significantly in terms of the number of scientists and other staff at their disposal. What the figures do not show are the staff fluctuations caused by the closure and founding of institutes, by retirements or by new appointments. Consider, for example, the fact that 18 institutes and seven further research establishments were created in the 'new' federal states (including Berlin) by 1997. Not only that, but the closure of 20 institutes, departments and other research facilities between 1972 and 1984, when the MPS budget was really stagnating, vacated 600 posts, thereby facilitating the establishment of ten new institutes and seven project groups. And between 1984 and 1990, 62 Directors, almost a third of the total number of directorial posts, had to be filled again. Thus, there can be no doubt that apart from the marked elements of continuity at the level of Presidents and Secretaries General, there has been an ongoing process of staff turnover and renewal, not only among the academic staff, but also among the Directors.

The fact that the number of fellowship holders and visiting scientists, PhD students and post docs working at the MPS institutes rose from 2,045 in 1972 (no relevant figures are available from 1960) to 6,281 in 2008 is an impressive testament to the great appeal of the Max Planck Society, mainly to junior scientists, but also to established and successful colleagues from other institutions and countries. Such prestige is a product of the singular scientific accomplishments achieved from the early days of the Kaiser Wilhelm Society to the present day. One of the most important conditions for such achievements was and is the continuously redefined and constantly reconfirmed link between continuity and change, tradition and willingness to renew, on both the staff and the institutional level. Given this realisation, it may well be concluded that, in its anniversary year, the Max Planck Society, Germany's leading scientific community, can look back at a momentous past and at the same time gaze forward to no less grand a future.

Structures, finances and the relationship with politics

The organisational framework

RÜDIGER HACHTMANN

Two decades before the foundation of the KWS, Theodor Mommsen declared that in future 'big science, which could not be accomplished by individuals alone but which will be directed by an individual, will be a vital part of our cultural development', just as large nations and big industry had already become. Mommsen's postulate provided a pithy turn of phrase for both the establishment of a large-scale scientific operation, as was to emerge in the form of the KWS, and its structure.

From 1871, the German Reich became a 'large nation' which was overtaking Great Britain economically and found itself in competition with the USA. However, German industry had only emerged as a leading global power because of the rapid advancements made in the natural sciences and technical disciplines. The further progress of these fields appeared to be in jeopardy at the turn of the century as the number of students was growing, putting greater pressure on university lecturers in terms of lecturing duties and examinations. It was feared that basic research would be especially neglected as a result. The latter had largely been concentrated at the universities until then, whereas research focusing on direct application was carried out at the emerging technical universities and the institutes founded within them. It was believed that the German Reich was at risk of falling behind the other major powers scientifically.

It was against this backdrop that the KWS was officially founded on 11 January 1911 as a large-scale scientific operation. But how would this major research establishment be organised? In contrast to major industrial operations, the Kaiser Wilhelm Society for the Advancement of Science was given a decentralised core structure – it consisted of a growing number of research institutions which soon developed a distinctive corporate identity despite their heterogeneity in terms of disciplines.

The individual institutes, for their part, would be managed based on the patriarchal model of large-scale industrial enterprises. The key figure was the Director of the respective Kaiser Wilhelm institute. He built the institute around himself, decided on the research focus and appointed staff as he saw fit. His autocratic position was only restricted by a type of supervisory board, the Board of Trustees, which primarily monitored the proper use of funds, and the KWS's central management bodies.

The KWS was intentionally founded as a 'registered society'. This step was taken to protect against unwanted state influence. The founders of the KWS also hoped that this legal form would make it easier to obtain funding from industry as well as government grants. This expectation was only partially met. However, it does go a long way towards explaining the strong position of leading companies in the German Reich in the KWS's central bodies. The research society's highest decision-making body was nominally the General Meeting, attended by 200 KWS members initially, but by almost 1,000 from the 1920s onwards. However, the General Meeting effectively remained a body of approval. The Senate, the Executive Committee and the Administrative Headquarters had the greatest influence over how the organisation was run. The General Meeting served to elect 14 of the 32 Senators. A further 14 were appointed by the Kaiser until 1918 and by the Prussian Minister of Culture and the Reich's Interior Minister after his abdication. The three Section Heads of the Scientific

Council (formed in 1928) and the Managing Director of the Executive Committee were also members of the Senate. The Executive Committee, effectively the governing body of the KWS, was appointed from the ranks of the Senate, which approved the budget and use of funds, decided on the foundation and closure of institutes and the admission and exclusion of members, and submitted the accounts to the General Meeting each year in an annual report. In order to fall into line with the Nazis' 'leader principle', but without really changing anything significantly, the Presidential Advisory Board replaced the Executive Committee in July 1937. In addition to the President, the Executive Committee or the Presidential Advisory Board was made up of two Vice Presidents, two secretaries and two treasurers (three from the end of 1925). They all worked in an honorary capacity until 1945, including the four KWS Presidents, von Harnack, Planck, Bosch and Vögler. The Administrative Headquarters was responsible for the day-to-day business.

The KWS's basic structure was not affected by the First World War or the revolution. However, a Scientific Advisory Council was established at the end of 1928 which comprised the Scientific Members of the KWS. It represented the expert counterweight to the Senate and the Administrative Headquarters, which was becoming increasingly independent on account of its growing responsibilities. All in all, the KWS's core organisational structure proved itself extremely flexible. It was one of the main reasons why the Society was quickly able to establish itself as a leading organisation in the complex and federally fragmented German scientific landscape. The external stations of the KWS's success are marked out in the establishment of its institutes: the KWIs for Chemistry and for Physical Chemistry and Electrochemistry began their work in 1912. The institutes for Biology, Coal Research (Mülheim), 'Experimental Therapy' and Occupational Physiology were also set up before the war. As the First World War began, plans to establish a KWI for Brain Research and an Institute for German History were put on hold. However, the war did not disrupt the emergence of the KWS, in fact it had quite the opposite effect. The KWI for Physical Chemistry and Electrochemistry under Fritz Haber, who had ensured the production of German explosives using the method of ammonia synthesis developed by Carl Bosch and himself and who was also jointly responsible for the production and deployment of poisonous gas, effectively became a government weapons factory with a 1,500-strong workforce. The KWI for Iron Research and a second KWI for Coal Research (in Breslau, modern-day Wrocław, from 1922) were set up, the KWI for Physics under Albert Einstein was founded (which only received its own buildings between 1935 and 1938) and the Göttingen-based aerodynamic testing facility as well as the Hydrobiological Institute in Plön became part of the KWS in 1917 and early 1918. The German Research Institute for Psychiatry in Munich was also first supported by the KWS in the spring of 1918 but was only officially incorporated into the scientific organisation in March 1924.

The foundation of the Weimar Republic did not change the KWS's position as a leading scientific organisation. The majority of researchers as well as Senators and Executive Committee members had their reservations about parliamentary democracy. Holding fast to the name of their imperial protector, they were unwavering in their opposition to proposals for a change of title from socialists and democrats alike. The representatives of the Weimar democracy nevertheless showed much goodwill towards the KWS. When private financial donations started to wane from the beginning of the 1920s, the state stepped in as a financial backer. The government contribution to the KWS's budget, which had stood at a third after the currency stabilisation in 1924, increased to two-thirds by 1931 while the total budget tripled at the same time, rising from three million reichsmarks in 1924 to nine million RM in 1929.

The scientific organisation expanded in the early 1920s with the addition of the KWI for Metal Research and a few smaller institutions. Yet the survival of the KWS could not be taken for granted, particularly in view

of the upheaval caused by galloping inflation in 1923 and financial uncertainty. Other research institutions collapsed owing to the economic and political instability of the Weimar Republic. The 'König-Friedrich-August-Stiftung für wissenschaftliche Forschung zu Leipzig', for instance (known as the 'Sächsische Staatliche Forschungsinstitute' from 1919), which had 12 institutes under its mantle, did not recover from the consequences of inflation and was disbanded. Why did the KWS escape the same fate? The scientific excellence of the Directors and their staff is not the sole reason for this.

The survival of the KWS and its continued emergence was largely the result of the shrewd strategy deployed by its Administrative Headquarters. The foundation of a total of 16 new institutes in the second half of the 1920s, which was primarily driven by the KWS's management committees, was influenced by the pragmatic consideration that a large-scale scientific organisation with 30 highly regarded institutes could not easily be disbanded, especially if its locations were distributed across the entire Reich. The Society's large, core institutes had their headquarters in Prussia until the mid-1920s. The foundation of the KWI for Leather Research in Dresden in 1921/22 and the KWI for Medical Research in Heidelberg in 1927–30, the relocation of the KWI for Metal Research from Berlin to Stuttgart in 1933/34 and, finally, the establishment and takeover of various small research institutions in Austria and Bavaria were carried out, to a large extent, by the management of the KWS with the intention of placing the medium-sized imperial states and the Austrian Republic under political and financial obligation as well as Prussia and the Reich.

Another key factor was that science was seen as a vital resource by all leading figures in the fields of politics, industry and research and an area in which the German Reich was still a 'world power', a fact which would foster its re-emergence as a major power. The management of the KWS astutely took account of this by founding institutes that were in keeping with the zeitgeist in terms of their thematic direction. In founding the Kaiser Wilhelm Institute for Anthropology, Human Heredity and Eugenics in mid-September 1927, for example, it wanted to make a contribution to the 'containment of the rapidly growing need for care among the population and to preserve and promote the healthy bearers of Germany's future', as its first President, Adolf von Harnack, said. Improving the opportunities of German industry in the global market was the reason behind the foundation of the KWI for Comparative and International Private Law at the start of April 1926. In the words of the Director General and Head of the Central Administration of the KWS, Friedrich Glum, in December 1924, the main aim of the KWI for Comparative Public Law and International Law was to manage 'the scientific preparatory work and to support the […] fight against the Treaty of Versailles, the Dawes Plan and the Young Plan'. The systematic establishment of links between the scientific organisation and the key decision makers in politics and government was ultimately of fundamental importance. At least as important was the goodwill of almost all industrialists of high standing in the German Reich. They were often visibly pursuing vested interests through their commitment to individual institutes. It is no coincidence that the funding the KWS received from business primarily went to the institutes for coal, iron and metal research and chemistry, in other words, research facilities whose output promised long-term benefits for industry.

The admission of important representatives of the Reich and federal states to the KWS's management committees had a peculiar effect: when the President or other representatives of the Executive Committee and the Senate negotiated with government representatives on funding, the establishment of new institutes or other issues, they were often sat opposite people who also belonged to the KWS's management committees and were obviously well disposed towards the research organisation. The KWS was effectively negotiating with itself. The Society also upheld close relations with the leaders of the Reich's military. As Glum declared at the

start of the 1920s, these people could unrestrictedly 'avail themselves of the scientific experience of our institutes'. Indeed, since the middle of 1926, almost all relevant Kaiser Wilhelm institutes had been involved in weapons research prohibited under the terms of the Treaty of Versailles. The weapons research, uninterrupted by the global depression, was a key element in the continuity between the pre- and post-1933 eras and explains why many at the KWS did not initially find the Nazis' rise to power at all disruptive. The desire for 'national emergence' was strongly felt within the KWS, too. The impression of proximity to the new holders of power was enhanced by the fact that the 'leader principle' propagated by the National Socialists seemed to be structurally akin to the Harnack principle. Another key factor in the Society's willingness to adapt was that, after a brief period of uncertainty in 1933/34, the new regime essentially guaranteed the continuation of the KWS and did not interfere with the research institution's organisational structure.

Many people in the KWS were in fact incensed by the radical anti-Semitism of the Nazi movement. During a meeting with Hitler on 16 May 1933, Max Planck insisted that 'it would be damaging if valuable Jews were forced to emigrate since their scientific work was urgently needed and countries abroad would then primarily benefit from this'. However, there was little open opposition. The expulsion of Jewish colleagues was accepted with a shrug by most non-Jewish scientists at the KWS. The disappearance of the Stormtrooper hooligans from mid-1934 and Hitler's foreign policy success saw the distance initially kept by many people quickly disappear. Ludwig Prandtl, Director of the KWI for Fluid Dynamics and the KWS's aerodynamic testing facility, was not alone in admiring the dictator as a 'man of remarkable strength of character'.

The fact that the Nazi regime was in no way opposed to science – it could not afford to be – was decisive. Even the most narrow-minded Nazis were aware that the dictatorship needed the sciences to keep up with the latest developments in order to wage modern warfare. The initial phase in which zealous Nazis attempted to ideologise the sciences was quickly over. Pragmatism and 'focus on success' took over in scientific activities far beyond the KWS. Under the 'Third Reich' the broad field of 'normal' sciences remained at the forefront internationally, both conceptually and methodologically, with the Kaiser Wilhelm institutes playing a significant part. However, it was not until 1937 that action began to be taken to expand the Kaiser Wilhelm Institute for Plant Breeding, which had taken up its research activities back in mid-1928, as well as to found additional institutes in the field of agricultural science along with a series of other KWS research institutions.

In the first years of Nazi rule, the Administrative Headquarters of the KWS was unable to turn the high regard in which it was held into hard cash. Standing at 5.7 million RM, the KWS's income was at about the same level in 1936 as it had been in 1931, the year of economic crisis (5.5 million RM). This was not on account of a lack of political enthusiasm. Friedrich Glum, Head of the Administrative Headquarters, had made no secret of his admiration for Mussolini and the 'power of the fascist spirit' from 1930 onwards. Writing in the prestigious Berliner Börsen Zeitung in 1933, Glum exalted the 'national revolution' under Hitler, the 'new Luther', who would achieve the much-desired 'breakthrough into the hostile world of the non-German spirit'. However, by singing the praises of the Italian duce, Glum had backed the wrong horse. Extolling the virtues of Italian fascism in the early years of the Nazi dictatorship did not pay dividends given that it was locked in intense competition with German National Socialism until 1936. The KWS's total budget did not increase significantly until 1937, when it rose by an annual 20% or more. In 1943, the Society's budget stood at 14.7 million RM.

The announcement of the 'four-year plan' in September 1936 and the establishment of the Reich Research Council in the spring of 1937 laid the groundwork for the founding of new Kaiser Wilhelm institutes, including the KWI for Biophysics (1937), the KWI for Bast Fiber

Research (1938), the KWS Research Station for Stratospheric Physics (1938), the KWI for Animal Breeding Research (1939), the KWI for Agrarian Research (1940/41) and the construction of the KWI for Physics (1935/38). At the end of 1939, most of the Kaiser Wilhelm institutes were declared 'essential to the war effort' and therefore became an essential part of the Third Reich's military, industrial and scientific capabilities. The scientific staff of the KWS institutes were deferred from military service at an early stage. The total number of staff employed at the Society's research institutions and the Administrative Headquarters increased from just under 600 in 1923 and slightly less than 1,000 at the end of the 1920s to almost 2,000 in 1943/44.

For the KWS, 1937 proved to be a watershed year. Carl Bosch, the founder of IG-Farben and Nobel Prize winner, was elected as the KWS's first industry President. Even more importantly, Ernst Telschow replaced Friedrich Glum as Secretary General of the KWS. Telschow's assumption of office, in particular, marked a paradigm shift. The approach changed. In contrast to the right-wing intellectual Glum, who loved making public appearances, the new Secretary General ran the KWS discreetly. Telschow refrained from heaping praise on Nazi policy. He knew that the leading Nazis disapproved of this and that they wanted researchers and scientific administrators to go about their business quietly.

Above all, Telschow re-established the political principle paraphrased above as 'the KWS negotiating with itself'. After the Nazis came to power, the networks with the political elite were largely destroyed. Despite his best efforts, Glum did not succeed in establishing relationships with the new political decision makers. This is the main reason why he finally had to go in 1937. Telschow, in contrast, encouraged Bosch to accept many of the leading officials in charge of science policy in the dictatorship into the Senate and the Presidential Advisory Board. He also established personal relationships with many influential Nazis, fully aware that power and influence was vested to a much greater extent than before in individuals under Nazi rule and that politics was conducted informally. Telschow, as well as other key figures in the KWS management bodies, such as Gustav Krupp, Carl Friedrich von Siemens and Albert Vögler, also belonged to central networks where the main members of the old and new elites drew up and finalised the general principles of Nazi science policy. The growth of Telschow's power was a paradoxical effect of the 'leader principle' that was tailored to the President of the KWS and introduced in 1937 as the statutes were updated. Bosch was in ill health when he took up the office of President and he delegated the power vested in him to Telschow. Telschow's interregnum between the death of Bosch at the end of April 1940 and the appointment of Vögler as the KWS's second 'industry President' at the end of July 1941 further strengthened the Secretary General's position.

Albert Vögler, the founder and head of Vereinigte Stahlwerke, was in fact a strong figure. However, his main sphere of activity remained the economy (geographically, the Ruhr region), even during the war. Whenever Vögler came to the Reich's capital, he was overburdened with so many responsibilities – he was, among other things, the main advisor to Albert Speer, the Reich's Minister of Defence – that he had little time available for the KWS. Vögler therefore delegated much of the day-to-day business to his Secretary General.

From 1938 through to the second half of the war, the KWS expanded institutionally far beyond the borders of what was now the 'Greater German Reich', in particular into south-eastern Europe. The KWS began to reorganise itself based on a form of 'metropolis and periphery' model. It wanted to leave basic research in Berlin's Dahlem suburb and other locations in the 'old Reich'. In 1938, Vienna and Prague were added as additional science metropolises. Only regional research institutions would be located on the European periphery, primarily agricultural and biological institutes which would establish the scientific basis for the economic use of locally typical fauna and flora or focus on specific regional geological problems (such as coal and silicate research), partly with a view to ensuring optimal eco-

nomic exploitation. This approach dovetailed perfectly with the imperialistic economic ambitions of the Nazi regime, which aimed to establish 'Greater Germany' as the highly industrial core of future Nazi Europe and, above all, to make eastern and south-eastern Europe agricultural colonies.

This 'metropolis and periphery' model corresponded to three basic forms of the KWS's institutional expansion which, at the same time, were also in line with the Nazi regime's concept of 'racial space'. It focused on 'consensual expansion', particularly in Austria, and later also in Alsace, the 'Sudetenland' and, to an extent, in the 'protectorate of Bohemia and Moravia'. In other words, organisational expansion was based on cooperation on an equal footing with 'local' scientists and their institutes, the intention being to incorporate them into the KWS's group of research institutions. The Society's second type of institutional expansion in Nazi-controlled Europe, 'development policy expansion', also focused on amicable agreement, but assumed that the countries concerned were scientifically less advanced. This research policy 'development aid' was aimed at the states associated with the Nazi dictatorship, primarily in south-eastern Europe. Under this approach, a German-Bulgarian Institute for Agricultural Research was established in Sofia (Bulgaria) in 1941 and a German-Greek Institute for Biology was set up within the KWS in Piraeus (Greece) in 1942/43. There is also evidence that similar forms of scientific development aid were planned for Slovakia and Hungary. Finally, a third form of activity beyond the borders of the 'old Reich' can only be described as 'aggressive expansion'. It treated scientists and research institutions as pawns which could be deployed at will. This kind of appropriation of resources began in September 1939 as the German army marched into Poland. It increasingly came to the forefront with the attack on the Soviet Union and culminated in out-and-out forays in the occupied eastern European territories, and also Italy from the autumn of 1943, involving many eminent scientists from the KWS.

The relocation of the main KWS research institutions to areas of the country that were not coming under aerial bombardment, mainly in the western part of the Reich, which had been planned early on and irrespective of the outcome of the war, meant the conditions for re-establishing the research society at the end of the 'Third Reich' were favourable. Furthermore, in addition to several institutes, the management bodies of the KWS, which were left without a head after the suicide of Albert Vögler, and the Administrative Headquarters under Telschow also moved to Göttingen at the beginning of 1945, and the university city of Göttingen was in the British zone of occupation. The British were open to plans for the re-establishment of the research society in western Germany, despite the victorious powers having passed initial resolutions to prevent the KWS from reforming. Against the backdrop of the hardening Cold War fronts and with the help of Colonel Bertie Blount, the official responsible for science and research in the Four-Power Control Commission in the British zone who soon became a committed champion of reforming or newly founding the KWS, Otto Hahn, Werner Heisenberg, Ernst Telschow and others succeeded in re-establishing the Society largely based on the old structures within a short space of time. This was initially achieved in the British zone in September 1946, then in the bizone by February 1948 and finally in all three western zones by July 1949. The price to be paid for reformation was the loss of the Kaiser Wilhelm Society name. Only after the venerable Max Planck, who had returned to the head of the KWS in July 1945, declared his willingness to lend his own name to prevent the collapse of the scientific organisation did the MPS's first President, Otto Hahn, and others drop their opposition to the name change.

The Max Planck Society was soon back on a solid footing both institutionally and financially. At the end of March 1949, shortly before the foundation of the Federal Republic of Germany, the culture and finance ministers of the then 11 federal states (including West Berlin) agreed in the 'Königstein agreement on the funding of scientific research institutions' that the permanent fund-

ing of the MPS and other central research organisations would be the joint responsibility of the federal states. Initially irregular co-funding from federal government was later introduced, which was made permanent in the 1970s. This effectively guaranteed the funding of the MPS. The Königstein agreement also marked a departure from the practice applied until 1945 whereby the funding of research organisations had essentially been based on donations from industry. Although the scientific organisation effectively became a publicly funded institution in 1949, federal government and the federal states gave assurances that they would refrain from intervention in the affairs of the MPS. In order to meet the requirement of fundamentally ensuring 'freedom of science' from political influence, the main researchers were to be largely responsible for deciding which research fields the institutes would focus on and which projects their scientific staff would pursue.

The MPS essentially followed in the footsteps of its predecessor in terms of organisational structure. The Harnack principle, in other words the autocratic position of the Director, continued to apply for the time being. The annual General Meeting of members officially remained the most senior body. The general principles of research policy were determined by the Senate and the Executive Committee after 1948 as they had been during the KWS period. However, in stark contrast to the predecessor organisation, the President now worked on a full-time rather than voluntary basis. The power of scientists vis-à-vis the representatives of industry increased significantly on the management committees. Individual industrialists and representatives of the financial sector did nevertheless play an important role in the MPS. Hermann Reusch (chairman of Gutehoffnungshütte) served as treasurer of the MPS for over a decade from 1952; Carl Wurster (chairman of the Supervisory Board of BASF) influenced the MPS's destiny for many years as Vice President from 1966; Karl Blessing, the long-serving President of the Bundesbank, was a member of the Executive Committee from 1966 until his death in 1971, as was Horst K. Jannott (chairman of Munich Re) from 1970 to 1981. The fact that the economic elite's influence on the MPS had declined significantly overall in comparison to the late Wilhelmine imperial period, the Weimar Republic and the 'Third Reich', and that 'industry Presidents', such as Carl Bosch or Albert Vögler, were now inconceivable at the head of the MPS is explained by structural economic factors. As the Korean boom began, the Federal Republic was quickly integrated into an expanding global market. Many German companies became multinational conglomerates and, moreover, the flow of capital became globalised from the 1980s onwards. This also had an impact on the relationship between the economy and science. Leading members of the economic elite began to identify much less strongly with national research than had traditionally been the case, particularly in the final third of last century in Germany compared to the first half of the 20th century. The stock market flotation of many large companies favoured a short-term, profit-orientated approach and saw the strategic interest in basic research, which Carl Bosch, Albert Vögler, Gustav Krupp, Carl Friedrich von Siemens and many other leading industrialists had held, diminish.

The zeitgeist also had an effect politically. The Max Planck Society was not unaffected by the reform movement of the 1960s and 1970s. In the early 1970s, there was a 'rebellion of the scientific rank and file against the omnipotence of the institutes' leaders', as the SPIEGEL sardonically commented at the end of June 1971. The 'rank and file' called for co-determination in the form of a greater say in the research work that was to be carried out, a reduction in the influence of the business world on scientific research and its own representatives on the MPS's Senate and Executive Committee. The call for co-determination was initially met with incomprehension and, to an extent, outrage by those at the top of the Society. Adolf Butenandt complained: 'We cannot destroy such a wonderful organisation by suddenly turning everything on its head.' The Harnack principle should not be meddled with, he said. Edmund Marsch, who later became deputy Secretary General of the

MPS, attempted to rebut the proposal by remarking: 'There is no co-determination at NASA.'

Butenandt and Marsch need not have bothered putting forward such a defensive argument. The Harnack principle had already been moderated a few years earlier through an amendment to the statutes at the end of 1964. This formalised what various institutes had already been practicing. The institutes did not have to be managed monocratically, as the Vice President of the MPS, Hans Dölle, had laconically put it. In fact, the Harnack principle, named after the first President, had certainly not always been slavishly implemented at the KWS. However, what had been the exception until 1945 started to become the rule in the 1960s.

The principle of internal evaluation was also formalised to a greater extent with the amendment to the statutes in 1972. The management of an institute, and also of independent departments, was handed over to the Director or Board of Directors on a fixed-term basis only. After a seven-year period, the Executive Committee would decide whether an individual's management function was to be extended or whether a new call for applications was to be made based on a precisely defined assessment procedure. The set-up of interdisciplinary project groups for a limited period was also facilitated, which could form the basis for new Max Planck institutes in the best case scenario. That was the case with the MPI for Psycholinguistics (in Njimwegen since 1980), the MPI of Quantum Optics (in Garching since 1981) and the MPI for Foreign and International Social Law (in Munich since 1975), for example. This approach was partly based on previous experience, as, for example, the 'Division for Virus Research' (under Butenandt, Alfred Kühn and Fritz von Wettstein) had been formed from the ranks of leading scientists at the KWI for Biology and Biochemistry between 1937 and autumn 1945. Some action was also taken to put co-determination into practice in the early 1970s. 'Ordinary' scientific staff were involved in the consultation and decision-making processes in the subsequent period, though not to the extent of significantly restricting the key position of Directors and department heads.

The occasional conflicts about democracy and co-determination within the MPS did not prevent the presidency of Otto Hahn, and even more so that of Butenandt, from being considered extraordinarily successful. In 1948, the MPS's budget for the 25 founding institutes and research centres stood at around 7 million deutschmarks. By 1960, when Hahn passed on the presidency to Butenandt and Ernst Telschow stepped down as Secretary General, the MPS's budget had risen to 80 million DM. In the ensuing 12 years of the Butenandt era, the MPS's budget soared again to almost 530 million DM in 1972. Staff numbers increased during this period from 2,600 at 40 institutes to around 10,000 at 52. The total number of employees has now risen to over 20,000 at a total of 80 institutes. The annual budget stands at around 1.3 billion euros.

The fall of the Berlin Wall brought about the biggest post-war turning point and resulted in fundamental restructuring of the network of institutes. In 1990, the MPS set itself the goal of having a third of all institutes located in the new federal states of eastern Germany, which was achieved through the foundation of 18 institutes by 2003. To make way for them, four institutes and one institute section were closed in the old federal states of western Germany with the loss of 740 jobs. The funding principle in the form agreed in 1948 continued to apply. However, the importance of private donors has grown in recent times. The Ernst Strüngmann Institute for Brain Research in Frankfurt is the latest example of an institute being founded as a public-private partnership between the MPS and private benefactors.

The MPS is an indispensable feature on the German and international research map. The traditionally amicable cooperation with the DFG, founded in 1920 as the 'Notgemeinschaft Deutscher Wissenschaft' (Emergency Association of German Science) mainly on the initiative of KWS scientists such as Fritz Haber, became even closer from 1945 onwards, particularly through the intensive support that was provided in the establishment of special research sections at the universities.

Despite competition from other successful national research societies, such as the Helmholtz and Fraunhofer Societies and later the Leibniz Association, the MPS managed to consolidate and expand its position as the leading player in non-university research in the Federal Republic of Germany. Numerous Nobel Prizes and the MPS's reputation as one of the best non-university research organisations in the world bear testimony to this success.

Success stories in research

Strategies and preconditions at the Kaiser Wilhelm Society and the Max Planck Society

JÜRGEN RENN • HORST KANT

When it comes to the past, science has a tendency to forget. It shrugs off outdated prejudices and abandons arguments that have ceased to be prolific. Nonetheless, from the perspective of a history of science that is orientated towards the challenges of the present, questions do arise: What can be learned from past scientific breakthroughs that might help to resolve today's problems? What part does the particular institutional composition of the Kaiser Wilhelm and Max Planck Societies have to play? The Max Planck Society is a unique institution in the world of basic research. It carries on the tradition of the Kaiser Wilhelm Society and serves as a role model with world-wide appeal. But on what experiences and principles is this based? How did first the Kaiser Wilhelm Society and later the Max Planck Society decide on the subjects of their research, where were the breakthroughs made, and to what structural conditions can these successes be attributed? What is the relationship between the dynamics of scientific evolution and the dynamics of society at large? As simple as these questions may appear, they are difficult to answer, for we are faced here with historical research problems that have so far gone largely unaddressed.

Today, however, a historical analysis and consideration of the internal and external conditions behind scientific successes is becoming ever more urgent – both in view of the global challenges that only science can overcome and in the light of historical changes that the role of research organisations such as the MPS has undergone. What role can institutions bound to national structures such as the MPS play in the globalised science of the future? How competitive is the MPS in terms of flexibility and critical mass, compared with private research institutions in the USA? How is the process of consolidating excellent research at the universities and extending institutionally funded basic research to other research institutions affecting the division of labour in Germany's system of scientific research? What tasks should the MPS take upon itself in the continuing development of a global, Internet-based research infrastructure?

Without thorough historical analyses that place the development of research practices in the context of societal dynamics, such questions can only be answered superficially. This essay can offer no such comprehensive analysis; it can only attempt on the basis of selected historical examples to highlight certain strategies that remain effective for the MPS to this day, and make plain the potentially prolific nature of a perspective that considers both the challenges facing the intellectual dynamics of science and the way these can be overcome in the context of institutionalised research.

Progress is not an exclusively cumulative process. It also involves rearranging our systems of knowledge. The evolution of modern quantum and relativity physics and the accompanying alterations to the classical concepts of space, time and matter is a prime example – with far-reaching effects for science as a whole. Such innovations are never the result of a spontaneous paradigm shift, but derive instead from the long-term and frequently stormy amalgamation of heterogeneous bodies of knowledge. To identify and resolve the productive internal conflicts between knowledge systems, it is often necessary to adopt a perspective other than that which first triggered the conflict. Such perspectives tend to originate outside the mainstream rather than at the core. A good example is the role of the unconventional thinker Albert Einstein in the foundation of modern physics.

The long-term, heterogeneous and indeed discontinuous nature of scientific progress and the need to integrate such maverick perspectives place particular demands on the manner in which research is organised that do not necessarily coincide with the undisputed need to pursue the mainstream. One of the great scientific breakthroughs in the history of the KWS/MPS lay in splitting the uranium atom. Another was the discovery of organometallic catalysts for the polymerisation of olefins at the MPI für Kohlenforschung (coal research). In 1953 this led to the development of the low-pressure polyethylene process – a breakthrough which had economic consequences unforeseeable at the time. Other notable successes include the establishment of molecular electrophysiology (at the MPI of Biochemistry), the elucidation of ribosome structure (at the MPI for Molecular Genetics) and the origination of research into both human development and ageing (at the MPI for Human Development).

Among other factors, the success of the KWS/MPS over the past hundred years has derived from the fact that the institutes often served as a catalyst for the restructuring of knowledge systems. The long-term, sustained institutional support for such restructuring processes within and beyond the mainstream is of key importance and the real mission of the MPS. Let us consider a few chapters from the history of the KWS/MPS from this aspect. Naturally we can only touch upon the historical examples that light the Society's path.

What were the criteria for success and on what were expectations based?

The traditional image of scientific progress is one of continuous growth within fixed boundaries, with certain exceptions. From this image, two types of success can be derived. The first is successful participation in the mainstream, made evident by the impact factor. The second is an individual and pre-eminent achievement often associated with a reorientation of knowledge. Such achievements are frequently recognised only when the 'new' is no longer new, but has instead become part of the mainstream. Consider the time lag in awarding Ernst Ruska a Nobel Prize for developing the electron microscope. On the other hand, given the key role played by the restructuring of knowledge systems in the advancement of science, these criteria for success are inadequate insofar as they both relate to the mainstream. Among Einstein's early works, it was his little-known dissertation that had the biggest impact in terms of citations, simply because it came closest to the mainstream.

Neither criterion is useful for predicting research, nor as indicators of a reorientation of knowledge: the impact factor generally comes too soon and the Nobel Prize too late. Otto Warburg was awarded the Nobel Prize in 1931, shortly after being appointed director of a Kaiser Wilhelm Institute of his own, whereas his pioneering research work had been done beforehand at the KWI for Biology. And Werner Heisenberg had already been a Nobel Laureate for ten years due to his work on quantum mechanics before he became a director at the KWI for Physics. Ultimately, it is history alone that decides how long the success of basic research is sustained.

In the past the MPS has nevertheless consistently managed to achieve structural successes. The appropriate prognoses were based upon the judgement concerning the right person, the right place and the right time. Thus Max Planck, Fritz Haber and Walther Nernst 'discovered' Einstein around 1912 as a candidate for the KWI for Physics which was about to be founded. Emil Fischer 'discovered' Richard Willstätter and Otto Hahn for the KWI for Chemistry: Fischer had already given Hahn a position at his university institute back in 1907 to research radioactivity, a field which enjoyed little acceptance among organic chemists, and in 1912 he ensured that Hahn was given a department of his own at the KWI for Chemistry. Fischer persuaded Willstätter to move to Berlin to conduct research in the promising field of vegetable dyes. Later, as President of the MPS, Otto Hahn 'saw to it' that Wolfgang Gentner took up the mantle of Walther Bothe by promising him an MPI for Nuclear Physics which was independent of the MPI for Medical Research.

Such judgements and their consequences were, of course, to a large extent fortuitous, but was that all they were?

What mechanisms enabled the KWS/MPS to achieve structural success?

The particular manner in which research is promoted by the MPIs mirrors to a large extent the long-term, heterogeneous and discontinuous nature of scientific progress. The principles underlying the research strategy of the MPS include subsidiarity, an interdisciplinary approach and the Harnack principle. Subsidiarity here implies adopting a broader outlook than that of the mainstream, for instance, in consideration of effective long-term research strategies of a kind that universities cannot always afford. Gravitational research, for example, is a field in which the support provided by the KWS and later the MPS for basic research outside the mainstream led in the long term to outstanding results, from the formulation of the general theory of relativity by Albert Einstein to the leading role the MPS now plays in the field of gravitational waves – because the Society chose to back this horse in the 1980s when no other institution had the capacity or funds to do so. Likewise, the leading international role now played by the MPS in the comparative study of public and private law can be traced back to decisions taken on the basis of the subsidiarity principle in the 1920s. The KWI for Comparative Public Law and International Law owed its establishment in 1924 not least to the desire to explore the consequences in international law of the Treaty of Versailles. Of course, in a changing academic landscape the subsidiarity principle must constantly be redefined.

Another characteristic feature is the Society's practice of researching into promising borderline areas where productive conflicts are to be found. An impressive example here is the interdisciplinary work of the MPI for Psycholinguistics, to which we owe an understanding of the system of language production and other breakthroughs which have established this area of study at an international level.

After all, the advancement of research at the MPIs is geared to the Harnack principle, here considered as an opportunity to allow new scientific perspectives to take effect in stable institutional structures, even when this involves some risk. Thus Max Planck as the President of the KWS accepted a reorientation of the only recently established Physics Institute at the KWI for Medical Research upon appointing Walther Bothe in 1934. Planck knew that this would shift the focus away from medical physics and towards the fledgling science of nuclear physics, but he wanted to establish a home for this new and future-orientated field of study at the KWS. The elucidation of the structure of ribosomes by Heinz-Günter Wittmann and his colleagues at the MPI for Molecular Genetics took around forty years to achieve, and there had been no initial guarantee of success.

However, history shows that research outside the mainstream is not advantageous in every scientific situation. Planck's idea in 1932, for example, to establish a KWI for Earth Radiation and Dowsing was rightly not pursued.

Research in borderline areas presupposes an interdisciplinary coherence, which can in reality fail to transcend departmental borders. Experience shows that cooperation is sometimes more effective between departments at different institutes than between units at one and the same institution. It is hardly possible to overestimate the potential of the network constituted by the MPS as a means to support successful interdisciplinary research. A particular line of research being pursued need not always lead to a progressive breakthrough, however. There are also such things as opportunistic or even regressive successes. Opportunistic successes are often the result of an excessive pressure to succeed, which can, in turn, lead to the conventionalisation of initially innovative work. As an extreme example of a regressive breakthrough, consider the racist research conducted by the KWS in the 'Third Reich'.

From a historical perspective, other factors have played a part in the successes of the MPS, in particular the choice of topics and institutional efficiency. In terms

of the selection of topics, various strategies have proven successful in the past, one among them being the act of reflecting on the status of the subject itself. The crisis facing classical physics at the start of the twentieth century was evident to many physicists, even if they had no idea how to resolve it. Such was their awareness that leading physicists and scientific administrators decided to set about founding a KWI for Physics that would be dedicated to resolving this fundamental crisis, and to recruit Einstein to head this institute.

Reflecting on the status of the subject can lead to the conclusion that the task of an institute should be to act as a catalyst to nurture innovative perspectives that already exist. After all, scientific breakthroughs also need to be sustained. Take, for example, Konrad Lorenz's ideas for comparative behavioural research, which set a new pattern that was adopted with the foundation of the Max Planck Institute for Behavioural Physiology in 1954.

Political opportunities, too, can be utilised to further the cause of interesting research prospects, as in the case of the foundation in 1963 of the MPI for Extraterrestrial Physics under Reimar Lüst – initially as a subsection of the MPI for Physics and Astrophysics. The shock waves triggered by Sputnik caused the USA to cast around for European partners to assist in space research. The political constellation at the time provided sufficient scope to found a new institute to exploit existing avenues of research at the Max Planck Institutes for Physics and Astrophysics, Aeronomics and Nuclear Physics and to supplement theory with experimental practice.

It is likewise helpful to consider the areas in which the particular strengths of the MPS lie or can be developed. The position of humanities within a Society dominated by natural sciences provides them with a unique research context. Institutes working in these fields are able not only to build bridges between the 'two cultures', as the MPI for Human Cognitive and Brain Sciences and the MPI for Evolutionary Anthropology are doing. It can also help to overcome some of the traditional fragmentation within the humanities themselves. Similarly, the two art history institutes maintained by the MPS in Italy, the Bibliotheca Hertziana in Rome – one of the first institutes founded by the KWS – and the Art History Institute in Florence, which was acquired as recently as 2002, demonstrate in differing ways the potential for innovation that can still be extracted from established research traditions situated in a privileged cultural environment. In addition, it can provide models for future internationalisation strategies along the lines of the present plans to establish an institute in Luxembourg and a research group in Spain.

The issue of development processes plays a vital role at many Max Planck Institutes today, from cosmology to developmental biology, brain research to evolutionary anthropology and the history of science to ageing. Research of this nature can only be conducted with a long-term perspective and requires precisely the kind of institutional support which the MPS offers. Such staying power is also called for in research into nuclear fusion on the lines pursued by the world-leading MPI for Plasma Physics, the largest centre of fusion research in Europe. Back in the 1950s it was anticipated that nuclear fusion would be commercially viable within about twenty years. By today's reckoning, it will take until at least 2050 before such power plants are available.

Surprising perspectives

Meeting social challenges such as energy supply is no exception in the history of successful research choices. A much-overlooked tradition at the KWS was to establish institutes dedicated to basic applied science, often with generous funding from industry. The Institutes for Coal Research, Fiber Chemistry and Leather Research are just three examples. Current examples of applied or potentially applicable basic research being conducted within the MPS include work on international and foreign law, human development, education, biotechnology, earth systems and, of course, energy.

One strategy adopted in the selection of research topics has proven to be particularly promising: the development of new perspectives derived from what was originally marginal research. A recent example in the field of biology was the discovery of the agrobacterium tumefaciens by Jozef Schell (MPI for Plant Breeding Research) in the course of his work on plant tumours. This unexpectedly opened the way for DNA transfers in plants, and thus provided a basis for green genetic engineering.

Restructuring systems of knowledge poses major challenges for the capacity of the institute and the MPS as a whole in terms of flexibility and productivity. Institutional efficiency also implies a capacity to accommodate new and unexpected changes in the direction of research and surprise shifts in emphasis, as well as offering opportunities for development at all levels, from individuals to research groups and even entire institutes.

Numerous cases in the history of the MPS underscore the principle of productivity, in other words the ability of institutes to come up with new topics and the capacity of the MPS to afford these an appropriate institutional basis. One example is the development of chronobiology, from the pioneering work conducted by Jürgen Aschoff in the mid-1950s at the MPI for Medical Research to the subsequent institutionalisation of this field at the MPI for Behavioural Physiology. The MPI for Biophysical Chemistry was spun off in a similar manner in 1971 from the MPI for Physical Chemistry, which itself originated under Karl-Friedrich Bonhoeffer in Göttingen in 1948 as an offshoot of Berlin's KWI for Physical Chemistry.

Valuable cooperation between institutes

Institutional efficiency can also be reflected in the ability of entire institutes to mutate. Outstanding examples of this include the KWI for Coal Research and subsequent MPI für Kohlenforschung and the Fritz Haber Institute of the Max Planck Society, which have constantly reinvented themselves against the backdrop of significant scientific achievements. The history of the Institute for Coal Research began with the problems inherent in refining coal, followed by the concept of converting coal directly into electrical energy. However, successes such as the development of the Fischer-Tropsch process of extracting liquid hydrocarbons (1925) and Karl Ziegler's low-pressure polyethylene process (1953), already mentioned above, steered the institute in other directions. Likewise, the Fritz Haber Institute has successfully shifted its research focus several times in its history. In the process, however, major issues like the quest for a comprehensive understanding of catalysis continued to give the direction for the Institute's work. The 2007 Nobel Prize for Chemistry awarded to Gerhard Ertl of the Fritz Haber Institute for his work on catalytic processes rewarded this staying power.

The development of genuine cooperation in or between institutes can be of decisive importance for the institutional efficiency with which a particular line of research is conducted. Success is dependent on whether there is a clearly defined focus for convergence, whether cooperation is supported by the use of shared research resources or service departments, and whether inter-departmental project groups add the necessary degree of adaptability. The 'Earth Systems Research' network (Freiwillige Verbund für Erdsystemforschung) incorporating the Max Planck Institutes for Chemistry in Mainz, Meteorology in Hamburg and Biogeochemistry in Jena, which also affiliates cooperating departments at four or more other institutes, is a prime example of how to efficiently address interdisciplinary issues.

It also points to another dimension of institutional efficiency: choosing the right scale on which to operate. On the one hand, it generally makes sense to start with smaller, flexible units. Yet on the other hand, out-of-the-ordinary research projects often need to achieve critical mass if they are to survive and prevail over mainstream activities.

With its specific mission, the MPS plays an impor-

tant role in the academic division of labour in Germany. Its success is substantially dependent on the politically guaranteed freedom of self-administered research institutes to choose their own organisational forms and research topics in the wider field of basic research. Globally, too, the MPS has become a paradigm. Indeed, it will be able to better exploit its structural advantages if it becomes more of a global player in future – always provided that it manages internally to preserve a shared awareness of its particular role. This, in turn, places a natural limit on its conceivable expansion in the form of a communication horizon, beyond which the Society's identity is at risk.

One of the future challenges facing the MPS is the need to heighten its profile as a scientific organisation offering a unique freedom of research – the opportunity, in other words, to step outside the mainstream, combined with guaranteed continuity of research and openness towards new directions in research. Sharpening the profile of the MPS in this way will necessitate even greater flexibility in both the internal structures of the institutes and their external relations.

No research plan, however cleverly devised, can succeed without the MPS placing greater emphasis on an internal as well as external awareness of its specific role in the division of research effort. Given that the concept of excellence is politically charged and is becoming increasingly less trenchant as a unique distinguishing feature of the MPS, public perception of the Society's particular mission will be decisive in determining how successful it is in attracting both resources and young scientists. Internally, the internationally composed scientific advisory boards guarantee a qualitative evaluation of the institutes that is geared to the scientific discourse and the highest scholarly criteria imposed by it. Not only does this system of evaluation safeguard the excellence of research, it has often helped to prevent risky innovations being tripped up by the hurdles of mainstream standards. In future the MPS ought therefore to continue, both internally and externally, to develop a reflective culture orientated towards its role as a catalyst for radical changes, and proactively seek recognition of this role. Such a culture of reflection should include not only an awareness of the hazards inherent in scientific research when moral as well as social contexts are ignored and criteria of efficiency and external opportunity are given free rein. It should also make plain the opportunities that lie in basic research that addresses societal challenges in a context which embraces both scientific as well as social and cultural dimensions.

Still, the matter of whether scientific research is delivering sufficient benefits and whether basic research ought not to be assessed primarily on the basis of its economic utility remains a recurring issue in the media and public debates. A look back at the successes of the KWS and the MPS shows how short sighted such reservations are. Consider Einstein, who is said to have once remarked: 'If science had been left to engineers, our petroleum lamps would work perfectly but we would have no electricity!'

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