RATIONALISM AND ECLECTICISM; ON THE ROLE OF IRON IN BRITAIN IN THE SECOND HALF OF THE NINETEENTH CENTURY

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Being an architect, I would like to preface my statements with a brief consideration of the work of the leading architects of the late eighteenth century and the second half of the nineteenth century. I think this will make rediscovery and re-evaluation of the buildings of this much neglected period more understandable. Its rediscovery in the Federal Republic of Germany has assumed a very definitive shape in 1977 when a prize was awarded to a historically oriented design of the Stuttgart State Gallery and its implementation. The same applied to the English architects James Stirling and Richard Rogers, who have been seen by some as eclecticism and rationalism have been the focal points in discussions about architecture in the Federal Republic. They enjoy the same widespread use today as sociological slogans did in the sixties. History, that is history of the arts, not social history, has become the platform for debates among architects. The reason is dissatisfaction with, and withdrawal from, the so-called modern, functional architecture. Its thesaurus of forms, those of the industrial revolution, which the modern movement had hoped to produce a major educational impact upon the renewal of architecture, today is being accused of this very industrial applicability. The hopes and accusations as old as building with industrially prefabricated elements; in the nineteenth century, they were raised again and again especially in connection with iron architecture. But there are other phenomena to indicate the proximity of the 20th to the 19th centuries. Thus, Eduard Beaucamp in the "Frankfurter Allgemeine Zeitung" of July 14, 1980 wrote under the heading "The Future Lies in the Past:" "Contemporary art is full of indecision, ambiguity, full of eclecticism and historicism... The loss of firm goals and trends, it appears, has resulted in an interwar lack of orientation than the loss of style in the 19th century ever did."

Two examples: In 1851, Joseph Paxton had built the Crystal Palace, the very symbol of modern architecture. At the same time, jointly with Augustus Pugin, he built Kenmore House in approximately four different styles. Today, the American functionalist Philip Johnson, a disciple of Mies van der Rohe and one of the founders of the "International Style," boasts of simultaneously erecting, in twelve different styles, in the early twentieth century, a house high riser with a tailboy-like Renaissance gable in New York, another one, with Victorian gothic towers, in Pittsburgh. Charles Jencks, the well-known architectural critic, in his book titled "The Language of the Post-Modern Architecture," demands: "The intellectual honesty of the architect can be measured by his ability to work in a pluralistic way." (1) With his demand for radical eclecticism, Jencks turns against the rational, functionalist tradition of modern architecture. A comparable development is characteristic of the second half of the 19th century. In the sixties of the 19th century, a change in the attitude to iron construction marks the transition from early Victorianism to the culmination of the Victorian period. Iron had lost the touch of the novelty, of progress, which had adhered to it in the early Victorian phase. In the taste of the public, it acquired the connotation of something cheap, to be used for rational purposes only and, for the same reasons which had resulted in its widespread application, is now no longer used for representative public buildings, at least not as an externally visible material dominating the outward appearance. Yet, when the Crystal Palace had been completed for the 1851 Great Exhibition, iron seemed to have become eligible as a structural material for representative buildings. This would have been a logical extension of a development that had grown out of engineering construction, independent of traditional architecture, in the early years of the 19th century. In view of contemporary reports, reference is first made to the beginnings of an architectural consideration of iron. Thus, Lothar Bucher in his widely quoted "Kulturhistorische Skizzen zur Geschichte der Industriellen Architektur" (1951), wrote: "When seeing this building not erected out of solid brickwork, visitors realize that all rules by which architecture had been assessed so far had now ceased to be valid. (2) Also "The Times" confirmed: "A completely new architectural order was created." (3) In addition, the Crystal Palace met the demands by many architects and critics for a new meaning for truthfulness in design, strict simplicity, in line with the spirit of the time. However, in their final opinion they yet expressed the conviction "that this is not architecture: It is a piece of engineering of the highest value and at the highest level, but it is not architecture." The work is completely lacking in form, devoid of the very idea of stability and soliinity. This is a summary published in 1851 by the British architectural journal "Ecclesiologist." Paxton himself accepted this verdict on his building, acknowledging that iron and glass structures would have to be limited to certain defined buildings. Consequently, the expected revolution in architecture did not take place. Already in the second Crystal Palace built 1853 by Paxton in Sydenham out of parts of the 1851 building showed the attempt, in the complex use of forms and motifs, to go back to traditional forms of architecture. This likewise applies to the glass palaces, except for the Munich glass Palace of 1854, built subsequently: 1853 in Dublin and New York, 1864 in Ausburg. Engineers and producers of cast iron used the chance offered to them by the emerging craze for glass by marketing prefabricated iron structures. Magazines, market halls and winter gardens covered with glass roofs were built all over Britain in the sixties and seventies of the 19th century. Prefabricated residential houses, theaters, market halls were shipped from Britain into the world. Paxton himself tried to make use of his popularity in proposing a wide variety of projects for glass structures; the roof of the Royal Exchange in London, a Crystal Sanitarium 200 ft. long and 72 ft. wide, or the architect as a representative of the fine arts, as we find it in the person of Paxton, is not limited to 19th century architecture. Thus, the "Illustrated London News" edition of May 24, 1851, commenting on the works of the fine arts displayed in the Crystal Palace, found that "they were in fact works of great and fine art." 4 These common, useful things, objects of bourgeois existence, no longer met such a high standard of design that they have been produced almost unnoticed this day, from simple Wedgwood pottery to Thonet's bentwood furniture and on to men's clothing and blue jeans.
Such approaches towards an industrial culture recognizing the character of the period and reacting to it appropriately can be found throughout the 19th century. They appear to have been implemented especially by engineers and designers in areas free from any pretensions to art. Thus, mainly bridges, railway station halls, exhibition halls and market halls, industrial installations, ships, docks, etc., document the tradition in engineering design. However, all these tentative approaches were unable to stop historicism or prevent it; towards the end of the century, it also invaded building construction and functionally conceived buildings with pretensions to art, which were made out of traditional materials. Let me show you a few examples of the repercussions of the Crystal Palace on buildings in Great Britain after 1851, which have survived to this day. They will reveal that especially railway engineers absorbed Paxton's developments, used and advanced them.

King's Cross Station in London was erected in 1851, simultaneous with Paxton's building, according to a design by the engineer Lewis Cubitt (1799-1883). The structure of the two parallel, barrel shaped roofs consisted of glued timber trusses similar to those used by Paxton. In 1870 and 1877, they had to be replaced by rolled arched trusses made of wrought iron, which did not alter the original impression in any way. King's Cross is London's only terminus with the roofs of the halls visibly constituting parts of the architecture. As far as design is concerned, it is an extraordinarily independent, and still functional tradition of the 19th century in Great Britain.

Fox and Henderson, who were the contractors contributing greatly to the construction of the Crystal Palace, used the girders developed there for Oxford Station built in 1842. I.K. Brunel (1806-1859), the engineer, and H.D. Wyatt (1820-1877), the architect, both members of the committee which had entrusted Paxton with the construction of the exhibition building, erected Paddington Station in London in 1852-1854. Fox and Henderson again were the contractors responsible for the shed. It is therefore hardly surprising to see that the girding of the original three-side hall designed as a "bridge-and-tunnel" system of the Crystal Palace. For the color concept, the architect Owen Jones (1809-1874) was commissioned, who had been responsible for the colors used in the Crystal Palace. Brunel, who was a celebrity even at that time, calling in an influential architect to design his shed may be regarded as a first symptom of the apparent loss of confidence in his own abilities. A consequence of the destruction of belief in progress. However, Paddington Station is still wholly in the tradition of early iron construction. The bright interior is reminiscent of the greenhouses of Chatsworth or Kew and the Crystal Palace, which had been Brunel's models. Another building in the wake of the Great Exhibition Palace, but one whose fate reflects the changed attitude towards iron buildings, is the Museum of Science and Art. It was erected in Brompton, which is now South Kensington, on the site of the present Victoria and Albert Museum, from the financial surplus of the Great Exhibition. Britain at that time was engaged in a war against Russia, the Crimean War, which helped France to dominate the continent, and thus was unable to afford costly planning. Consequently, according to the concept of the Department of Practical Art, the museum building was to be an iron structure easily dismantled, very much like the Great Exhibition building in Hyde Park. The design was completed in 1855-1856 by D. Young of Birmingham with modifications under the supervision of James Fergusson (1796-1861), who had already been responsible for supervising the construction of the Crystal Palace. The building, which has a rectangular form, consists of three aisles, each 42 ft. wide, which are spanned by light, crescent shaped wrought iron trusses resting on cast iron stanchions 26 ft. high. While the inner stanchions, which were recessed under an upper floor in the two side aisles, have circular cross sections, the stanchions in the central aisle have H-shaped cross sections, which is a remarkable innovation over Paxton's design. The facade elements between the supports visible from the outside were made of corrugated sheet metal paneled with wood on the inside. Cantilever brackets ensured the longitudinal stiffness of the building. In his criticism, the editor of the "Builder" called it "Brompton Boilers," thus expressing the general lack of enthusiasm on the part of the public about this functional building that was to be a museum. Today, clad behind brickwork, it stands in the London East End as the Bethnal Green Museum.

The eclectic concept of a museum of science using also iron and glass for architectural design purposes is evident from the Oxford University Museum built at the same time. It was designed in 1855-56 by Thomas Deane (1792-1871) and Benjamin Woodward (1815-1861) in cooperation with John Ruskin (1819-1900) as a Gothic monastery arranged around a courtyard covered with glass. The architects made iron obey the rules of the revivalist style of Gothic, and, unlike engineers, they handled a material necessary to solve certain structural problems.

On the basis of the design experience accumulated in building the Crystal Palace and the Museum of Science and Art, despite criticism by the public, which more and more rejected the use of iron for purposes of architectural design, the final decisive step was taken in Britain in the sixties or the 19th century in building multipurpose iron frame structures.

In Glasgow, then the main center of iron trade, a four-story commercial building was erected at the corner of Jermyn Street and Argyle Street in 1855-56, completely unnoticed by contemporary technical publications: Gardner's Building with cast iron facades facing both streets. The outer walls were constructed of brick, but the facades were of cast iron, a characteristic of the "Brompton Boilers." The box-type reinforced girders on which the iron facade was a frame for the design, had acquired patents. They comprised wrought iron columns and forged flat iron bars, allowing relatively wide spans to be designed, compared with American examples of the same period. The "Builder" ignored this building, much in the same way in which it had made fun at the "Brompton Boilers" as examples of structural architecture. The contemporary public in the High Victorian period did not like the impression of lightness, openness, regularity and the precision necessarily going with the use of iron. "Although the iron is for everything, short of strucrures carry courted iron facade, and constantly talked about it, they did not like it." (5)

In Liverpool, another center where iron had been used at a very early stage also for purposes of traditional architecture (let me remind you only of the churches built by Thomas Rickman, St. George's Church, 1813; St. Michael's, 1814; St. Philip's, 1816, whose interior was made all of prefabricated cast iron elements), some glass and iron facades were built in the fifties and sixties. The logical step to the aesthetics
of iron frame structures was taken by the architect Peter Ellis (1804-1884), who remained unknown outside of Liverpool, in two buildings violently criticized, as usual, by the London "Builder", 16th Street, 1864, and 16th Street, 1866. Oriel Chambers, 1864, and 16th Court Street, 1866. Ellis named its to the glazed cast iron oriels suspended between extremely thin stone pillars and extending beyond the floor level. Already the two facades facing the street are remarkably independent solutions to find in a commercial building. Inside, cast iron frames composed of square H-shaped stanchions and girders with the cross sections of an inverted T constitute the load carrying structure. The surprising structural and aesthetic solution which can arise from an open mind working on a problem are visible in the structural and formal solutions found for the facades on the courtyard side. Those were suspended in front of the cast iron stanchions, a-rail curtain wall and the first of which I found. From bottom to top it recedes further at each floor level, thus providing additional lighting through skylights. This constituted an important improvement in lighting conditions in the narrow courtyards. Ellis adopted the same solution for the rear front of the building on 16th Street, which stands in an even narrower courtyard surrounded by buildings all around. The fascinating nature of this instance is especially the spiral staircase of cast iron standing in front of the facade and glazed and clad with iron plates. No other buildings are known for which Ellis had been responsible as an architect. After the bitter reviews in the "Builder" he worked as a civil engineer for another eighteen years.

Peter Ellis's withdrawal is quite illustrative of the change in public taste over to the traditional forms of historic architecture in the sixties of the 19th century. Consequently, it is no surprise that the first truly consistent multiple-story iron frame building of a modern type was not any contemporary influence but was in effect an industrial building, the Boat Store of Sheerness. It reflects design and structural aspects of functional architecture, which have remained within the same building. Through ten years earlier, 1849-50, Jean Bogardus in New York had built a two-story factory out of cast iron elements which, formally, was a building of its time, no precise documents are available about the structural design, for the building was pulled down again as early as in 1859. Also the Crystal Palace in London, which was not a multiple-story frame structure in the modern sense of the term and, without detracting from its importance, formally must also be regarded as being of the 19th century. The Boat Store (6) was built in H.M. dockyards of Sheerness in 1858-1860, seven years after the Crystal Palace. It has been preserved almost intact; the original ribbed hipped roof, the windows and the interior lighting, and lower loads on the foundations, for the building had to be founded on piles. The boat store building is 210 ft. long, 135 ft. wide and has an overall height of 53 ft. The nave, which is a hall lighted from above, is spanned by one traveling crane each at the levels of the three upper stories. In the two-story aisles, four rows of cast iron stanchions spaced 16 ft. apart laterally and 30 ft. apart longitudinally, which were bolted together with cast iron cross beams and riveted wrought iron sheet metal supports in the long direction, constitute the load carrying and, at the same time, rigidifying structure. The stability of the building is ensured solely by the large area connections of the bolts to the building. One condition for this to work is the H-shaped cross section of the stanchions, which have been used already in the Museum of Science and Art and the buildings by Peter Ellis. The design allows the rigid connection of the stanchions to the beam. Each stanchion consists of two parts held together at the level of the second story. The outer, box-shaped corner columns bolted together at four elements to a total height of 40 ft. They carry the parapet elements made of corrugated sheet metal are attached between the stanchions by iron cleats. Three saddle roofs top the space. The trusses, each supporting the 7 ft. external columns of wrought iron, while all elements subjected to compression loads are made of cast iron.

Besides the quality of detail, the factor decisive for the development of framing construction is the design of the rigid connection between the stanchions and the beams, which ensures the stiffness of the building both in the longitudinal and transverse directions. The structural elements employed up to that time had been braces, arched trusses or St. Andrew's crosses. Green's structural and architectural achievements remained almost without any consequences until the nineties of the 19th century. Only when the high rise of the first Chicago School were built, they became the state of the art of frame structures.

The history of the first iron frame structures is also a history of the mounting resistance against iron architecture. However, this affected not only the architecture, but was also directed against railroads, steam engines, technical innovation in general, and new ideas in particular. It was accompanied by a loss of confidence in engineers and by an increasing danger of the position of architects as forces conserving traditional culture. A well-known example is the Great Exhibition of London. The shed, next to New York Central Station the widest spanned railway hall in the world (234 ft.), which had been built by P.W. Harlow (1812-1852) and R.M. Ordish (1824-1896) had been completed in 1851, when the competition was opened for the entrance hall and the hotel. Owen Jones, who had collaborated with Paxton on the Crystal Palace, in his proposal arranged the new buildings in such a way that the front of the huge hall dominated the facade. All other drafts, including that by Gilbert Scott (1811-1878), which was realized in 1853, had been rejected. The Hall, 1851, being only an engineering structure, could not at the same time also be a piece of architecture. Cladding light and transparent iron structures with heavy stone architecture became the common way of combining the functional requirement for wide spans, light rooms and light structures with the pretension at permanent, representative architecture. The lastarchitect, namely assigning to the engineer a clearly defined problem as part of the architect's design, can also be seen in the Royal Albert Hall, a concert hall for 8000 built in London by P. Fowke (1865-86). The spectacular feature of that building is the dome of forged iron topping a hall with an elliptical plan with a span between 185 ft. and 219 ft. Towards the auditorium, it was shielded by a suspended ceiling, thus not influencing space in any way. For its engineering, Harwood had been engaged, the hall of St. Pancras, and J.K. Grover. Fowke's building for the 1852 Great Exhibition in London, a quasi-successor to the Crystal Palace, had been particularly interesting, for it included a material part of the house in front of the building in its material part of the house in front of the building in its
predecessors, this did not contribute to the further advancement of the building problem at hand. The Royal Scottish Museum in Edinburgh, built in 1861, also by Fowler, is an attempt to combine the lightness and brightness of an iron frame structure, such as the Crystal Palace, with solid stone Renaissance style architecture. He wished to influence the form of building construction finally also had an impact on representative engineering structures. R.M. Ordish adapted Albert Bridge across the River Thames, built in London 1873 as one of the first cable-stayed bridges, to the Gothic style concepts of his period. When awarding the contract for construction of Liverpool Street Station in London, 1875, the railway company placing the contract expected the engineer, E. Wilson (1820-1877), to assign a churchlike character to the station. Certainly the most famous example of this development is Tower Bridge, 1886-1894. The engineer J.W. Barry (1836-1916) and the architect H. Jones (1819-1887) are the creators of this famous symbol of London. Jones was knighted for his design. The towers of the mediaeval drawing bridge are the seats for the solidified suspended frame structure of the two side arms. The hydraulic system of the movable back elements is enclosed in the foundations of the towers.

The development I sketched for the period of time mentioned above is particularly true of London and the cultural centers in Britain. Yet, functional buildings in the best tradition of the early Victorian period continued to be built right into the nineties: shelters, such as Piccadilly Station in Manchester, 1862; Temple Meads Station in Bristol, 1875; Queen Street Station in Glasgow, 1880. Brighton Station, 1881, and the last of its kind, the shelter of Darlington, Bank Top Station, 1887. Market halls were built in Derby, 1866, Carlisle, 1869, Halifax, 1895; to mention just a few.

Bridges, such as the Royal Albert Bridge near Saltash, 1859, near Cambus O\'May, 1903, and the greatest achievement in engineering since the construction of Britannia tubular bridge forty years earlier: the Firth of Forth railway bridge built by J. Fowler and B. Baker in 1890. It marks a final culminating point in British engineering construction. Like R. Stephenson, who had introduced the use of wrought iron in large structures in Britannia Bridge, Baker for the first time used steel, which was more than fifty percent stronger, for a bridge of this size. In 1851, the Crystal Palace had met with the greatest approval everywhere. One generation later, Baker had to defend the Firth of Forth railway bridge against the most violent attacks. William Morris called it "the supreme specimen of all ugliness." (7) He was concerned about the radical interference with the environment by the structure, which was two and a half kilometers long, which could not be designed to any subjective form because of the inherent structural laws that determined its shape. Baker replied that the beauty of a wide spanned bridge could not be compared to that of a silver chimney ornament. One had to understand the functions of its elements to be able to judge it.

Buildings in Britain in the 19th century are characterized by a style facing backward and, at the same time, by openness in developing contemporary architecture in the light of a building problem, structural design and material. That this is also very true of the 20th century is borne out by the most recent trends in modern architecture.

Historicism cannot be restricted to the 19th century. As functional building cannot be regarded as an invention only of the Bauhaus.

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