Architectural Styles and Industrial Buildings

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The first industrial buildings, grim and straightforward as they were, would apparently not qualify as architecture if one adopted the notion that "architecture is the play of light and shade". However, if functionalism is architecture and it is within total architectural integrity for the form to follow function, then these same buildings, flat-faced and monotonous though they may occasionally be, rate highly as architectural accomplishments.

"Industrial buildings have never fitted easily into the history of architecture, a history which so often seems to revolve around great houses and churches". (1) The industrial building, whenever it may have been first erected, wherever and in whatever form, came into being to serve a purpose; that of enveloping the machine and equipment, labour and materials, and the services of the function of production and manufacture. Thus, industrial buildings have always been functional, although the stylistic facades did not bear this message initially and for a long time into the history of Industrial buildings. Over the years efficiency has increased manyfolds, due largely to monumental changes in available building material, appliances and services, and technologically advanced construction methods; and facades, too, have given in to express the changes. A building, industrial or otherwise, is functional when it is constructed primarily with regard to practical necessities rather than to aesthetic considerations. Industrial buildings (factories, warehouses, mills, etc.) have never been anything short of functional for obvious reasons. However, traditional aesthetic styles, despite activities within being quite to the contrary, have often adorned facades of industrial buildings since the earliest days. Like all other building

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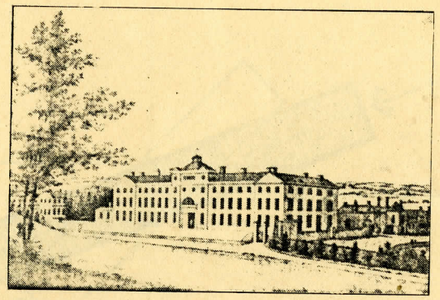

Figure 1. The Soho Manufactury, 1764-66

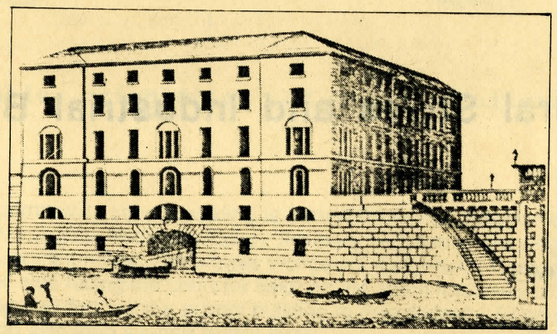

Figure 2. Albion Mill, London, 1783-86

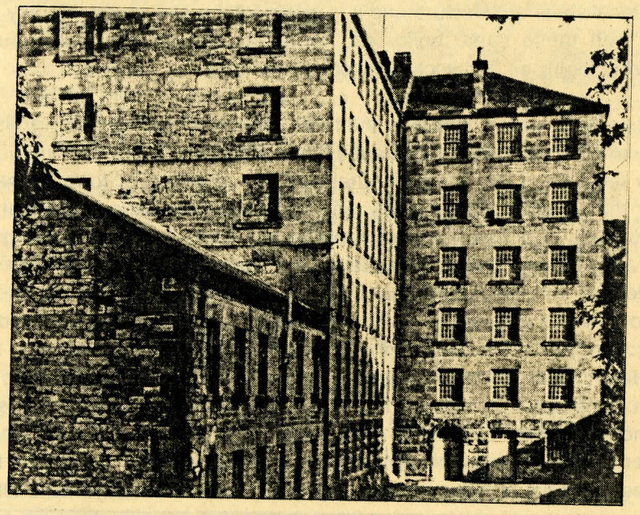

Figure 3. Calver Mill, Curbar, Derbyshire, 1785

types, it took industrial buildings decades to shake off the traditional styles in terms of outward appearances. Although the first industries date back hundreds of years, the expression of the activities inside the buildings on the facade is a feature very much of the present century.

Functionalism and architecture are inseparable since buildings are always erected to fulfill a need. Every building has a particular function or several functions to fufill. In terms of industrial buildings, a warehouse complies the function of storage whereas a factory may have to satisfy a chain of functions. It has been said that recent functional architecture may be traced back, through various architects in Britain's manufacturing areas, to an earlier tradition in which a powerful emphasis on utility arose from the needs of the so-called Industrial Revolution. The argument involved linking together the warehouses, mills,breweries, sheds and bridges erected in the period 1760-1840 and suggesting that functional building did not have its origins in the modern era, but was critically associated with industrialization. (2)

Ancient buildings derive their peculiar charactor not only from the way the challenge of function is met by logical and economical use of materials and technology, but also from the aesthetic ideals of the times. In effect, the character of today's buildings is similarly moulded, but it owes much to the fact that architects have accepted "the principle that the process of designing a building begins with a close analysis of the needs it is to serve". (3) The objective is to fullfill such needs economically and logically. The emphasis is now on the basic geometry of architecture rather than historical styles. In fact, the modernisation of architecture began with building facades expressing truthfully the qualities of the materials and the strength of the constructional techniques employed. Expression was further extended to the quality and character of the space within the building. Thus, the space no longer hid behind the decorative shell or the two-dimensional facades of the historical sytles. Soon the space and the elements which contained it became parts of one entity- -architecture.

The change from historical styles to the styles of structural and functional clarity has also meant a change in the role of the architect. From the role of a mere decorator of non-functional elements, limited to designing the facade of the factory in masonry or brickwork, the architect today plays a pivotal role of executing and supervising the design and construction of a building in all its many aspects.

Previously the engineer held the initiative in the design of industrial buildings. Since the engineer was the designer of the machine and equipment, it was assumed that he knew of how best to enclose them. The engineer's knowledge of new structural materials and construction methods put the architect at a disadvantage. However, as expression of materials, technology and purpose, utility of space, planning, organisation and management and such other aspects which are in the architectural domain became increasingly important, the initiative gradually shifted to the architect. The architect today deals with the engineers on their technical ground, assumes leadership of a group of specialist consultants, co-ordinates their skill and experience to give service to clients, advise clients on new developments and on technical aspects.(4)

The early industrial buildings were eclectic versions of the Greek, Italian, Gothic, Georgian or some other style. Functional expression was almost always compromised to accommodate

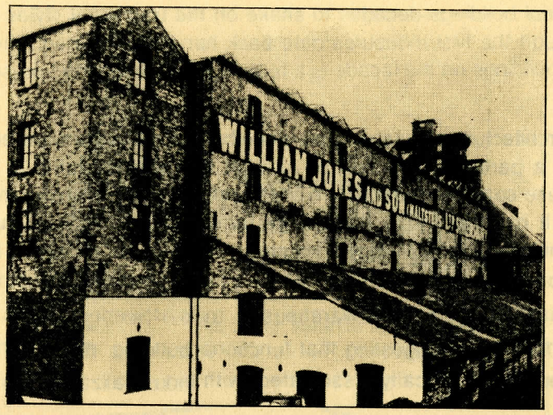

Figure .4 . Benyon, Marshall and Bage Flax Mill, Shrewsbury, 1797

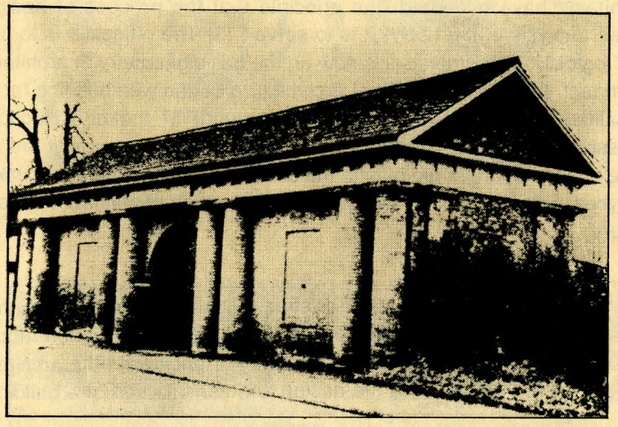

Figure .5 . Brick-built barn, Solihull, 1798

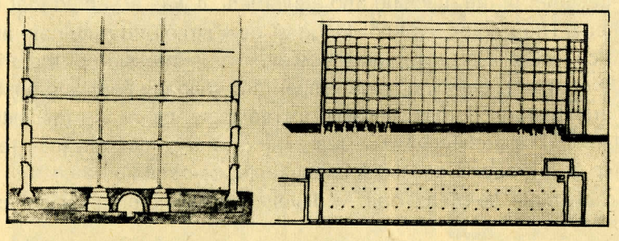

Figure .6 . Plan and section of Boulton and Watt's seven-storied mill, Salford, 1801

decorative motifs and styles. The predominant architectural style in the 17th and 18th centuries was Palladian. Based largely on the buildings of Andrea Palladio (1508-80) in Italy and those of Inigo Jones (1573-1652) in England, the Palladian principle was "effectively applied" to working buildings such as Samuel Wyatt's pitched-roof multi-storied Albion Mill, Southwark, London. (1783-86). (5) Built of brick external walls, timber posts and floors, it was destroyed by fire in 1791.

Richard Arkwright, who went to great lengths to protect the patents of his spinning machines, built the original building of the Masson Mill at Matlock Bath in the English Midlands in 1783. The buildings exemplifies the "immensity of eighteenth century ambition and its hard character". (6) A water mill, dominating the river valley, the building (which exists even today) is a strange layer cake of Venetian windows, bracketted between the larger subsequent wings of red brick.

In 1798 Sir John Soane, the architect of the original Bank of England, designed a brick barn at Solihull, Warwickshire, based on the Greek order. The longer elevation was comprised of four sets of detached double columns standing before windowless walls and supporting a triglyph frieze under a wide-eaved, low-pitched slate-covered, gable-ended roof. A central arched doorway on the longer elevation further pronounced the solidity of the facades. The design was in no way related to any previous farm building. The gatehouse and bridge also had Doric columns. (7)

Engineers' designs were rigidly Georgian or uncompromisingly functional. However, several engineers showed aesthetic sense; for example, John Rennie, who designed the Waterloo Bridge in London. Engineers were in great demand as designers of buildings because they provided the steam engines and machinery. They knew how to provide the structure which supported the long runs of machines, floor by floor, and the brick and masonry walls and timber roofs which enclosed them. The detailed aesthetic treatment was supplied by carpenters and masons who had the experience in classical design. As a matter of fact, during the 18th and 19th centuries; the creative minds were the mill engineers, who, "unhampered by architectural conventions invented metal skeleton construction and the all-glass wall, pioneered artificial heating and lighting, giving us the technological and aesthetic base for the architecture of our own day".(8)

The early 19th century was the age of the polymath virtuoso engineer, of Telford, Rennie, Fairbairn, Paine, the Jessops, the Brunels and the Stephensons. In no other period of English history were there so many engineers in practice whose names are still recognized. (9)

"In the design of industrial buildings, as in the 18th century, it was unusual to involve a major architect--- or even any kind of architect--- unless there was a need for prestige, or for a treatment of special environmental sensitivity" to make the buildings acceptable. Buildings housing industries were functional and rational in design. The element of prestige was sometimes included to impress visitors, client and customers and also to "inculcate in the employee a sense of corporate pride". (10)

The reforming measures and Acts of the early 19th century provided new oppurtunities for the architects, whose role, otherwise, was limited to providing the decorative shell to the more serious pursuits within. The role of the architect became more important because the socially

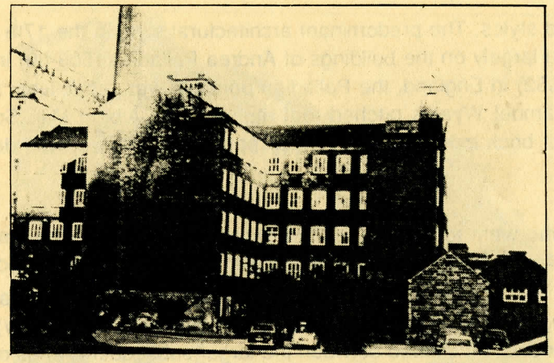

Figure 7. William Strutt's North Mill, Belper, 1803

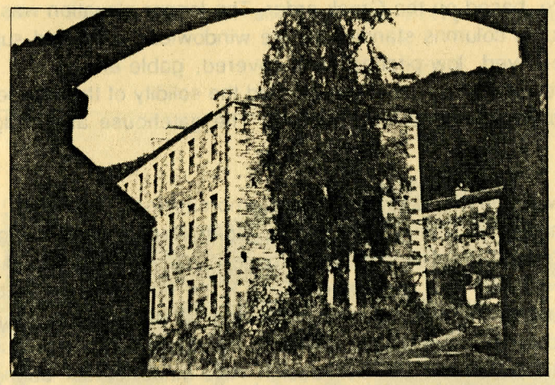

Figure 8. Robert Owen's Housing for workers at New Lanark, Scotland, 1785-1810

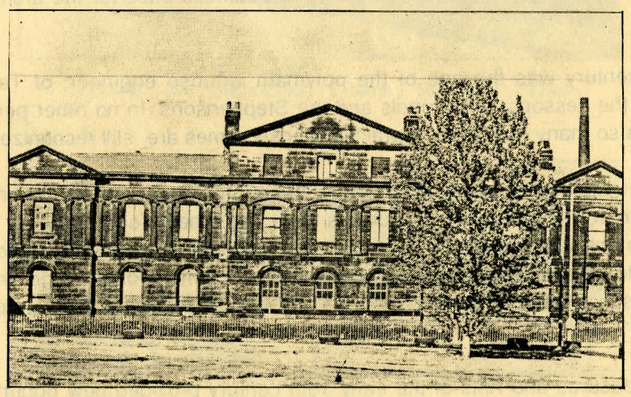

Figure 9. The Globe Works, Sheffield, 1825

ambitious owners found it a matter of prestige to own well-designed buildings and because there was a growing feeling that good conditions inside the factories, when provided, required a decent expression outside.

The socially conscious amongst the businessmen considered it their prestigious responsibility as builders in the new era to maintain the aesthetic ideal of the times and to contribute positively to the environment and the landscape. The earliest signs of architectural impact on industrial buildings can be seen in the Stanley Mill at Stonehouse in the West Country, England, built it 1813. Here, although the classical masonry arches with keystones form the base of the grand building, the structure is expressed with stone plasters dividing brick walls into structural bays. (11) The Kingston Mill, Bradford-on-Avon, England, built five years earlier, exhibited segmental arches showing a development from the four centered Tudor Arch towards a more structurally correct solution.

Industrial buildings of significant architectural interest were being built at a slow but steady rate. In about 1835 a warehouse at New Quay, Liverpool was composed of a series of identical bays in brickwork. The building was 21.34M high and the effect was dominantly columnar. The significance of the building can be understood even more when it is realized that, even in later years, particularly the 20 years from 1841, factory buildings showed a deliberate inclination towards domestic precedents.

James Bogardus (USA) built a cast iron factory in New York, 1848. Prefabricated cast iron components replaced masonry even in the outside wall which obtained a high degree of transparancy. In English factories at that time (mid 19th) and from the begining of 19th century, the load bearing structure consisted of cast iron piers and beams with external walls of masonry. James Bogardus's cast iron factory is the precursor of skeleton frame consturction and of Chicago school.

Architecture during this period was immersed in the study of the traditional styles, as expressed through decoration. Buildings for factories continued to be greatly influenced by Georgian, Greek, Gothic, French and Italian styles. The Saltaire Project (1850-53) at Bradford, England, designed by architect Henry F. Lockwood and William Mawson, borrowed the Italian style to glorify the main features. Saltaire was "Plagiarism tinctured with originality", as were indeed a whole range of buildings of the sixties and seventies. (12)

Few of the buildings designed in the early 19th century have survived the fire, redevelopment or the change in taste. The surviving few illustrate the similarity and solidity of Victorian functional architecture at its best. These buildings were considered dull and plain by the Victorians and when money was available latter Victorian industrialists did not hesitate to adorn their premises with ornate and romantic facades. In 1838-40, John Marshall commissioned the architect Joseph Banomi to design a neo-Egyptian elevation for the main facade, complete. The Egyptian influence was not surprising because Banomi had spent ten years in the land of the pyramids. (14)

An example of the Greek revival filtering into industrial architecture may be identified in the Globe Works, Green Lane, Sheffield, built in 1825 ---" a dignified classical monument". (15)

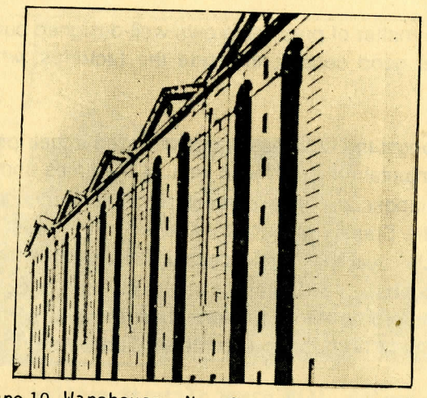

Figure 10 Warehouse, New Quay, Liverpool, 1835

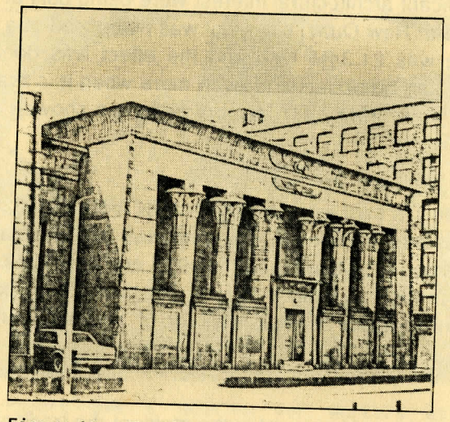

Figure 11. .Temple Mills,Leeds, 18838-40

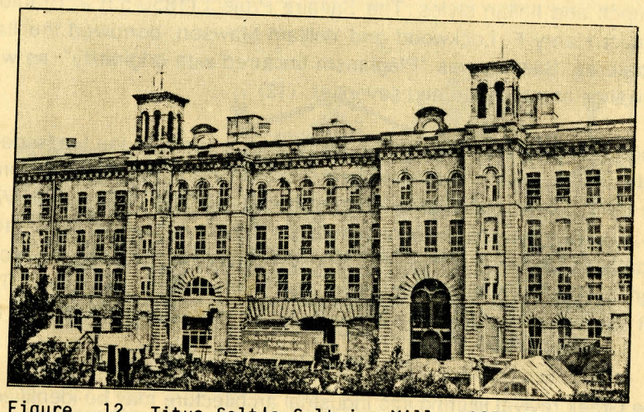

Figure .12 . Titus Salt's Saltaire Mills, 1851-53

Gothic style was rarely adopted in the 18th and even early in the 19th century. Gothic, particularly suited to irregular and intricate compositions, did not attract designers whose requirements at this stage was satisfied by a box-like structure of regular dimensions. However, by the mid-19th century, Gothic motifs were being increasingly employed in industrial buildings. Doge's Palace in Venice, after which was modelled Alfred Waterhouse's warehouse for Fryer and Binyon, was also inspirational in the design of James Templeton and Company's carpet factory, overlooking Glasgow Green, in brightly coloured brick. (16) The popularity of Gothic is also exemplified by laver and Barrand's painted Glass Manufactory (1859-60), London, designed by Robert J. Withers; and also E.W. Godwin's carriage factory (1862) at Bristol. These were examples in High Victorian Gothic. Nevertheless, Gothic never achieved the same popularity as Italianate for mills and warehouses. (17)

Voilet-le-Duc, in his lectures on architecture published in 1881 said of the continual playing with past styles "If we will consent to regard the works of the past as belonging to the past, as steps by which we must pass if we would attain to the knowledge of what is appropriate to our social conditions; if we proceed by way of analysis, and not by that of unreflecting imitation --we shall have opened the way and shall ourselves be able to pursue it". (18) Le Duc's statement may have fallen on deaf ears. Architects continued to pursue old styles so much so that they ignored the organisational aspects of the building which lay behind their flamboyant facades.

By 1860, the "Battle of the Styles" was well under way. Between Gothic and Classical, there was a constant search for a style which would meet the functional and aesthetic requirements of the times, particularly in view of the tremendous and unprecedented technical progress taking place. Architecture was still immersed in furnishing and decorative facade and gave little thought to the internal functions of factories. Indeed, it rarely found opportunities to do so. All that seemed necessary was a covered space with walls, floor and a roof for the machinery to be accommodated and for the work of manufacture to proceed.

While architects and artists tried to ignore the "loathsome nightmare" (19) that was the Industrial Revolution, a non-architect and a non-engineer by the name of Joseph Paxton had created a hall for the Great Exhibition of 1851 in Hyde Park (England) that was to be later considered a "monument to progress in building technology."(20) The Crystal Palace reflects not so much the period in which it was built, but rather an aesthetic and point of view that shares elements in common with its immediate past (the first, Romantic Classic Phase of modern architecture) and of the future (in the more frankly modernistic architecture of the 20th century) (21).

Between 1861-80 the Renaissance style often dominated the features of mills and factories but the homes were adorned by Gothic attributes. Other styles were also in vogue. "Tudor mansions were often raised on the demolished remains of the fine Georgian country houses, manors and farm buildings." (22)

In 1894, Thomas Harris, in his book "Three Periods of English Architecture", said that, contrary to keeping abreast of the times, architects were adopting foreign styles of the past. Harris was convinced that a new style must grow by taking into consideration the new construction. (23).

The design of many warehouses built during the last two decades of the 19th century was approaching eclecticism, with both styles and detail inextricably mixed. Some designs were mere street frontage, marking storage spaces for goods. The architects of the Soho Wharf near

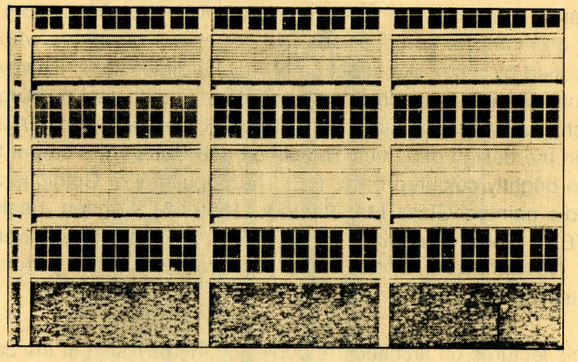

Figure 13 . Sheerness' Boathouse, 1858-60

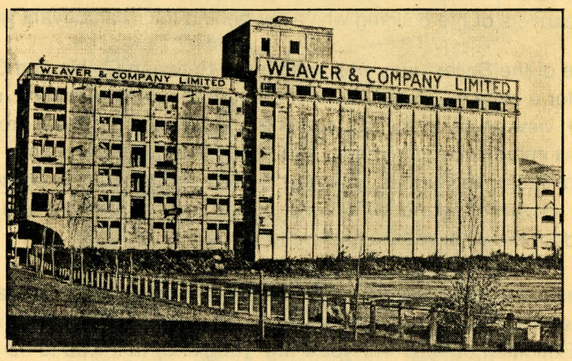

Figure 14 . Britain's first reinforced concrete building: Swansea, 1897-98

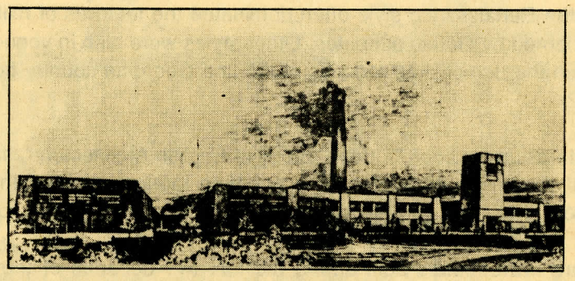

Figure 15 . Engineering Works, Queensferry, Chester, 1901

Westminster Bridge, London, built in 1884, gave enough evidence to show that their work was inspired by Venetian designs, whereas the warehouse at Bloomsbury, built in the same year and designed by Joseph Peacock, showed "simple but frank treatment of the main elements of constructive strength (24). Also in the same year, a warehouse in Star Yard, Carey Street, London desinged by W.F. Unsworth, achieved an exrtremely rich effect by the sensitive use of traceried panels in brickwork in line with the existing fashion in England. The trend was to follow the Belgian late Gothic, with a high gabled front.

Factories and warehouses towards the end of the 19th century showed little sign that their aesthetic apprearance followed naturally from the purposes of these buildings. There was, however, a growing sensitiveness to the demands of function. The techniques of functional planning, later so fundamentally to affect the form of industrial buildings, were beginning to be developed seriously. Concrete remained in the shadows of traditional building materials and was rarely recognised as a major building material by architects. The French used it but scarcely ventured to give any expression to it; it was used as a substitute and accordingly adopted to conventional architectural forms. The philosophical battle between science and art was one of the bitterest controversies of the 19th century and architecture, which evolved as a result of the fusion of both aesthetic and engineering skill attracted much of the fightings. (25)

The period of Edwardian industrial architecture (1900-1914) saw the rejection of "the popular and widely applied Gothic in favour of a host of styles, including a return to classical models. Wrought-iron, cast-iron, bricks and timber were gradually replaced by steel and reinforced concrete". (26)

During the years leading to the outbreak of the First World War, architects were still not involved to a larger extent in the design of industrial buildings. Clients were often of the opinion that employing architects served to increase the cost of such buildings. (27) Although the theory, "form follows function" was being acknowledged with much respect, the resulting functionalism was securely tied, with few exceptions, to the stylistic tradition. However, more attention was now being given to faotory plans, and stylistic influences were gradually dying out, "to be replaced be functional influences which were beginning to inform the entire architectural field."

Early in the 20th century the Americans were experimenting with dynamic proposals, many in concrete, but the past styles lingered on. The French and the Belgians were pursuing "art nouveau". The use of traditional bricks in modern form began in Amsterdam but was perfected in Germany. While such rapid and dynamic progress was being made elsewhere "laissez-faire" overtook Britain.

Even at a time when Frank Lloyd Wright introduced "Usonian" architecture using concrete with traditional materials and welcoming the landscape into the house; and when Irving Gill marked the introduction of "cubism" to the States via a house in Los Angeles in 1915, the past continued to creep in. For example, Cram and Ferguson's Gothic-bias in the Canterburian Tower in 1913 at Princeton University. The New York Grand Central Station built in 1903-13, was distinctly Roman Renaissance. (28)

Peter Behrens, architect to the GEC in Berlin, made a positive contribution to industrial architecture in particular and modern architecture in general, relying as he did upon the earlier

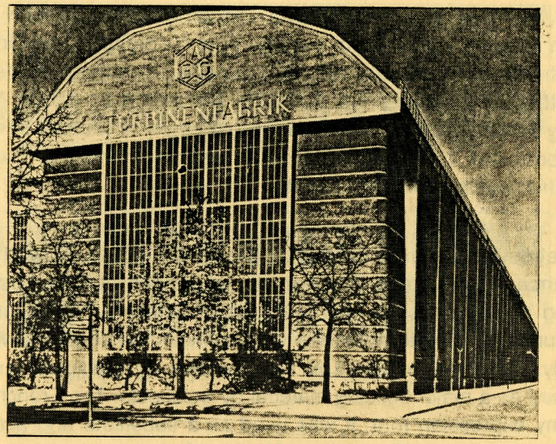

Figure 16 . Behrens' A.E.G. Turbine Factory, Moabit, Berlin, 1909

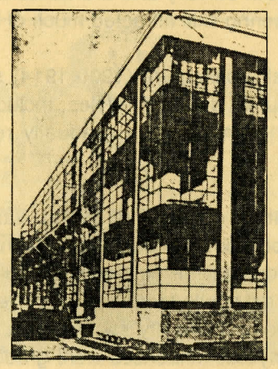

Figure 17 . Gropius and Meyer's Fagus Factory, Alfeld-on-der Leine, 1912

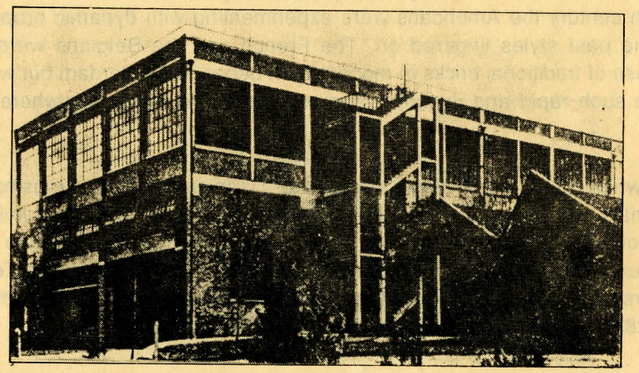

Figure 18 . Factory, Watford, 1921

works of engineers in cast-iron and glass. His turbine factory for AEG in North Berlin erected in 1909, was a huge steel-framed structure, with masonry-enclosed corners and glass infilling giving a tremendous feeling of space. (29) In the word of Behrens himself: (30)

> "All forms of sculptural and ornamental decoration were omitted, firstly because the function of a factory building demands simplicity of form, but more especially because the desired impression of solidity, and the proportions contributing to this impression, could only have been diminished rather than enhanced by it."

Hans Poelzig, in designing a chemical factory at Lubeck in 1911, clearly expressed the structure of the building. Walter Gropius, who earlier worked with Peter Behrens, designed in 1912 the Fagus Shoelace Factory at Alfeld a.d. Leine. The trend of expressing the structure and the materials was in vogue and the work of Gropius was fashionable. The Fagus factory boasted uncluttered orderliness in massing and quality detail. The ingenuity of Gropius' Fagus factory was the "unity between architectural form and structural techniques". H.B. Cresswell's Willens and Robinson's Ferry Engineering Works at Queensferry, Chester in 1901, was an outstanding contribution to industrial design because it gave a certain amount of character to the building in a manner naturally arising out of structure, and without any introduction of superfluous and unmeaning ornament. (31)

The stylistic confusion of the 19th century was even more inappropriate in industrial buildings than that found in churches, banks and office buildings. Architects realized this but did not achieve satisfactory results until the demands of welfare, building legislation and the mechanics of modernisation began to shape forms.

It was evident that a new age was gradually emerging and this was none the more expressive then in industrial buildings which were being erected to meet the demands of a bigger population, now exposed to new products as a result of changing times. Le Corbusier, in his book "Vers Une Architecture" declared in 1923." Thus we have the American grain elevators and factories, the magnificent first fruits of the new age. The American engineers overwhelm with their calculations our expiring architecture."

By the 1920s it was clear that architects were keen to express reinforced concrete, externally. Frank Lloyd Wright's Larkin building, Buffalo, N.Y. 1906, cast its influence to the design of the Witton Engineering Works, near Birmingham, with its bias towards external expression of the new material. The mammoth building, with the shorter street facade about 140m long, was monumentally treated. Massive doorways, crowned by cornices, were flanked by stout square piers. The voluminous staircase pronounced at the corner was lit by a window extending its whole height.

Despite the fact that the Industrial Revolution was staged in England, it was Germany which took the leadership in the application of architecture to industry. Walter Gropius founded the Bauhaus in 1919, which aimed at bringing together art and industry. Le Corbusier who designed only one industrial building, was another architect important to industry . He attended the Deutscher Werkbund, 1911-12, which was founded by Hermann Muthesius in 1907. The Werkbund emphasised on the economic aspect of design. Later Corbusier joined the Bauhaus band. Corbusier worked towards standardization and, therefore, virtually the industrialisation of architecture. He developed a theory of aesthetics based on the iconoclasm in art which led to

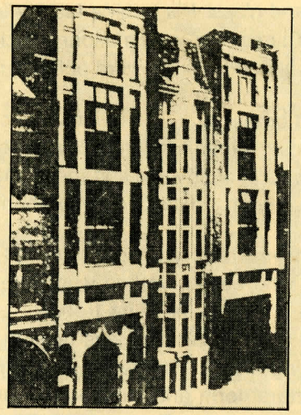

Figure 19 . Warehouse, Leicester, 1923

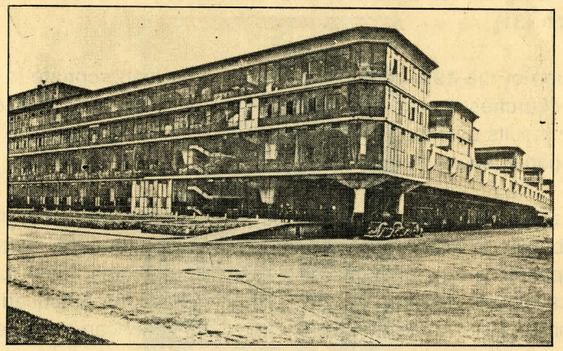

Figure 20 . Owen Williams' Factory for Boots, Nottingham, 1930-32

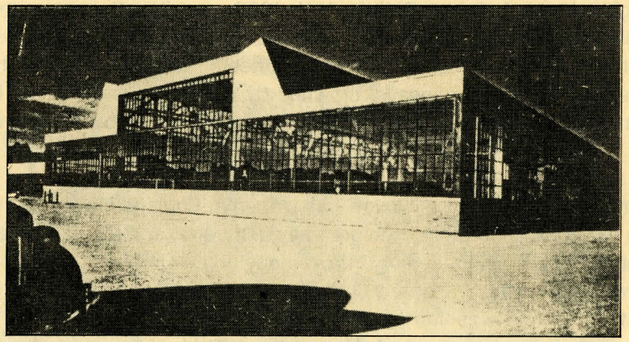

Figure 21 . The Export Building, Chrysler, Detroit, shows the characteristic Kahn roof profile

cubism. Most factory builders endow their building with a sense of meanness and economy, but in the Claude et Duval Factory in St. Die, completed in 1951, Corbusier has imparted his own belief in the nobility of work.

The influence of cubism coincided with the evolution and increase in use of concrete. Many architects, some of whom were artists first, went to the extent of imitating reinforced concrete by plastering brickwork and then painting it white. The importance of concrete was further increased when regulations required that steel used as the skeleton form of a multi-story building "must be protected from its tendency to twist and buckle if attacked by fire". Only in single -storey buildings could architects express the "T," "H" and "I" sections of steel in all its beautiful nakedness. (32) Glass was another material which contributed to the new modern look as was illustrated initially by the Crystal Palace. Later architects employed glazing not only to allow daylight and prevent wind and rain, but also to clearly pronouce the structure.

Engineer Owen Williams, a leading exponent of expressionism, (33) made an outstanding contribution to architecture. He deserves a mention in any discussion of industrial architecture becuase of the merit of one building, his most outstanding work, the Boots Factory at Beeston, Nottingham, built in 1932. In rationally approaching the problem, Williams ignored all building and planning precedents. Built of reinforced concrete and glass, the building, according to the Architects Journal (3 Aug 1932), was "a new species of factory design" because of the "sanity with which these two materials are used and the simplicity, even nakedness, of the design". (34)

During the War, factories in Britain were usually light steel structures covered with asbestos-cement cladding and topped with north-light roofs. In America, the war-time blackout gave a great boost to windowless factories, but twenty years later, although mechanical ventilation and lighting had become the norm, windows were reintroduced because people find it pleasant to look out. Until the end of the 1950s factories with short spans (less than 10m) and pitched roofs (lower than 4m) provided minimal enclosures for simple production equipment. Following the World War II, two major factors influencing factory design were : 1. Providing flexible space for optimising production layout and flow of materials and 2. speed of construction at low cost.

The Americans in the 1950s and 60s had adopted deep plans and air-conditioned windowless spaces for factories. But, in Britain the need for low cost meant that flexibility of the structure was never achieved, the two influences being mutually conflicting. It was in the 1960s that windowless, air-conditioned factories were introduced in Europe. But, the monitor roof, designed to allow a controlled amount of sunlight to do away with the shadow behind the machinery, was favoured for deep plan, air-conditioned spaces. Some factories were purpose- built to suit a particular process, later proving unsuitable for other types of production.

The OPEC crisis of 1973 has been the most important recent influence on industries, stimulating designers towards energy conservation. Long-term industrial disputes have also had an influence on the trend of industrial growth. Moreover, there has been growing evidence that both improved productivity and labour relations result from care taken in the design of the workplace.

The industrial building has come a long way since its humble beginnings. Its journey from cottage industry to the technologically- advanced units of the day is in essence a testimony to necessity and the ability to adopt to changing sources of power, machinery, building materials and methods of construction. Industrial buildings have broken away from meaningless imitation

of fragments of the past to have an expresssion which in uniquely "Industrial"

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