

WASC 706

On Her Majesty's Service

WASC 706

CODE No. 27-31

WASC 70

A BODLEY HEAD ARCHAEOLOGY

The Archaeology of Industry

KENNETH HUDSON

Drawings by
PIPPA BRAND

BRITISH LIBRARY
LENDING DIVISION
-2 JUN 1976
76/26393

THE BODLEY HEAD · London Sydney Toronto

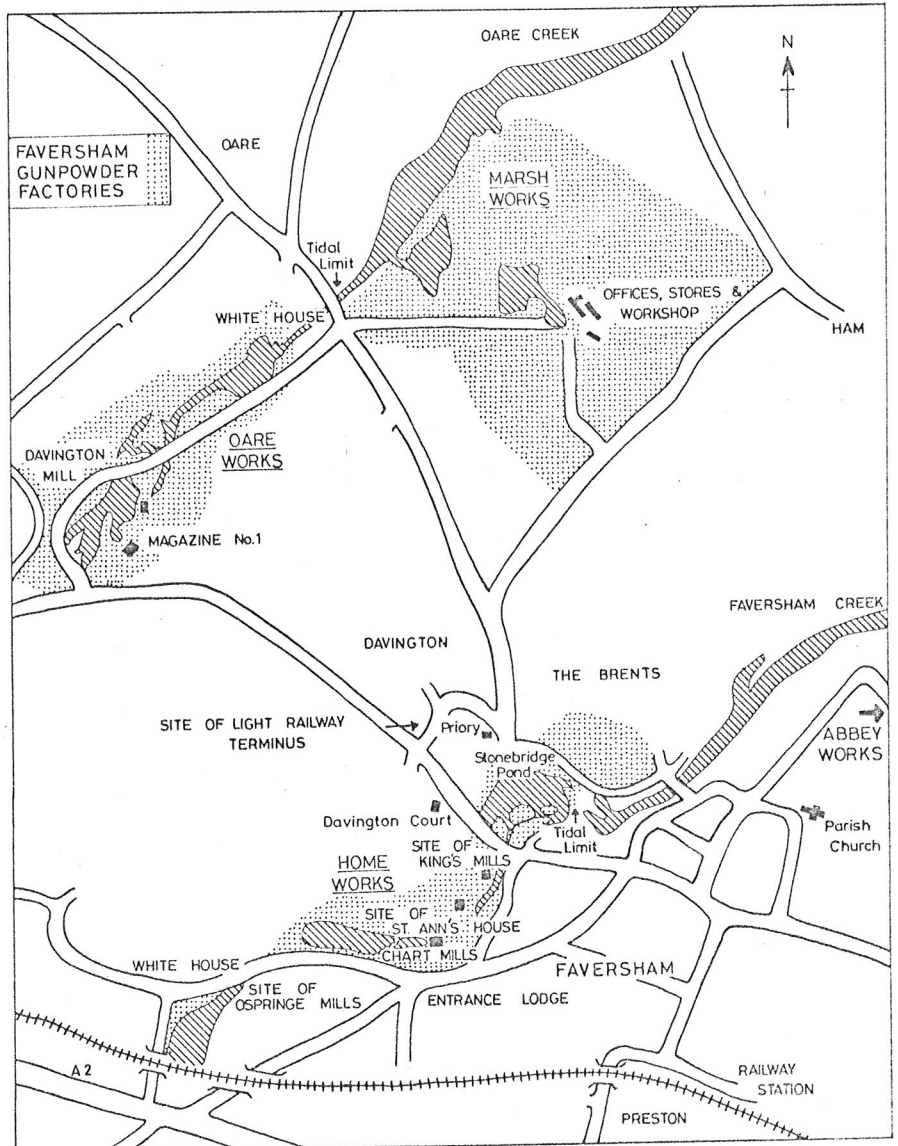
3

Factories and Mills

Three things can happen to an old factory, once its owners decide to take a careful look at it in order to assess if it is earning its keep. It can be modernised, possibly structurally, and certainly with new machinery. It can be made over to some completely different use. Or it can be closed completely, and either demolished or allowed to tumble down. In this chapter we shall be looking at examples of each of these possibilities, bearing in mind that certain kinds of structure are more likely to be fortunate than others. An old gasworks, for instance, is an old gasworks, and it is extremely difficult to think of any other use for it. A bridge is a bridge. And a gunpowder works is a gunpowder works, built in a particular way to meet a particular need; once it ceases to make what it was designed to make, the only answer would seem to be to pull it down. If anything of it should eventually happen to be preserved, we can count that something of an archaeological miracle.

Such a miracle occurred at Faversham, in Kent. Faversham has a good claim to be the birthplace of the British gunpowder industry. The first factory here started operating at some time before 1558. Before that time England imported all her gunpowder from the Continent. The choice of Faversham was not accidental. To begin with, a Tudor gunpowder factory had to be in the South of England, where the royal arsenals and dockyards were. If it had been in the North or the Midlands, transport costs would have been prohibitive. Then there was the question of raw materials. Gunpowder has three ingredients; saltpetre, sulphur and charcoal. Saltpetre came mostly from Italy and India, and sulphur from Italy, so it was essential, given the conditions of road transport in the sixteenth century, that

FACTORIES AND MILLS



The remains of the Faversham Gunpowder Factory today.

the works should be near a port. It took two tons of wood to make enough charcoal for one ton of gunpowder, so it was very desirable that the factory should be close to suitable woodlands. Faversham met all the requirements.

The original works, later known as the Home Works, was established on what is now known as St Ann's Estate. Soon afterwards another works, the Oare Works, was set up by the side of the Home Works, and both continued to prosper, under several changes of ownership, until 1760, when the Government decided to have a gunpowder factory of its own instead of relying entirely on private

FACTORIES AND MILLS

suppliers. The Home Works at Faversham was taken over as the Royal Gunpowder Factory in that year and a large programme of extensions and improvements was begun.

Among the improvements were measures for limiting the effects of blast should an explosion occur. The early manufacturing techniques had been primitive, using first a pestle and mortar to mix the powder and then stamp-mills, in which the mixture was pounded by mechanical hammers driven by horse- or water-power. This hammering was particularly likely to cause explosions. There was a very bad one in 1724, described by Daniel Defoe: 'The blast was not only frightful,' he wrote, 'but it shatter'd the whole town, broke the windows, blew down chimneys, and gable-ends not a few; also several people were killed at the powder-house itself, tho' not any, as I remember, in the town.' The use of stamp-mills was finally forbidden by Act of Parliament in 1772, but for many years before that the larger mills, such as Faversham, had been using what were known as edge-runner mills, in which heavy stones rolled round over the powder, which was placed in a circular stone trough.

In an attempt to contain the force of an explosion, eighteenth-century gunpowder works built thick walls in strategic positions and planted belts of trees which would eventually have the same effect. Today, these trees—or those which have survived—are in their prime, and at Faversham the magnificent cedar, oak, ash and beech trees, which were originally thought of as a safety precaution, are now, with the factories long closed, an important part of the amenities of the district. But the authorities at the Royal Gunpowder Factory did not rely on trees, walls and edge-runners alone to protect the works and the locality from disaster. A set of rules, issued in 1785, were the model for all future rule-books in the industry. The aim was to do everything possible to prevent a spark from occurring, and to this end all the machinery and even the hinges on the doors were to be kept well oiled, workmen were forbidden to wear their own shoes on the premises, barrels had to be brushed to make sure no grit was on them, the ground over which the powder-carts ran had to be covered with brick rubble, to prevent possible danger from flints, and the metalwork on wheelbarrows had to be of copper, not iron.

After the Napoleonic Wars the works went back to private ownership, and from then until 1934, when production finally came to an end, there were several interesting innovations—gun-cotton in 1846 (Faversham had the first gun-cotton factory in the world); pellets in

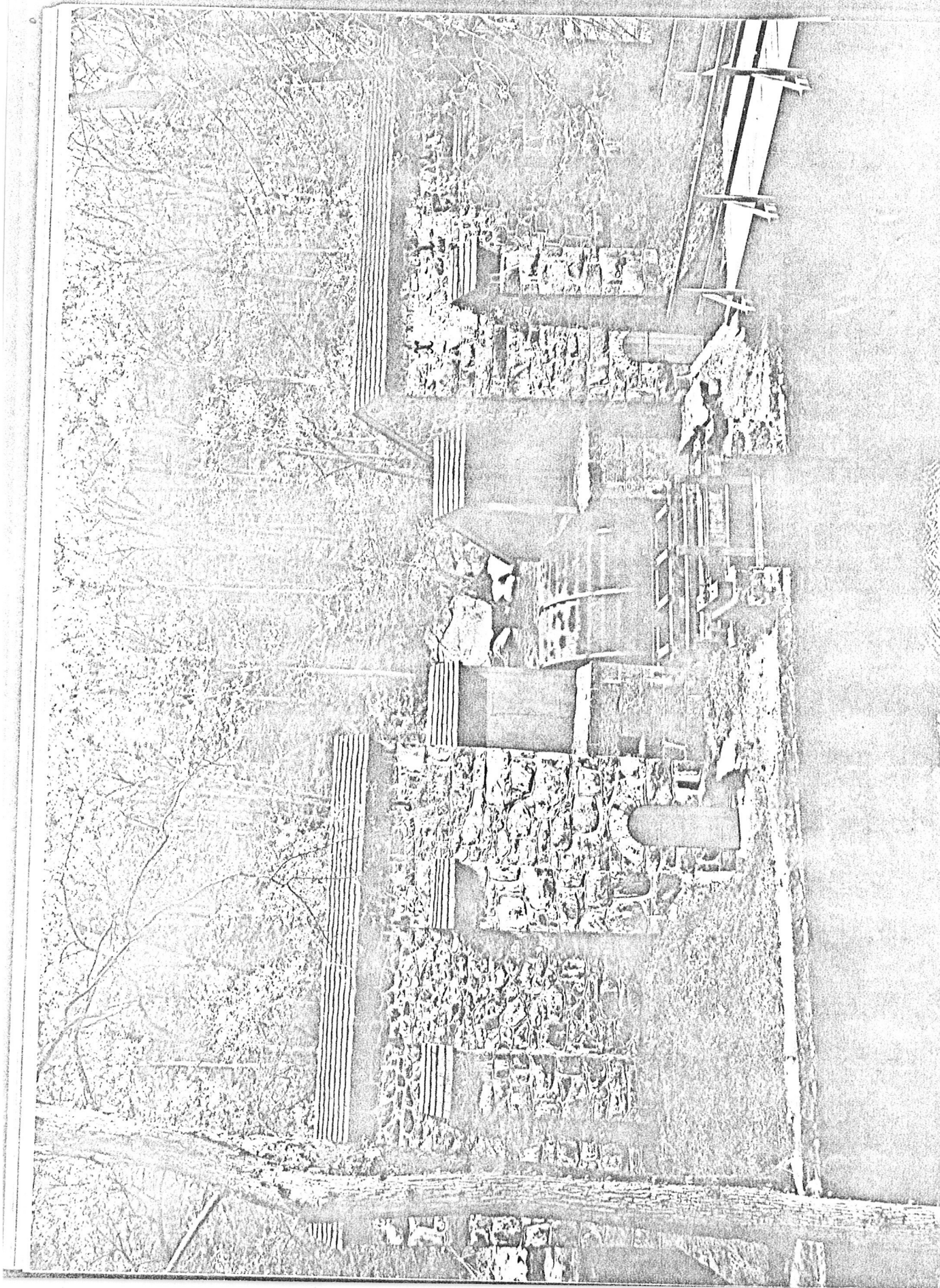
FACTORIES AND MILLS



Volunteers excavating
Chart Gunpowder
Mills, Home Works,
Faversham.

1876; nitro-glycerine in 1892; cordite in 1892. But despite strict precautions, including the placing of buildings at some distance from one another and the building of protective mounds of earth between them, there were also some terrible accidents, including a particularly bad one in 1916 when over one hundred people lost their lives in a TNT explosion.

Most of the factory buildings have now disappeared, but as a result of planned demolition, not accidental explosions. Gravel working has obliterated some of the sites, although a number of the eighteenth-century houses survive. The most important remains are at Chart Mills, in the heart of the old Royal Factory complex. Here, in the middle of a modern housing estate, are four mills where the mixture was ground, the only examples left in Britain. When reconstruction began in the 1960s, three of the mills had lost most of their equipment, but the fourth was almost complete, looking very much as it did in the eighteenth century, with its waterwheel and its massive machinery. The very active Faversham Society has restored



FACTORIES AND MILLS

the whole group, the aim being 'to recreate the mills authentically in their setting, giving the impression not of a lifeless museum-piece, but of active machinery which has just been stopped for an inspection'. It is not permanently stopped however: on special occasions the waterwheel runs and the mill grinds, not gunpowder, but a harmless concoction based on sawdust.

What has happened at Faversham to preserve this historic site is not, it should be noted, as a result of any interest shown by the last owners, Imperial Chemical Industries, although this is a very rich and influential concern. The fact that we can now see this group of mills operating is entirely due to the initiative of a private society. The situation at the equally remarkable gunpowder mills on the Brandywine River—the Eleutherian Mills—near Wilmington in Delaware, has been quite different.

These mills were established by Eleuthère Irénée du Pont, who arrived in America in 1799. By 1811 his mills on the Brandywine had become the largest industrial enterprise in America, with a profit in that year of \$45,000, an unusual amount for the time. Du Ponts today are not the biggest company in America, but they are firmly in the top league and—an important factor in the survival of the Eleutherian Mills—the family has continued to live in the area, with mansions and estates at Winterthur. The preservation of the Brandywine Mills has been very much a du Pont affair. The little stone-built, water-driven mills (there are twenty of them) were spread out for safety along the river bank, and they have been excellently restored or 'stabilised', but the project has not been confined to them. The Brandywine Village Historic District, with its well-preserved houses (mainly of the late eighteenth century) and its shops and flour mills, puts the gunpowder business in a meaningful local context.

E. I. du Pont's impressive stone and stucco house, built in 1803 and now open to the public, is furnished in a style which reflects the changing tastes and interests of five generations of the mill-owner's family. By the side of the house is a small building which, until 1890, served as the du Pont Company office. It has now been restored to its mid-nineteenth-century office appearance, with clerks' desks, high stools, a wood stove and whale-oil lamps. The President's office is furnished with original pieces, including the Presidential desk, powder containers and a carpet bag used by a salesman to carry samples. Near the house is a large barn, which formerly housed company and family vehicles and was the centre of

A pair of restored
powder mills on the
Brandywine River.

FACTORIES AND MILLS



The Du Pont black powder mills on the Brandywine River.

the estate farm. It has now been restored and a museum of wagons, carriages and farm implements is established in it.

The company's first professional chemist was Lammot du Pont, the grandson of the founder. His experiments were conducted a mile or so away in a small workshop which has now been moved to a site nearer the house and furnished with the equipment in use in the mid-nineteenth century. E. I. du Pont was a keen gardener and botanist. After the family moved from the Eleutherian Mills in 1890, the garden became overgrown and eventually all evidence of it disappeared. It has now been restored, following excavations which revealed the original paths, the well, and the foundations of the hot-houses, cold frames and gazebo.

The du Ponts did very well for themselves. Gunpowder was a highly profitable commodity, a fact evidenced not only by the personal fortunes of entrepreneurs such as Eleuthère du Pont, but by the great houses they built for themselves, which are just as significant a part of the archaeology of gunpowder as the mills are. Apart

FACTORIES AND MILLS

from the du Pont residences at Winterthur, there is a remarkable small palace at Haverford, Pennsylvania, where another of America's leading gunpowder manufacturers based himself. His mansion, appropriately called Nitre Hall, still survives, together with the powder magazine.

Nitre Hall and the Brandywine have enough material still remaining above ground to make both the physical and the mental reconstruction of the industrial past a relatively easy matter. At other sites a greater effort is required. The Caughley Porcelain Works, near Broseley in Shropshire, is an example of a place where the archaeologist had to work hard to bring together information from every possible source, at a time when the site was about to be totally destroyed by open-cast clay-working.

The factory was established in 1754, initially to produce earthenware. Soon afterwards it began to make porcelain of the finest quality. In 1780 Thomas Turner, the proprietor, visited porcelain factories in France and brought back several skilled workmen with him. The very successful Broseley Blue Dragon design was in production by 1782 and in 1790 Turner perfected a bright violet-blue underglaze decoration, which also proved popular. In 1799 Turner retired, and sold his business to one of his former apprentices, John Rose, who had a factory at Coalport, the home of the celebrated Coalport porcelain. The notice in *Eddomes Salopian Journal*, announcing the sale of his stock by auction, said:

'The stock consists of a great number of beautiful tea and coffee equipages of various much approved patterns, in full and short sets, richly executed in enamel and burnished gold, together with a great variety of elegant blue and white tea and coffee sets, table and dessert services, muffin plates, butter tubs, etc. Mugs, jugs, egg cups and drainers, butter cups, custard cups of different sorts and sizes, pickle shells, eye baths, asparagus servers, toy tables, tea sets and candlesticks, etc., in pearl white with a great variety of other articles both useful and ornamental.'

Rose eventually found the Caughley factory uneconomic to run and concentrated his activities at Coalport, on the opposite bank of the Severn. In 1814 Caughley was closed and the materials from it were ferried across the river to enlarge the Coalport factory.

In 1964, when open-cast clay-working was about to obliterate the site, Dr A. W. J. Houghton surveyed it with the excavators and bulldozers hard on his heels. What he found showed that Caughley had



Blue dragon pattern on
Caughley porcelain.

produced a much wider range of pottery than the written evidence suggested. Dr Houghton's investigation was a model of archaeological detection. He noticed to begin with that the two tracks leading from the factory site to the river were scattered with fragments of Caughley ware, both glazed and unglazed. Since the men preparing for the excavation of clay on the factory site had found only three small pits containing broken pottery, Dr Houghton very reasonably concluded that the normal practice had been to dump the rubbish in the river.

Where the factory had been, he came across a great deal of material which had been used in making and firing the pottery. There were broken saggars (the dishes on which pottery was stacked for transfer to the kiln), and large quantities of separator rings, which were placed between one object and another during firing. Large flints were scattered about, for grinding and mixing with the clay, which would have been kaolin, brought by sea and river from Cornwall (the local clay is suitable for making bricks and drain-pipes, but not fine porcelain). There were also lumps of gypsum lying around, to be used for making moulds.

Among the sherds, Dr Houghton found earthenware of various colours, glazed and unglazed, and quantities of decorated porcelain, some with polychrome decoration. A few pieces of French and Chinese porcelain also came to light, suggesting that fine quality examples were imported so that the English workmen could copy the designs. Some of the fragments of Caughley ware were decorated with gold lines and stars, which shows that gilding was not, as traditionally supposed, carried out only in London. The great variety of types and patterns found on the site shows that Caughley found a market, or perhaps created one, for goods which came between the luxury porcelain made in the eighteenth century by a few small concerns and the mass-produced articles which met the taste of the affluent middle-class of the early Victorian period. Its

blue-and-white tea and dinner services symbolise this. As the dumps of broken pieces on the site showed, Caughley blue-and-white was of a consistently high quality—ladies with social aspirations had no reason to be ashamed of possessing it—and yet produced in large enough quantities to keep the price reasonably low.

A similar piece of detective work was undertaken in 1962 by Geoffrey Lewis at the Catcliffe Glassworks, near Sheffield. The twelve-metre brick cone here has been a local landmark since it was built in 1740. Mr Lewis, with a team from the Sheffield City Museum, excavated the flue and other parts of the cone in 1962, when it was believed that demolition was imminent. Fortunately, however, representations to what was then the Ministry of Works (now the Department of the Environment) were successful and the cone, the only one to survive in anything like a complete state, is now officially scheduled as an industrial monument.

These conical glasshouses, which were in fashion in England and the Weser region of Germany from about 1730 until 1850, were complete working units, not just kilns, in which all the working processes took place, from melting the glass to annealing the final product. The tall building with its small roof acted as a chimney, and the openings round the base provided an adequate draught. The furnace, which contained the pots of glass, was in the centre of the floor area and the other work connected with glass-making went on around it. A similar cone, which lost its top half many years ago, still exists in Bristol. Until the mid-1960s it was used by a firm of fertiliser manufacturers for mixing and storing compound fertilisers. The site was then bought by a hotel company, which restored the old cone and now uses it as the main restaurant for its new hotel, the *Dragonara*. This restaurant is now the only remaining building of the once important Bristol glass industry.

At Catcliffe, the archaeologists had a good deal more to work on—and were able to add a bit more. The history of the glasshouse was already fairly well known, from its establishment in 1740 until its closure some time between 1884 and 1887. Bottles dated later than this were, however, discovered during the excavations and an old man who had once worked at Catcliffe and who had read in the local paper about Mr Lewis's investigations confirmed that the works had, in fact, been subsequently reopened for a very brief period. He said that another firm started making bottles there in 1900 and went bankrupt within a year. Reference to a local directory confirmed this. The firm is listed for 1901 only.

FACTORIES AND MILLS

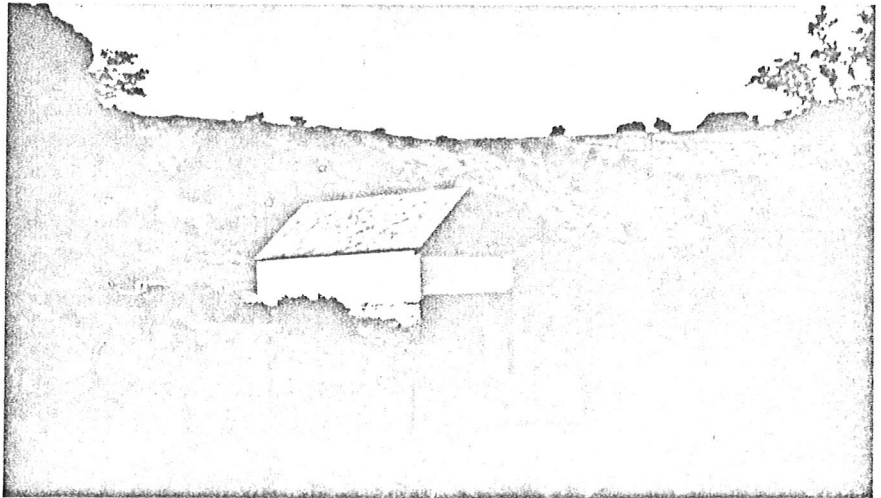
None of the glass found during the excavations dates from earlier than the middle of the nineteenth century. The broken glass from the furnace flue was mainly coloured bottles. Careful examination showed that none of it had been made at Catcliffe and that all of it was later than 1887. The style was characteristic of the first decade of the present century and the names on the bottles included those of three Sheffield firms, a wine and spirit merchant, a chemist and druggist, and a brewer. All these firms were flourishing in 1900 and it became clear that this glass had been bought for remelting as what glass-makers call cullet—scrap glass—during the brief re-opening of Catcliffe at the turn of the century. The research at Catcliffe provides a good illustration of the value of combining three sorts of evidence: material from excavations; written history; and reminiscences of old workers.

An interesting piece of intercontinental detective work took place during 1966–67. It concerned an early nineteenth-century woollen mill at Bathurst, Eastern Province, South Africa. An architect in practice at Grahamstown wrote to me, saying that he had recently surveyed the mill as a preliminary step towards restoration by a South African foundation which exists to preserve and rehabilitate all types of industrial monuments. The architect wanted to discover more about the builder of the mill, Samuel Bradshaw, who was believed to have emigrated to South Africa from Gloucestershire in England; and he was also anxious to obtain details of the type of machinery with which Bradshaw would have been familiar and which he would have installed in his mill at Bathurst. The intention of the Trust was to buy or make equipment which would give as accurate an impression as possible of the mill as it was in its working days. This meant that, by an odd trick of history, the most complete representation of a nineteenth-century Gloucestershire mill would eventually be found in South Africa.

All that was known then was that in 1820, although some of the Hottentot people in the area had sheep which had been obtained for them by missionaries, there was no way of processing the wool mechanically. The situation changed when Samuel Bradshaw, thirty-six years of age and a weaver, landed in South Africa on April 30th 1820, as the leader of a party of emigrants from Gloucestershire. He built the mill, with the intention of producing blankets.

Bradshaw is a rare name in Gloucestershire, but a series of lucky clues led to the village of Cam, where the parish registers yielded

FACTORIES AND MILLS



The restored Bradshaw
Wool Mill, Bathurst,
South Africa.

the fact that Samuel Bradshaw had been baptised there in 1784. As a result of the decline of the local cloth trade many people emigrated from Cam between 1820 and 1830, mostly to America. Bradshaw and his group were exceptional in choosing South Africa.

In 1820 the woollen trade in the West of England was half-way between the old home-industry and the modern factory. The yarn-making was carried out in the factory; the weaving in the home; and the finishing again in the factory. The mill at Bathurst would have followed this pattern. It would have been what was known as a scribbling and fulling mill, preparing the yarn and fulling the cloth. The settlers would in all probability have had to make the machinery themselves, although it is just possible that, since the party is known to have included a number of skilled weavers, they brought some items with them. By 1966 everything had gone from the old mill, and to make it operational once more, machines of the old type had to be copied from museum pieces in England.

Preserving a mill six and a half metres long and five metres wide, as at Bathurst, is one thing, but preserving over one and a half kms of mills, on both sides of a river, is quite another. This was the problem that faced the great American textile manufacturing towns of Manchester, in New Hampshire, and Lowell, Massachusetts, and both towns have found it insoluble. By the end of the 1930s, the mill-owners had begun to transfer their operations to the Southern states, where union difficulties were less serious and where manufacturing could take place in new, single-storey buildings that were better suited to modern needs. The New England mills were abandoned one by one, either to fall into dereliction or to find them-

FACTORIES AND MILLS

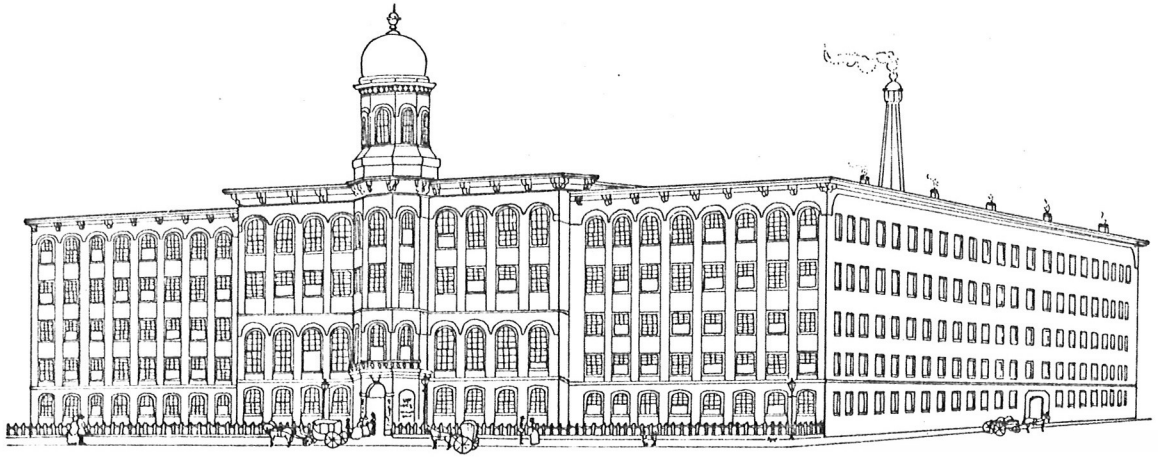
selves divided up into a number of smaller factories. By the 1960s both the planning authorities and the local population had become tired of having so much unwanted, neglected property on their doorsteps, and a wide-ranging programme of demolition became inevitable. During the past five years, acres of mill buildings and workers' lodging houses have been flattened, and many of the most important and characteristic monuments of nineteenth-century industrial America have vanished from the scene.

Forewarned of what was about to happen, the Smithsonian Institution, the Merrimack Valley Textile Museum and the National Park Service co-operated in a mammoth and very professional survey of a number of the more historically interesting mills. This is certainly the most ambitious industrial archaeology project ever to have been organised, and it was carried through successfully during two summers, 1967 and 1968. In the time available it was not possible to survey every textile mill in New England—Lowell, for instance, had to be omitted entirely—but what was achieved has illustrated the value of co-operation and good management if adequate records are to be made before the evidence is swept away. The photographs, architectural drawings and written research material have all been deposited in the Library of Congress in Washington, so that they can be readily consulted by the general public, and they have also been edited into a book, published by the Historic American Buildings Survey. This is the kind of survey and recording work which is, as yet, very rare in industrial archaeology.

Each section in the survey says exactly where the mill was located, who the owners and occupiers were, what it was used for and what its historical significance is. A typical entry here would be, for the Harris Mill, Harrisville, New Hampshire:

'The earliest surviving woollen mill in the village, it was built by Milan Harris in 1832-1833. It is a rare example of pre-"slow-burning" mill construction, with its joist floor-framing and top "trap door" clerestory windows.'

There is a brief history of the mill, a note of any articles that have been written about it, a detailed description of its construction—this is backed up by photographs and drawings—and an account of its condition when the survey was carried out. Any surviving machines or fittings are mentioned, and, in the case of the Harris Mill, the team has noted, 'There are no sanitary facilities in the building,' which is the kind of useful information normally over-



The Chickering piano factory in Boston from a mid-nineteenth-century print.

looked by industrial archaeologists, who are apt to mention only what exists and to forget what does not exist.

If projects like the New England Mill Survey had been carried out extensively in all the major industrialised countries during the past fifty years, we should now be much better equipped to recreate an accurate picture of how our ancestors earned a living. One sad aspect of this particular survey should be mentioned—there was no time and no money to collect the memories of men and women who had worked in the mills. The result, inevitably, is archaeology without people, a weakness which the organisers fully realise.

Few old industrial premises have been as fortunate as the former Chickering piano factory, at 791 Tremont, Boston, Massachusetts. Five storeys high and covering two and a half acres, it was built in 1853 for Jonas Chickering, who had scored a great success with his exhibit at the Great Exhibition in London two years earlier, and at the time it was opened it was the second largest building in America (the first was the US Capitol in Washington). It had 23,250 square metres of enclosed space, with a vast, 2,090 square metres inner courtyard—the size of a football field. Americans are very fond of statistics and like to mention that Chickering's splendidly constructed piano palace required, among other items, three million bricks; 503,000 metres of timber; 11,000 panes of glass; 18 kilometres of iron piping; 300 barrels of nails and 24,180 square metres of flooring. At one time the company was turning out more than 400 pianos a day, with its own clipper ship to bring rosewood and mahogany from South America.

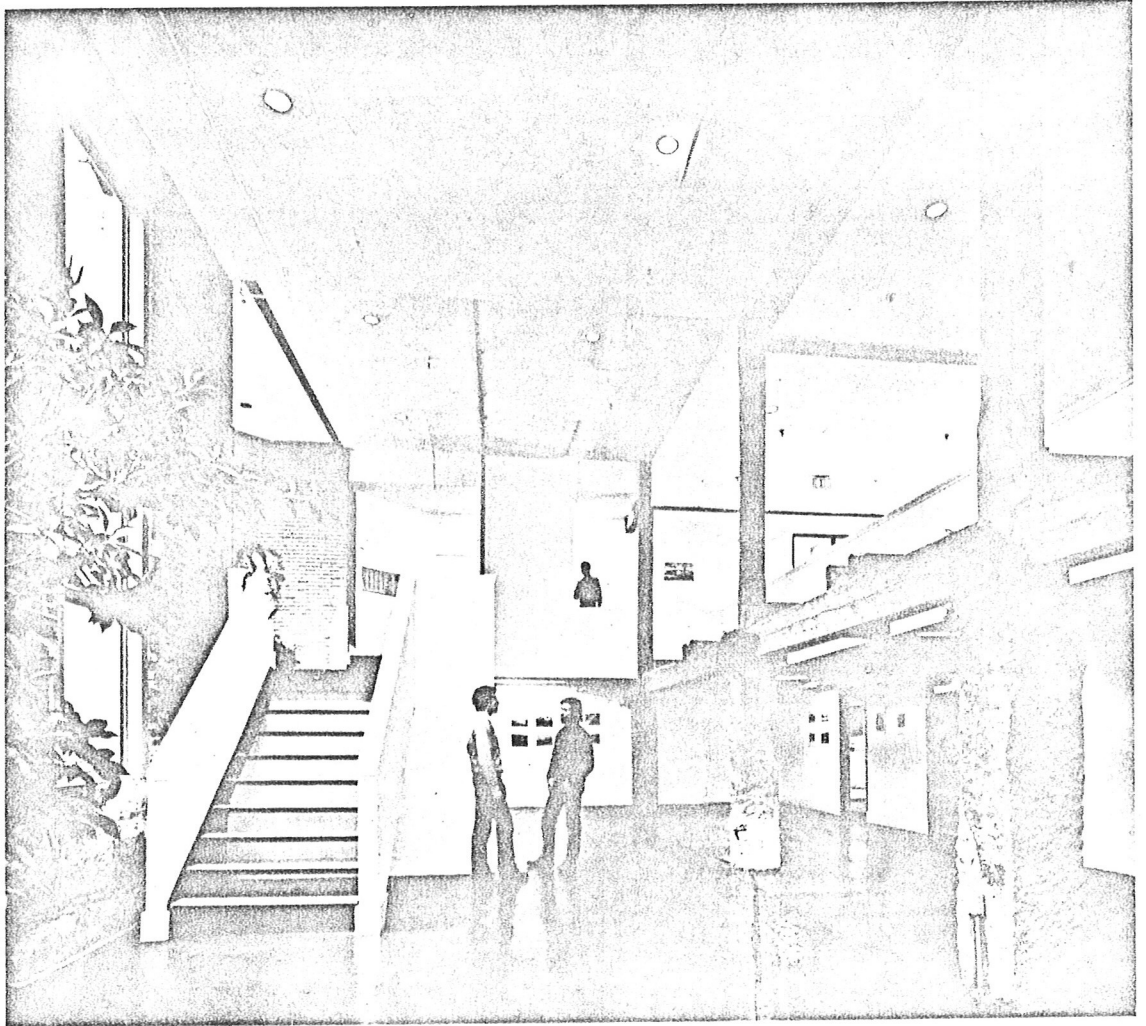
Chickering's piano manufacturing came to an end in the 1930s and the great factory was then rented out in bits to a number of dif-

FACTORIES AND MILLS

ferent firms—an organ and piano repairing workshop, laundries, a harpsichord manufacturer, several furniture makers, a picture-frame maker, the *New England Free Press*, and many others. For forty years practically no maintenance was carried out, but the building remained structurally sound. Early in 1971 a young Boston architect, Simeon Bruner, happened to be giving a face-lift to one of the furniture showrooms in the old factory and it occurred to him that 791 Tremont would be ideal for an artists' housing project, which he and his friend, Bob Gelardin, a planner and relocation expert, had been thinking about for some time. Their idea was to design large open living units which painters, sculptors and musicians could arrange to meet their own particular working requirements. Only bathroom and kitchen fixtures would be provided, and movable cupboards to serve as room dividers.

Bruner and Gelardin bought the building and persuaded the Massachusetts Housing Finance Agency to grant them a three million dollar loan to convert it. No attempt was made to disguise the fact that it was a factory. Brick walls were left unplastered and wooden beams exposed, and fitments were arranged so as to prevent the iron columns supporting the ceilings from coming in the middle of the kitchen or bathroom. Studios for people like musicians and sculptors, whose occupations involve a good deal of noise, were acoustically treated. Wide doors and lifts and outsize drains were provided, to get bulky materials in and up, and stone chippings and other working debris away. Dark-rooms were installed, the basement was converted into an exhibition area, every apartment was connected with a master television aerial, and a restaurant, meeting rooms and parking-spaces were added to the amenities. The only thing missing, one might suggest, is something which will surely come in time—a small museum devoted to Chickering and his pianos, to act as a bridge between the past and the present.

Without a boldly conceived project of this kind, the Chickering factory, one of Boston's most notable landmarks for more than a century, would certainly have had to be demolished. As matters worked out, however, the building was saved and several hundred artists and craftsmen and their families have been very satisfactorily housed. The same solution to a growing problem would undoubtedly find an equally warm welcome in Paris, London, or any other large urban area. It would also allow a number of historic industrial buildings, no longer needed for their original purpose but in good structural condition, to be saved.



Studio conversions in the Chickering piano factory.

The Chickering factory may have been an interesting building and its disappearance would certainly have removed one of Boston's most familiar sights; but piano-manufacturing is not, as yet, a branch of industry which has attracted any marked amount of nostalgia or enthusiasm among preservationists. Without doubt the most popular lines so far, the ones with most fans, have been railways, windmills and watermills, in that order. Every country in Europe has a considerable number of surviving watermills in varying states of repair, and, for the most part, rather fewer windmills. Windmills are more exposed and go to pieces quicker once they are no longer used and maintenance has stopped. Watermills have often been adapted to other uses. They can sometimes be converted into pleasant houses and they can be found carrying out a wide range of

FACTORIES AND MILLS

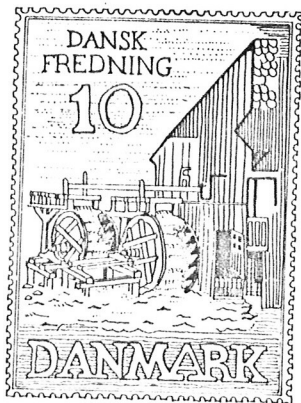
functions as farm-buildings. It is rare nowadays to come across one with its old machinery intact, and even rarer to be able to see a mill still grinding corn. During the past fifty years milling has become a highly centralised affair, mainly concentrated at the major ports, and most of the inland mills, of whatever age or size, have been driven out of business.

No country has tried harder or more systematically than Denmark to preserve some of its typical mills in working order. In 1953 the National Museum set up a Mill Preservation Board, with the aim of preserving a selected number of mills on their original sites. Several had already been moved to open-air museums, but that is not at all the same thing. From its early days the head of the Board has been Anders Jespersen, an engineer who is probably the greatest living authority on the traditional type of mill; a complete enthusiast whose life is totally dedicated to mills. He is a great believer in keeping the mill functioning wherever possible, with a State subsidy if necessary, and as proof of this he himself has bought and restored a beautiful seventeenth-century watermill and miller's house on the island of Fyn, and made it his home. Several other public-spirited Danes have done the same thing, spending a great deal of their own money on restoring the buildings and the wooden machinery of an old mill while there are still craftsmen around who can carry out the work. A local engineer has, for example, saved Børkop Mill in Jutland. Built in 1830, this large mill, with two waterwheels, was close to collapse in 1959 when Mr Christoffersen bought it and brought it back into working order, with a subsidy from the Mill Board. This mill was chosen for the special watermill stamp, which was issued by the Danish Post Office in May 1962, as a token of the practical interest which the Government was showing in restoring these important relics of the country's industrial past.

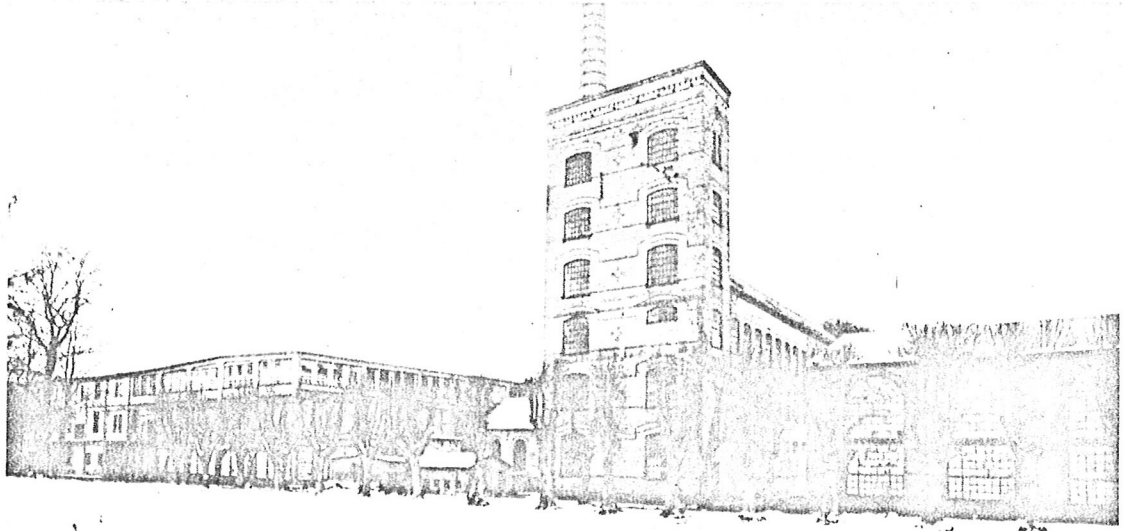
Nybjerg Mill is also in Jutland. It was built in 1850 and a century later it was bought as a semi-ruin by a businessman, who spent £7,000 of his own money on restoring it and bringing it back into use. The work here included digging out the mill-pond again, after it had been allowed to run dry and to spend twenty-five years as a meadow.

For the past five years, the Mill Board has had its own workshop centre, suitably located at an old windmill near Odense. Here a small group of skilled craftsmen has been got together, with one or two apprentices, stocks of timber have been built up—some of the largest pieces are gifts from the State forests—and specialised machinery

Stamp showing Børkop Mill, Jutland.



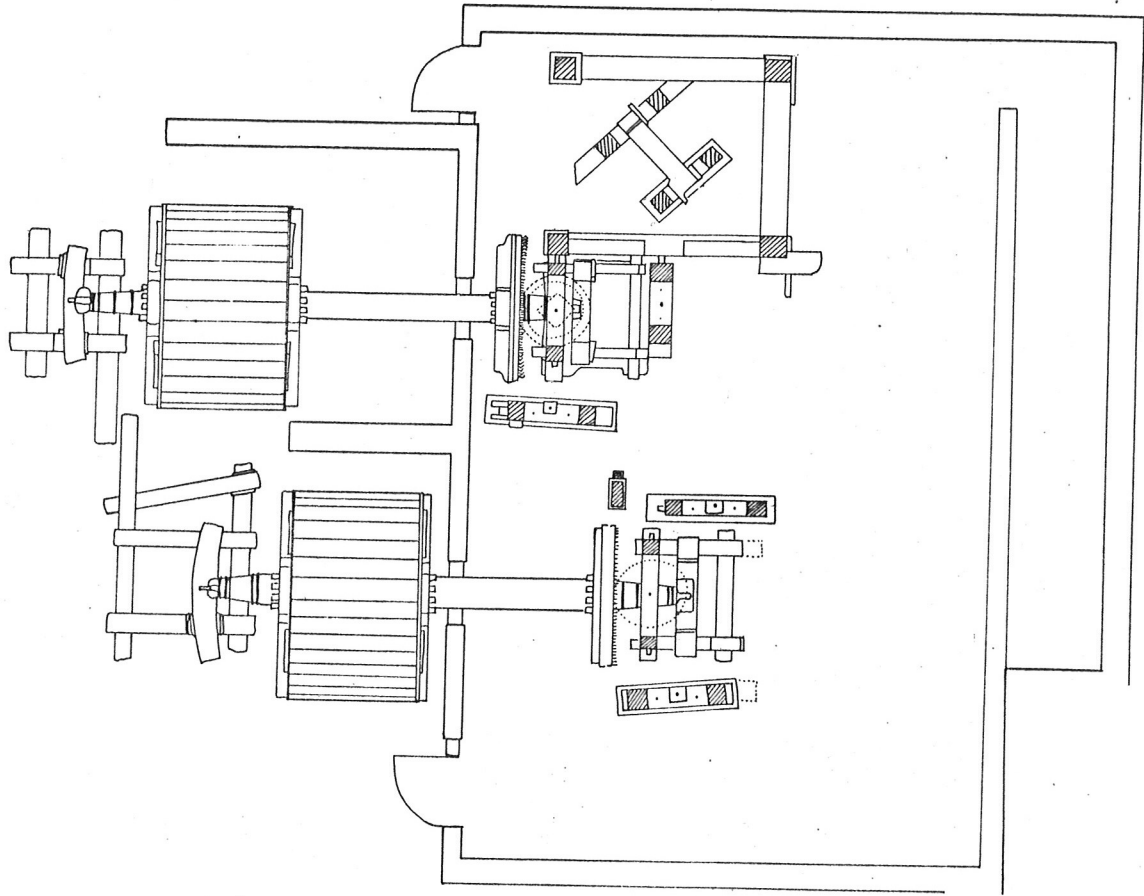
FACTORIES AND MILLS



Brede Works, Denmark, near the home of the Danish Mill Board.

installed to allow the work to be accomplished with the greatest efficiency and at the lowest cost. This workshop centre is a model for what will eventually have to be achieved elsewhere, if old industrial plant is to be repaired and maintained in an age in which the necessary craftsmen are almost ceasing to exist. By concentrating all one's resources at a single point, as the Danes have done for their mills, a school of craftsmen can be built up and apprentices given a proper training. Work can then be undertaken on contract for old buildings or machines which are in need of expert attention. Such schemes are being discussed in a number of countries—by the Smithsonian Institution in Washington, for example, and by the Ironbridge Gorge Museum Trust in Britain—but Denmark has got there first.

The Danish Mill Board practises what it preaches. Its own headquarters, in the Brede Works, not far from Copenhagen, is in one of the most interesting old factory buildings in Denmark. There was a watermill on the site in the fourteenth century, probably used by the skimmers to grind oak-bark for tanning their hides. In 1628 a gunpowder mill was set up there, for crushing and mixing the charcoal, sulphur and saltpetre. This lasted for forty years and in 1668 a copper-works replaced the gunpowder works and operated until 1810, producing pots and pans and other brass and copper utensils, together with scythes. At that point the works underwent great changes, being transformed into Modeweg's textile factory. The first steam-engine was introduced in 1840 and shortly afterwards the first



Plan of the water-wheels and gearing at Borkop Mill.

water-turbines and power looms. Modeweg's went out of business in 1956 and the Government bought the buildings, partly as an administrative headquarters for the Mill Board and partly as a store, and eventually a museum, for old machinery. It was a wise choice. In addition to being beautiful in themselves, the buildings are most attractively situated in wooded surroundings, with the great mill-pond stretching out in front. There are few industrial sites anywhere which have a longer and more varied history, and few which convey more strongly the feeling of what industry was like in its rural, water-powered days. The peaceful Mølleaa—Mill River—on which the Brede Works stands was the most important industrial area of Denmark during the seventeenth, eighteenth and nineteenth centuries, with nine mills producing cereals, paper, cotton, cloth, iron, starch, copper and brass, gunpowder and agricultural implements. Brede has to be visited and thought about within the context of the whole area, and as evidence that in a country with no

coal and plenty of water it was still profitable, even towards the latter part of the nineteenth century, to develop new industry on a basis of water-power and water-power alone. On the Mølleaa, turbines were cheaper to run than steam-engines.

Denmark, like Switzerland and Canada, is a fortunate country in that it has suffered hardly any damage from war for a very long time. The destruction of old buildings has been the result of a deliberate modernisation policy, not of bombs and invading armies. Industrial plants in Denmark were not destroyed in air raids, as they were in Poland, Germany, Britain and the Balkans. The industrial archaeology of war-ravaged countries is liable to be unbalanced; water-mills, stone quarries and workshops in the countryside have a better chance of survival than factories in urban target areas.

Romania illustrates this situation very well. This is a country with rich oil and gas reserves. The use of oil drawn from natural springs has been recorded there since the fifteenth century, although no attempt was made to bore for it until the 1820s, when the first well was mechanically drilled, using wooden rods and the Canadian percussion system. The pioneering Romanian petroleum distillery was commissioned in 1857 at Rîfov, near Ploiești, to supply paraffin to the city of Bucharest, the first place in the world to have this type of street lighting. With the growth of automobile transport, production increased rapidly during the 1920s and '30s, but during the 1939-45 war enormous damage was done by air raids and the Romanian oil industry virtually ceased to exist. The Petroleum Museum at Ploiești, which deals with the history of the extraction and use of petroleum, is very much a matter of models and diagrams. Any archaeology of the early days of the industry which survived until 1939 (and there was not much—wooden derricks and wooden huts are very impermanent affairs) was thoroughly dealt with by American bombers.

But, and this is the important point, Romania had no other industry of any size before 1945. Since the nation's resources were socialised in 1945, industrial development has been very rapid. By 1968, the volume of industrial production had risen to ten times the 1938 figure, with sixty-five per cent of the machinery needed by its industries being produced at home. Exactly the same is true of Yugoslavia, Bulgaria and Hungary. In all these countries, the Industrial Revolution came more than 150 years later than it did in Britain; and for this reason the cotton mills, engineering works, canals and iron foundries which were common enough here and

FACTORIES AND MILLS

which are part of the stock-in-trade of our industrial historians and archaeologists simply did not exist in countries which only emerged from a backward peasant economy when the political system changed. Early industrial buildings in countries like Romania date from the late 1940s and early 1950s, not from 1800. Apart from little rural windmills and watermills, this is where their industrial archaeology begins.

A survey carried out in Bulgaria in 1878 showed how completely dependent the country then was on agriculture and handicrafts, with only twenty enterprises that could reasonably be called factories. Ten of them produced food or beverages, four textiles, five leather or furs, and one was concerned with metal-working. Even as late as 1914, twenty-six per cent of all Bulgarian goods were made in people's homes, fifty per cent in what were called 'artisan workshops', and only twenty-four per cent in factories. In 1945 the number of craftsmen working on their own, or with one or two assistants, was higher than in 1920.

In these circumstances, one has to have an elastic definition of 'industrial monument'. Bor, in Yugoslavia, offers a good example. Yugoslavia now produces more copper than any other country. The copper mining and smelting works at Bor have been important since the 1920s, although the history of mining in the area goes back to prehistoric times. Photographs taken in 1905 show only a small settlement of wooden buildings, but there was considerable development during the next ten years, mostly with French capital. The installations were almost totally destroyed during the war and the most interesting piece of history, if not archaeology, to be seen there now is the plaque commemorating the handing over of the plant to the control of the workers in 1964. Similar plaques are to be found at many other factories and mines in Yugoslavia, marking a turning-point in the industrial history of the country.