The Mechanisation of Architectural Woodwork in Britain from the Late-Eighteenth to the Early-Twentieth Century, and its Practical, Social and Aesthetic implications. Part II: Technological Progress c.1860 to c.1915

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In the first part of this paper, published in volume 8, the major developments in the field up to the mid-nineteenth century were outlined, and our intention was to conclude the study in this issue. However, it became clear that while the developments of the early period largely conditioned what happened later in the century, as the movement towards mechanism gained momentum it also gained in complexity and scale – to an extent that made it impossible to deal with all the various strands of the later developments in a single paper. It was, therefore, decided to concentrate in this section on the technological advances. It seems sensible to find out exactly what the technical achievements were before trying to assess their practical, economic, social and cultural consequences.

Building Up a Manufacturing Base

In his book *Modern Woodworking Machinery* (1924), Stafford Ransome, scion of one of the established manufacturing houses for such machinery in Britain, gave a simple definition of the goal which had motivated several generations of engineers/manufacturers in this branch of mechanical engineering. He wrote: "The aim of woodworking machinery is to accomplish by mechanical means everything that can be done by the artisan in the conversion of timber, from the felling of the tree in the forest to the production of the smallest and most insignificant of articles and to do all such work far more efficiently, rapidly and economically".[1]

In the 1860s, where we resume our account of the mechanism of woodwork, that objective was but a distant prospect. Despite the significant advances made by the British engineers and manufacturers in the wake of the Great Exhibition of 1851 progress was slow compared with other fields of engineering. As late as 1875 – eight decades since Bentham and Brunel had secured a place for mechanised woodwork as one of the great engineering challenges of the century – the industry was still regarded in professional circles as being in its infancy.[2]

The problem, as the engineer/manufacturer John Richards observed in 1872, lay as much with the nature of the raw material that the technology had to process as with the complex organisational requirements of the industry which had to support its conversion.[3] Unlike metal with predictable properties that lend it readily to systematic standardisation and refinement of the manufacturing processes as well as the machinery, wood was an organic material whose variable composition placed unique operational demands on the equipment. The extreme fragility of some of the end products and the unusually high operational speed of the machines in practice caused complications of an order unknown in metal processing.

Given these limitations, and the fact that, compared with the metal industries, woodworking was considered less crucial to the industrial movement in Britain and therefore less well resourced, the achievement of the small group of "entrepreneurs" who developed the industry in this country during this period should not be underestimated. Not only did they strive (as was

shown in my previous paper) to modernise the industry in response to the American threat in the aftermath of the Great Exhibition, they subsequently were able to hold their own in an increasingly competitive international market against producers operating under more favourable socio-economic conditions.

The demand for machined wooden products continued to grow throughout the second half of the nineteenth century offering many opportunities for engineering enterprise. Several new manufacturing firms joined the ranks of those who took the lead during the 1850s and 1860s: Samuel Worssam and Co, Chelsea; Powis, James Co., Lambeth (1847); Thomas Robinson and Son, Rochdale (1857) and John McDowell and Son, Johnstone near Glasgow (1838). But few of the British firms – family businesses mostly – ever became big in the American sense.[4] Nor were they inclined to specialise in the branch of industry they served. The local market was a diverse one, and depending on opportunity these companies were equally prepared to manufacture woodworking machinery for use in the railway, agriculture, furniture or building industries.[5]

Ransome's which, according to one source, produced about 250 machines in the early 1870s[6] was the supreme exponent of this kind of versatility, but to a greater or lesser degree the other firms operated on the same basis. They were run by professional men who seem not to have been inclined to theoretical speculation, but were always ready to experiment with a new idea. Their willingness to respond to the individual needs of their clients led to a great proliferation of customised machines with often only minor variations on established themes. One company, Greenwood and Batley, Leeds, which manufactured both metal and wood cutting machinery, is known to have produced as many as 793 different varieties of machine tool between 1856 and 1900, 457 of these only once during the period.[7] The manufacturing of woodworking machinery was and remained an extremely complicated business. One leading firm in 1909 was reported to have held patterns for no less than a thousand different machines.[8]

In the United States manufacturers of this kind of machinery also produced a great variety of machines. J A Fay & Co, of Cincinnati, the largest U.S. producer, for example already had 73 models on its books by 1860.[9] But the American industry was oriented towards mass production. As John Richards put it in 1873:

> *"Wood machines are made in America at this time like boots and shoes, or shovels and hatchets. You do not, as in most other countries, prepare a specification of what you want, as to capacity, belt power, adjustments and so on, but must take what is made for the general market."*[10]

This had a negative impact on the actual quality of the machinery produced, but kept prices low and brought the new technology within the reach of a much larger section of the woodworking community than was the case in Britain where the ethos of the consulting engineer still predominated over commercial concerns.[11]

Up until the late 1870s local manufacturers of general purpose woodworking machinery concentrated their efforts mainly on serving the larger concerns: timber merchants, general contractors, sawmillers, etc. Designing and fitting-out a steam saw mill for a company in New Zealand (Thomas Robinson & Co., 1865)[12], another in Siam (Samuel Worssam & Co., 1870)[13], or modernising a large builders merchants' workshop such as that of Messrs. Peto Brothers, Pimlico (Allen Ransome & Co., 1872)[14] evidently presented more of a challenge to the British engineers than developing machines for the popular market (Fig. 1).

Within this sphere they actively promoted their business. A case in point is the "Trial shop for Machinery in motion" erected by Messrs. A. Ransome & Co., in Chelsea in 1870 (Fig .2)

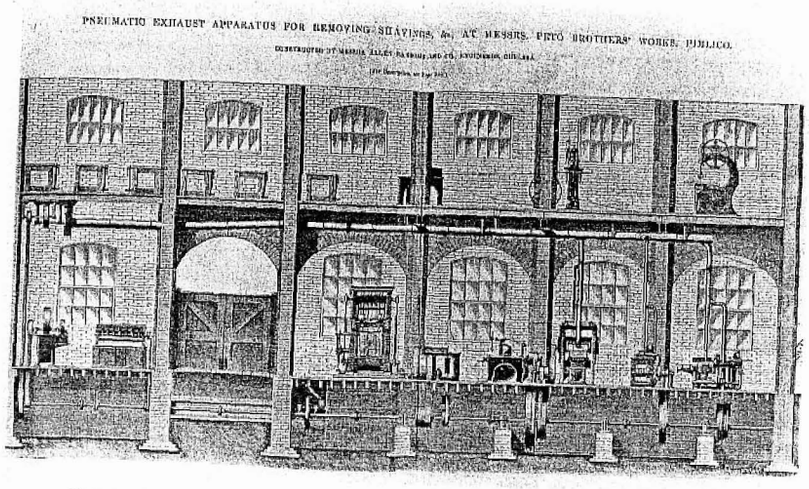


Fig 1: Workshop for Messrs. Peto, London (A. Ransome and Co., 1872), from *Engineering* 14 (1872)

especially for testing new models and demonstrating the capacity of their machinery to leading businessmen and contractors. An instance of its use was the series of practical tests conducted in 1886 with more than 40 different varieties of colonial timber in front of an audience of 150: civil engineers, builders, merchants and importers as well as many overseas dignitaries[15]. They advertised regularly in the professional press and exhibited at the numerous trade fairs, national as well as international, which became a fixture of the commercial and industrial calendars during the latter half of the nineteenth century.

The reputation of the British manufacturing industry for woodworking machinery was built upon three international exhibitions in particular: London (1862), Paris (1867) and Vienna (1873),

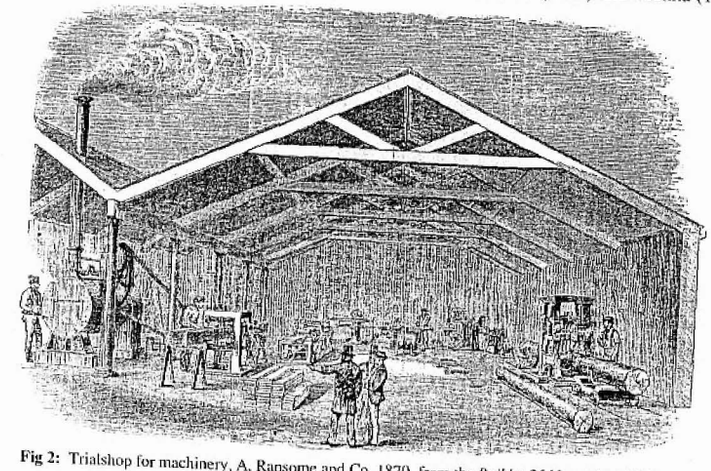


Fig 2: Trialshop for machinery, A. Ransome and Co. 1870, from the *Builder* 26 November 1870.

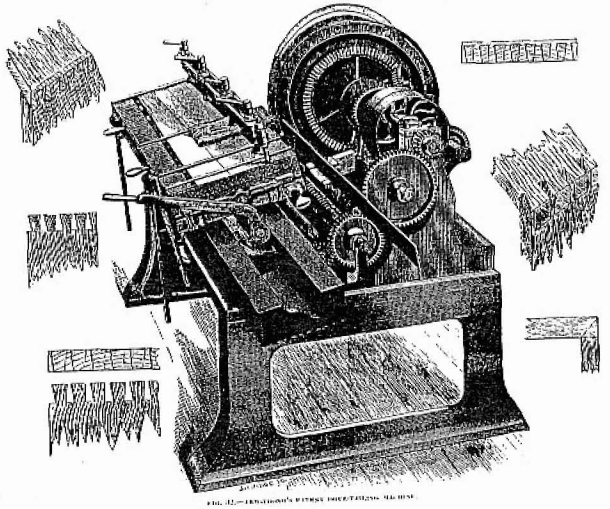


Fig 3: Armstrong's patent Dovetailing Machine 1867, from M. Powis Bale, *Woodworking Machinery* (1880).

where the major firms, Messrs. Worssam, Robinson, Powis, James & Co., and Ransome put on impressive medal-winning displays. Messrs. Ransome & Co. alone received two first class medals for progress for their new range of high speed machines at the Vienna Exhibition, plus the coveted Decoration of the Order of Franz Josef. Consequently, between 1872 and 1874 the latter company more than doubled its business and moved operations to a new purpose-built factory, the Stanley works in King's Road, Chelsea[16]. Apart from the commercial benefits arising from this concerted effort, at home and abroad, it gained the manufacturers the respect of the professional engineers even though by 1876 the subject itself had not yet gained the status of an independent branch of mechanical engineering[17]

Britain's outright leadership in the production of top quality woodworking machines was, however, not to last for long. The other European nations, especially France, Sweden and Germany were quick off the mark in establishing their own industries based on British and American technology, but they posed no immediate threat to British supremacy. As before, the only real challenge in this respect came from the U.S.A.[18] After their triumphant debut in the early 1850s the American makers of woodworking machinery disappeared from the international scene. The 1867 International Exhibition in Paris marked their eagerly awaited return. The journal Engineering described this event as follows:

> *"The exhibition of woodworking machinery in the American department has been looked for with considerable interest and attention on the part of European engineers. We are accustomed to consider America the natural home and the native land of this kind of machinery: we received from the United States the first models of those tools for making wood which are now in general use, these having been more or less modified by subsequent practice in the details, but always preserving their principle of action and the main features of their original inventors just as they were transmitted to us across the Atlantic. More than this we are at this moment accustomed to look to America whenever a fresh desideratum in woodworking*

> *machinery makes itself felt in general practice, and occasionally we are surprised by some new and ingenious tool coming over from the 'States', for which the necessity has hardly been felt until the advantages which its use affords show themselves clearly by its employment."*[19]

The actual American display on this occasion proved to be a disappointment to European observers. With the exception of the exhibits of Baxter D. Whitney & Sons, Inc., of Winchenden, Mass. and such individual attractions as the Armstrong Dovetailer (Fig 3), the U.S. exhibition was found to be of varying quality and not representative of the true state of development in that country.[20] The same situation seems to have prevailed at the major exhibitions of the 1870s in Vienna (1873), Philadelphia (1876) and Paris (1878).

It would appear as if the specialist nature of the American machines had set them so much apart from those of other nations that the comparisons which public demonstrations demanded became difficult. In practice, however, their influence was becoming increasingly apparent. Already at Vienna a British reporter noted that in the English section the "most ingenious of the special tools, as well as some of the best details of the ordinary ones are American."[21] The contemporary custom of buying out the patent rights for specific inventions, as well as the free borrowing of design concepts which were going on all the time, blurred distinctions between the products of the various manufacturers and often led to confusing claims to precedency in the field. An example of this is the following conclusion reached by a reporter of *The Daily News* on the woodworking machinery displayed at the Paris Trade Exhibition of 1878:

> *"On the whole, England, in woodworking machinery, is ahead of every other nation. At the same time it is, in our section, hard to say where England ends and America begins, so many of our valuable patents being of American invention."*[22]

Whatever doubts may have remained as to which of the two countries was contributing most towards progress in the field was dispelled by the International Exhibition of 1889 in Paris. On that occasion the large display of woodworking machinery by J.A. Fay & Co., Cincinnati, Ohio, stole the limelight, being generally regarded as a model demonstration of up to date technology in the field.[23] As one English commentator remarked afterwards:

> *"Most of the new improvements and applications in this class of machinery not only originate, but have to be developed in the United States before they are copied on this side."* [24]

This did not apply to every category of mechanical woodworking however, for in 1891 the United States was still considered to be lagging behind European (especially English) practice in such important areas as planing and sawing.[25] Due to internal commercial considerations the Americans had also been rather slow in adopting the more sturdy iron frame construction for their woodworking machines. Only 23 of the 73 machines illustrated in the 1860 catalogue of J.A. Fay & Co., for instance, were made of iron.[26] And, at the 1867 Paris Exhibition, American machines still predominantly had combined wood and iron frames.[27] By contrast, all the machines exhibited by U.K. producers at the 1862 London Exhibition already had cast iron frames. While more expensive than a wooden frame, and initially rather clumsy in design, the metal frame alone was capable of meeting the increasing demands made of later generations of wood cutting machinery, with precision tooling, stability and high operational speed as the major factors determining the quality of the end product. In this respect the British manufacturers,

therefore, had a distinct advantage over their foreign competitors, and the introduction of the hollow or "box" system of framing, which lightened the structure without loss of strength, from the 1860s on[28] further consolidated their position. In fact, it can be argued that the development of an appropriate technology for the construction of this class of machinery was the most important contribution which Britain made during the second half of the nineteenth century. This compensated in some measure for the shortcomings displayed by her manufacturers in the field of design, compared to their American counterparts. The journal *Engineering* credits the London firm John Richards & Co., (est. c.1870) with popularising superior quality iron framed woodworking machines in the American market through its association with a Philadelphia firm.[29] Whether or not this was the case by 1878, according to M. Powis Bale, the use of wooden frames for the general range of woodworking machinery had become "almost extinct".[30]

It was about this time that some English dealers (Charles Churchill & Co., Finsbury, London, being one) started importing American woodworking machinery on a large scale. This consolidated the already strong American influence and accelerated the shift in emphasis in the British market towards a lighter, cheaper class of machinery for general use in the building industry. As was the case in the 1850s the second wave of American influence attracted little opposition from local manufacturers. George Richards, principal of a leading Manchester-based firm, gave the following reasons for this in a paper presented to the Institution of Mechanical Engineers in March 1885.

> *"Altogether it is safe to assume that this influx of American ideas in wood cutting was beneficial, as it led to a wider adaptation of machines to handwork, and gave an impetus to the manufacture of wood cutting machinery in general, which makers of standard machines containing no important improvements could not readily have stimulated into activity."*[31]

The British were, of course, nett beneficiaries in this exchange, but the importance of individuals in creating a congenial atmosphere for mutual technological trade should not be forgotten. Chief among them were George Richards' father, John, whose London-based engineering firm was associated with an American producer, Kelly Engineers, Atlantic Works, Philadelphia. During the 1870s John Richards tirelessly campaigned for the adoption of American practice in the production of mechanised woodwork in Britain. He was particularly critical of what he considered to be a romantic attachment on the part of British manufacturers and their clients to machines as ingenious objects and their comparative neglect of related organisational matters. It was a fairly common criticism of British industry in the nineteenth century, but one which perhaps needs some qualification as is demonstrated by the case of the combination machine.

The combination machine, more commonly known as a "universal" or "general joiner" was a product of mid-century English technology, and mid-century thinking. Like the Swiss Army knife, the aim was to combine as many as possible functions in as small as possible a compass. Judging from its immediate popularity many must have regarded it as a neat and simple route to the general mechanisation of joinery in the building trade. In practice, however, the "universal joiner" did not live up to its early promise. Despite continuous experiment by leading manufacturers (Fig 4) the optimum combination remained elusive; it turned out to be either over-complex or too basic for tasks it had to perform in the general woodworking industry. It was initially more successful in railway carriage shops, pianoforte and cabinet factories, pattern shops and on estates.[32]

Among the "Universal Joiners's" severest critics was John Richards. He correctly observed in

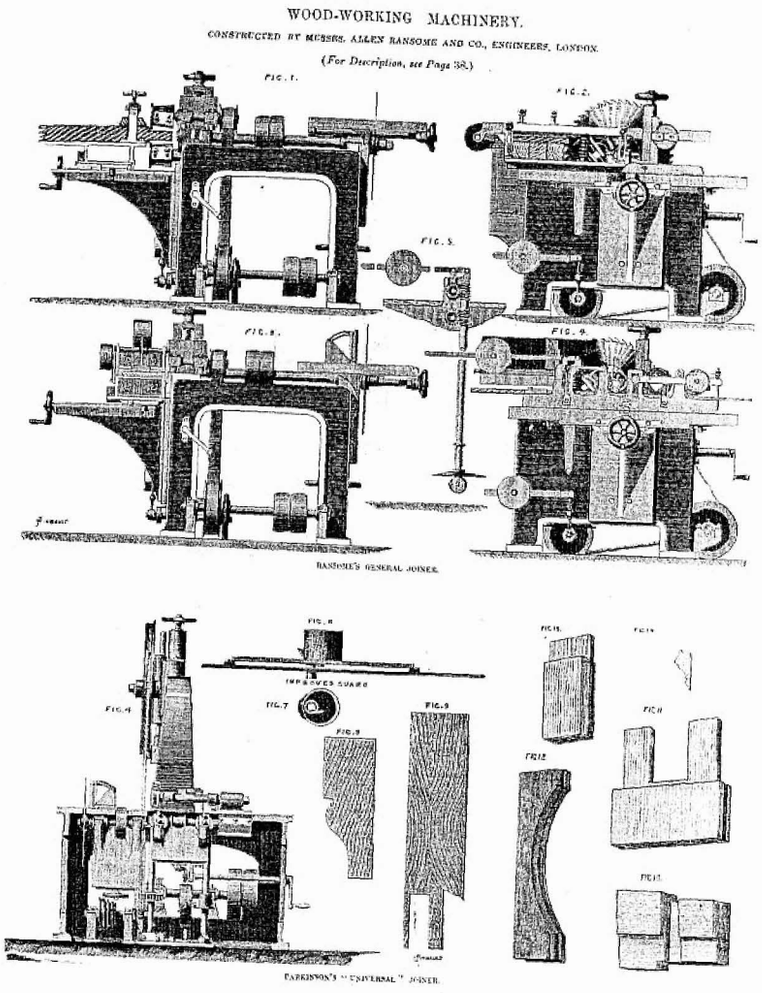


Fig 4: Ransome's General Joiner and Parkinson's 'Universal' Joiner 1870, from *Engineering* 9 (1870)

1872 that there was a fundamental flaw in the basic concept, namely that, "a machine which is arranged to do several different things is generally supposed to do but one at a time, hence the more functions it has, the greater the proportion of that part or parts which are idle."[33] In support of his argument Richards could point to tests conducted in the U.S.A. which had shown that in order to complete a specific task such as manufacturing a wagon wheel, only three specialised machines were required as opposed to 24 combination machines. While admitting that such an arrangement had its place in certain specific circumstances (for example,

a small one-man business, and when used in conjunction with standard single purpose machines for odd jobs in larger establishments) he felt that British manufacturers overestimated its capacity and were wasting their resources in developing a misguided project. This was also in contrast to manufacturers in other nations where the combination machine found little favour. Nonetheless, the "Admirable Crichton of woodworking machinery" as one admirer dubbed the "universal joiner" *in 1871, remained* a standard feature of the British manufacturers' catalogue, providing an outlet for their creative ambitions. This is sometimes reflected in the titles given to these machines. For example, Messrs. F.W. Reynolds & Co. called their new patent general joiner displayed at the Building Trades Exhibition in London in 1884 the "comprehensionist". The British trade seems to have shared this interest because combination machines continued to be popular into the twentieth century. Evidently its characteristics of ease and operation, compactness, small initial capital outlay and comparatively low running costs, suited conditions in this country. Although its worth as a woodworking tool remained controversial to many in the trade, the following editorial statement in *Illustrated Carpenter and Builder* of 1911 (Fig 5) shows that it was not without its supporters.

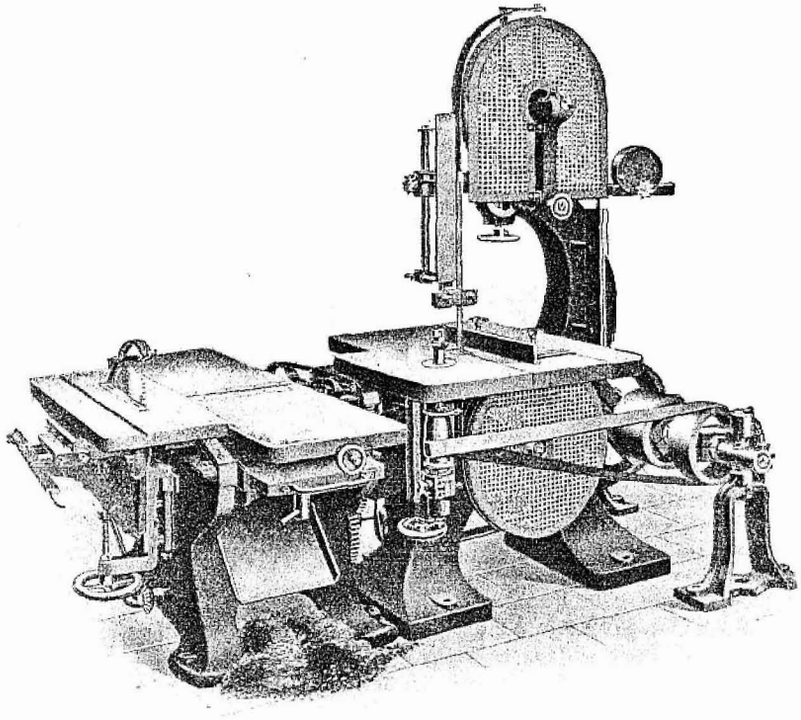


Fig 5: New Universal Woodworker. W.B. Haigh and Co. 1911. from *Illustrated Carpenter and Builder*, 10 November 1911.

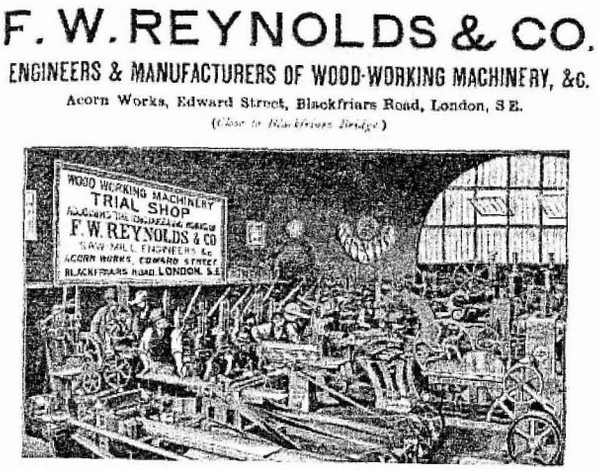


Fig 6: Trialshop of F.W. Reynolds and Co. 1897, from *Illustrated Carpenter and Builder*, 26 March 1897.

"The demand for and supply of special combinations of machines seems to be never ending. Even the smallest joiner or cabinetmaker today finds that if he is to offer his goods at a competitive price he must take advantage of every saving in wages and material presented to him. Machinery is the greatest factor in effecting savings, and, owing perhaps to confined space, small capital, or expense entailed in putting down several machines, the best and most practical advice that can be given is for our friend to go in for one of the many simple combined machines now offered."[34]

In the final analysis it would seem as if the combination machine had stood the test of time remarkably well. Far from being the phantasmagoric project that many considered it to be, it proved useful within its own terms of reference. It was a classic example of how a British invention, designed and developed specifically for the home market, could achieve a measure of success without conforming to what Arthur Shadwell, in 1913, called "the American plan", i.e. "rather to adjust the work to the tool than the tool to the work."[35] The universal joiner was not the only product of the alternative "British" approach to mechanisation which had survived the so-called "Great Depression" of the period 1873 to 1896, and emerged revitalised. By 1900 European manufacturers (essentially German and British) had assimilated American technical advances and their more robust machines were outperforming American ones even in terms of quality of output.[36]

After twenty-five years of sustained application following the second phase of American influence the local manufacturing base for the woodworking industry had been substantially transformed and Britain was again a force in the field. In the process the whole complexion of the industry had changed, both in terms of scale and range of production. A recent survey of specialised firms listed in Kelly's Directories for Britain shows that in 1877 there were still only 15 woodworking machinery manufacturers in the country. By 1892 that number had expanded fourfold, to 61. In 1907 it stood at 67.[37]

A new generation of manufacturers had emerged which produced a wider range of woodworking tools for general application in the building industry. The firm which seems to have become the leading specialist in builders' appliances during this period was F.W. Reynolds & Co., of Blackfriars Road, London (Fig 6). America still led the way in the production of a

cheaper category of handy lightweight machines for use in smaller workshops, where the use of power-driven machinery was inappropriate and large numbers of these machines were imported. But most of the principal British manufacturers were now producing an impressive range of labour-saving devices. Prominent among them were Messrs. Wilson Bros., Leeds (c.1852); John Richards & Co., London, later Manchester (c.1870); John Sagar & Co., Halifax (1875). During the 1890s some leading American and European firms, notably J.A. Fay & Co., Cincinnati and Ernst Kirchner & Co., Leipzig-Sellerhausen, also established bases in London and provided further stimulation to an already competitive industry.

Virtually every aspect of the woodworking trade was affected through the improvements brought about by this competition. The capabilities and ease of operation of tools were increased almost beyond recognition and new mechanical back-up systems developed for the workplace. An example of the latter was the new pneumatic exhaust apparatus for shavings and sawdust introduced by Messrs. Allen Ransome in 1872, following American practice. (Fig 1) Moreover, it was not only the machine tool industry which flourished. The manufacturers of hand tools for joiners increased in number from 104 in 1877 to 184 in 1892, although it then fell back to 158 in 1907.[39]

A casualty of this development was Britain's thriving plane-making industry dating back to the early eighteenth century. As W.L. Goodman had shown, the number of such plane makers rose to a peak of about 140 during the decade following the Great Exhibition, and then went into a steep decline as mechanised production increased. By 1900 there were only about 60 businesses left in the country producing such tools by hand.[40] One of the traditional centres for plane-making, York, which had about 30 workshops during the 1820s, had lost all but three by 1875/6.[41] Once again it would appear as if it was American influence which was decisive. By the mid-1880s the U.S.A. was the acknowledged leader in the field with American bench tools gaining in popularity in workshops throughout Britain for their ingenious designs and sound manufacture. One of the main importers of American appliances, Messrs. Chas. Churchill & Co., London, for example, had sold over 90,000 specimens of Bailey's Adjustable Plane by 1895.[42]

In contrast to Britain where wrought iron was mainly used, the U.S. producers used cast-iron which had the important advantage of facilitating a ready access to mass-produced, interchangeable parts for repair. It is yet another of the different approaches towards mechanisation which prevailed in the two countries. As was the case with machine tools the British responded positively to the challenge and leading firms like Messrs. D. Kimberly & Son, Birmingham; Charles Church & Co., London, and Richard Melhuish & Sons, London, soon built up a substantial international trade of their own.

In my previous paper (Vol. 8) it was mentioned that Britain began exporting woodworking machinery to France on a small scale as far back as the 1840s. By the third quarter of the nineteenth century that trade was a truly international one, and of substantial proportions. Unfortunately, in the absence of accurate trade and production figures for this branch of the machine tool industry it is almost impossible to form an impression of its true scale. J.B. Gruban, reviewing the state of the art of the European woodworking industry in 1900, claimed that the United Kingdom at the time exported about one-third of its production to Russia, France and other Continental countries as well as her colonies.[43] A specific instance which has been researched, namely the business records of the Leeds engineering firm, Greenwood & Batley, would seem to corroborate this general estimate.[44] Large quantities of this kind of machinery was, of course, imported but as will be shown later, the balance of trade was still in Britain's favour when the first itemised trade figures were released in 1920.

The estimated total value of woodworking machinery produced annually in this country was reported to be half a million pounds in 1909.[45] Only Germany and the United States exceeded this rate of production at the time, but both these nations had enormous indigenous timber resources, and thus commercial incentives to maintain a progressive manufacturing base in order to exploit these resources for home and overseas consumption. Without such an incentive and little chance of building up a competitive export trade in manufactured wooden products, the future of the British makers of woodworking machinery was more precarious. Their survival, more so than ever before, would depend on their ability to keep abreast of technical progress in the field.

The general upsurge of technological innovation which marked the later decades of the nineteenth and the early part of the twentieth centuries had major implications for the industry. Developments like the invention of alternative prime movers (internal combustion and electric motors), anti-friction ball-bearings, high speed steel and automation were posing challenges of an order unknown to the nineteenth century. The British industry, much to the frustration of "progressives" within its cadre, was slow to take full advantage of the exciting opportunities offered by the technology of the modern era. Despite enormous strides taken since the 1850s the woodworking trades, including those related to building, were still not fully mechanised, and significant sections of the community seem to have remained unconvinced of the need to do so.[46] Before we address our attention to this question we need to look at exactly what had actually been achieved in terms of mechanical wood conversion techniques since the mid-nineteenth century.

"A Good Tool is Half the Work"

Since there are several authoritative books which discuss the technicalities of these developments in some detail,[47] we need only briefly outline some of the major achievements which had a, influenced practice in this country. The capacities for both the standard arrangements for sawing, circular and reciprocating or frame saws, were significantly increased during the latter half of the nineteenth century as metal technology improved, but the greatest advance in the breaking-down process of woodwork came with the introduction of the bandsaw during the 1850s. This versatile tool was first developed by the French, but adopted on a large scale in Britain and the U.S.A. since then and completely transformed sawmill practice from the 1870s onwards. Some of these machines were very large. Brownlee & Co. of Glasgow, for example, in 1873 installed a horizontal bandsaw 40 feet long with a blade more than five inches wide in their new sawmill,[48] but the vertical ones were more common and were made even bigger. Smaller machines of the latter variety soon became indispensable in joiners' shops for general sawing purposes, as well as for the preparation stages of curvilinear woodwork. For more delicate ornamental flat work and inside cutting an older relative of the bandsaw, the fretsaw, served. In some arrangements the two were combined (Fig 7). These two types of saw together with the new generation of wood cutting machines which came on the British market during the third quarter of the century completely revolutionised the finishing processes of mechanical joinery.

Planing machines (including moulding) were made according to two basic principles: a rotary process in which the knife or cutting instrument chips away at the material, and a reciprocating process in which shavings are taken off in a similar manner as with a trying-plane or a panel-plane. The range of the former, which was one of the great innovations of the famous Bentham patent of 1793, was greatly extended by the development of the vertical spindle moulder or "shaper". Although foreseen by Bentham it was not until the 1850s that a practical method was

COMBINED BAND AND FRET SAW.

CONSTRUCTED BY S. WORSSAM AND CO., ENGINEERS, LONDON.

(*For Description, see opposite Page*).

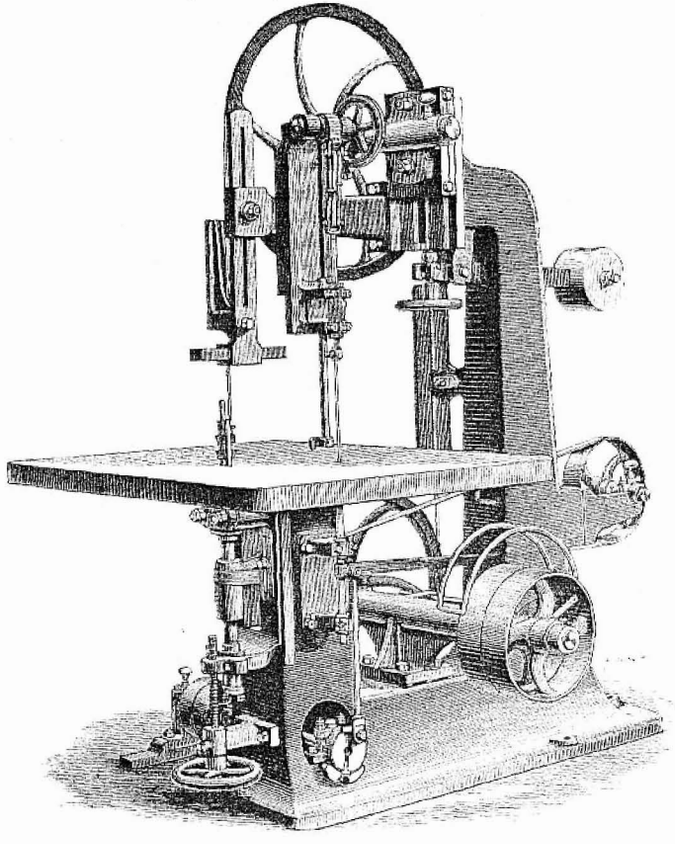
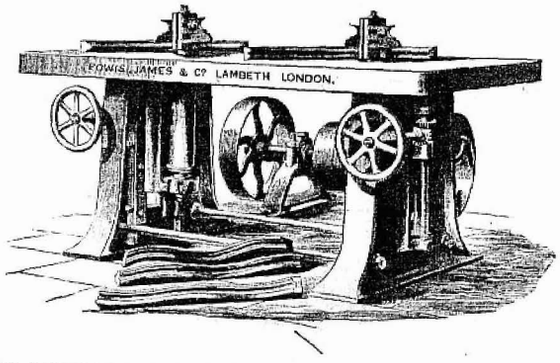


Fig 7: Combined Band and Fretshaw, Messrs. S. Worssam 1883, from *Engineering* 36 (1883).

devised. The credit for the invention goes to Andrew Gear of James-Ville, Ohio, who in 1853 exhibited a spindle shaper in New York, which was well received although its full potential was not realised until some years later. This machine, which, according to the manufacturer's catalogue of 1868, had the "capacity of thirty first class mechanics",[49] came with either single or twin spindles protruding above a flat table to which the cutters of various profiles could be fastened. The spindles revolved at high speed (about 5000 r.p.m.) and the machine could produce curvilinear as well as straight sections like an ordinary moulding machine. The drawback of the early spindle shapers was that they could produce good quality work only in fairly narrow sections (2-3 inches) and that due to the size of the cutter head, sharp curves had to be finished by hand.

DOUBLE VERTICAL SHAPING AND MOULDING MACHINE.



This Machine is intended for the same class of work, only larger and heavier, as the small one shown on the opposite page. It is fitted with two Cutting Heads, and will work Mouldings up to 6 inches in depth. The two Cutting Heads, each fitted with similar cutters, enable the workmen to always cut with the grain of the wood, and consequently make much cleaner work than otherwise; as when the one side is done, the wood has only to be reversed and worked on the other Cutter. Both the Cutting Spindles are made to rise and fall, so that the Cutters may be readily adjusted to depth of moulding required. One Pair of Straight Fences for working straight mouldings, and one Pair of Circular Fences for circular and crooked mouldings is supplied with the Machine.

Speed of Countershaft, 700.

Diameter of Driving Pulleys, 10 inches.

Fig 8: Double Vertical Shaping and Moulding Machine. Powis James and Co. 1862. from catalogue.

Molesworth, in his lecture to the Institution of Civil Engineers (1857), dealt with in my previous paper, illustrated an American single spindle moulder, but improved versions of both types were commercially available in this country by 1862 (Fig 8). British manufacturers continued to make modifications to extend the usefulness of this class of machinery to the local industry. During the 1880s the improved single machine with reversible action, which was cheaper and easier to operate, began to dominate.

In the second category of planing machine, that which operated by reciprocal action, two parallel methods had developed in the course of the nineteenth century: a transverse action (i.e. across, instead of along the fibres) and the longitudinally acting "cylinder machine". The former, based on an invention of Joseph Bramah's of 1808 (in America it became known as the Daniel's Planer), was very expensive and caused difficulties in maintaining edges. Consequently it was reserved mainly for heavy duty work.

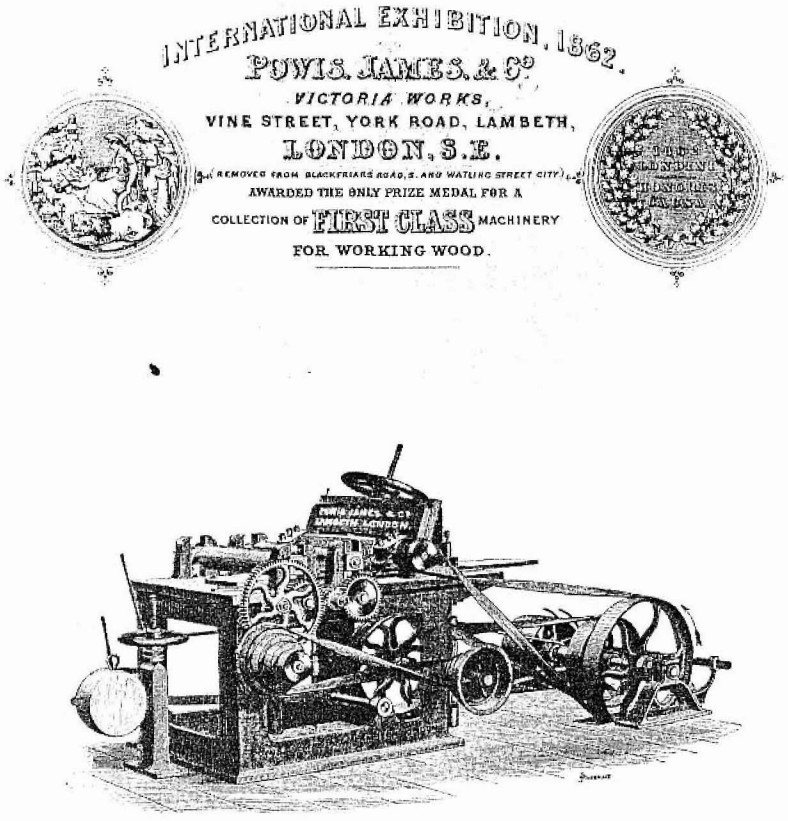


Fig 9: Patent Panel Planing Machine, Powis James and Co. 1862, from catalogue.

In the U.S.A. the model for the other kind of planer, the cylinder machine, was the so-called Woodworth planer developed in 1828. In Britain the prototype was initially the machine patented by Muir in 1827, but American influence became paramount after the introduction of a new class of surfacers and thicknessers (panel planers) during the 1970s. Prior to this British-made planing machines were still, despite considerable progress since the 1850s (Fig 9), often inappropriate for general application in the building industry. W.L. Sims explains why:

"They were not only too expensive, but unsuitable for a small joiner's requirements. Basically, he needed, after his saw bench, a machine which would do the work of a

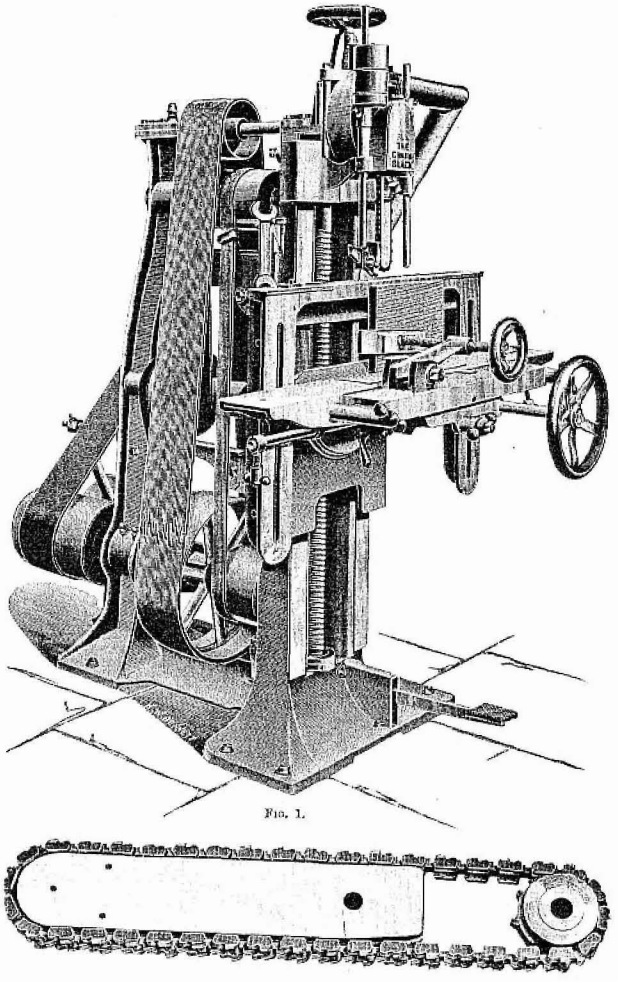
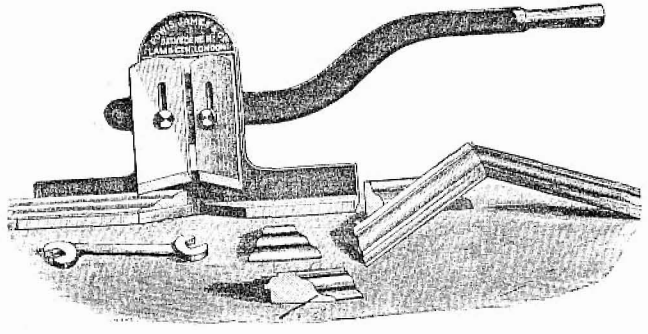


Fig 10: Chain Mortising Machine, New British Machine Co., Connecticut 1899, from *Engineering* 68 (1899)

hand plane. The introduction of the hand feed surfacer had provided this tool which would enable him to surface and joint by a simple machine instead of a hand plane and did not require quantity production to justify the installation. Similarly, the thicknesser would machine the component to a finished thickness and width and was handy enough to use for one-off requirement if so desired. These two machines undoubtedly sparked off the greater use of machinery by the smaller user and encouraged the joinery trade, and particularly builders and contractors, to install their own plants."[50]

POWIS, JAMES, & CO., Saw-Mill Engineers, Ironfounder, and Machinists,
VICTORIA WORKS, VINE STREET, YORK ROAD, LAMBETH, LONDON, S.E.

MITREING MACHINE.



THIS Machine is adapted for cutting Mitres on Mouldings for Door Panels, &c. The Irons are fixed at right angles to each other, and the Mitres are cut perfectly true and clean, and require no finishing. It can be readily screwed down to a Joiner's Bench, or moved about to wherever it may be required.

Complete, with Spanner. Price £ 1/

Fig 11: Mitreing Machine, Powis James and Co. 1862, from catalogue.

The appearance of the parquetting machine, a form of planer, in 1873, gave rise to the popularity of solid inlaid parquetry floors in Britain as well as on the Continent. Messrs. Worssam & Co., the inventors, became the acknowledged specialists for this category of machinery throughout Europe where it was highly successful. In Britain parquetry floors became popular during the 1890s.

An important extension to the range of finishing machines for woodwork was the "scraping machine" developed by Baxter D. Whitney & Son Inc. of Massachusetts, c.1857. It attracted considerable attention at the Paris Exhibition in 1876 and subsequently scraping machines were widely employed throughout Europe. It was particularly useful for machining hardwoods and for preparing high quality surfaces for varnishing at a time when the finish of ordinary machined work was still not very good compared to hand work. An improved version of this machine was produced by the company in the late 1870s. The sand papering machine, another American invention, manufactured in this country under licence from 1892,[51] had a similar function.

Equally useful were the improvements brought about in the specialist machines employed for jointing: mortising, tenoning, dove-tailing and mitring. The first two are such basic and repetitive activities in woodwork that they were natural early targets for mechanisation, and the technology for both was fairly well established by the 1860s. The original practice in Britain had been to use circular saws for tenoning, but increasingly the American practice of using rotary cutters was adopted during the second half of the century.

Hand-operated mortisers became available in Britain during the 1850s and since then they had remained part of the general stock of many leading manufacturers, with F.W. Reynolds & Co., London, becoming the principal specialist from the late 1870s onwards. By the 1880s the mortiser was one of the most widely adopted machine tools in builders' workshops and the object of continuous technical improvement in a competitive market. Neither of the two major innovations of the period in power mortising, the hollow chisel, introduced c.1862, and the cutting chain (1875) proved commercially viable in Britain before the end of the century. The latter (Fig 10) became popular after 1900 because of its rapid and accurate action. It was reputed to have the capacity, under normal circumstances, to prepare between 40 and 50 four-panel doors per hour, each having 10 mortices. The hollow chisel had to wait for the development of better quality tool steels before it was widely adopted.

Among the many arrangements for the saving of labour through the introduction of machinery in woodwork few presented as many difficulties as dove-tailing. This explains the excitement caused at the 1867 and 1873 International Exhibitions by the ingenious machine developed by S.T. Armstrong of New York (Fig 3). The Armstrong Dovetailer was subsequently produced under licence by manufacturers in France, Germany and Britain, including Messrs. Robinson & Son Limited, Rochdale.[52] Another American dove-tailing machine was manufactured under licence by Messrs. Greenwood & Batley, Leeds, during the 1860s.[53] These machines opened up many new possibilities in the field and stimulated further experiment by local manufacturers.

Less complicated than dove-tailing, but very handy for everyday joinery tasks such as mitring sash bars, mouldings, etc., was the trimmer or mitre-cutter. Powis, James & Co. already had such a hand-operated device on the market in 1862 (Fig 11). A similar tool, known as "Shute's Mitring Machine", and manufactured by Messrs. A. Ransome & Co. during the early 1870s, became the subject of a dispute between the latter company and a German manufacturer, Messrs. Zimmerman of Chemnitz, who later admitted having copied it.[54]

Attempts to develop power operated processes for mitring do not appear to have met with much success; hand-operated machines remained the norm. These were widely employed by the 1880s despite being, as *The Builder* pointed out in a review of woodworking machinery in 1881, hardly an improvement on traditional hand techniques.[55] An interesting new development came in 1904 with the introduction of an "American sash trimmer" by J.B. Stone & Co., Finsbury, London. (Fig 12). It was

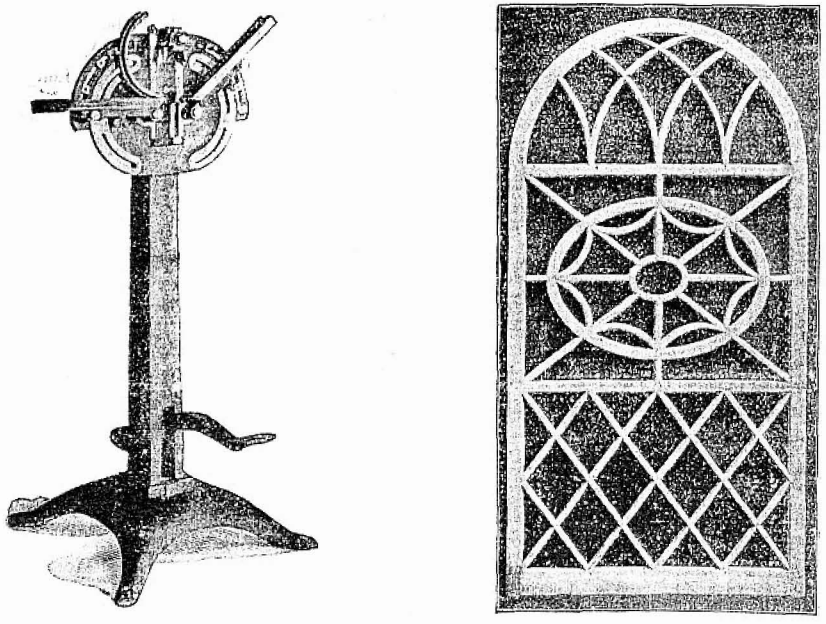


Fig 12: New American Sash Trimmer 1904, from *Illustrated Carpenter and Builder*, 25 March 1904.

designed especially for moulding all kinds of fancy sashes, a task which it apparently could execute in one quarter of the time it would take a master craftsman.[56]

In the U.S.A. and France manufacturers put much effort into developing the potential of the mechanical lathe for ornamental work (Fig 13). In Britain, perhaps understandably in view of the early successes achieved by Pratt and Jordan during the 1840s and 1850s, the emphasis fell on the woodcarving machine based on the router. Initially little progress was made. Although some of the early wood carving companies seem to have continued in operation[57] handwork was still the norm for this class of woodwork by the 1870s, causing engineers like John Richards to question the efficacy of the whole process.[58]

However, the router, which acted like a drill, did have unique advantages over other kinds of cutting device. Problems with vibration limited its application to lighter work, but in cutting recesses into the face of flat boards and for copying intricate three-dimensional carved objects, it had no equal. This alone was enough to ensure its survival in an age which favoured intricate ornamentation, and there were several attempts in Britain and the U.S.A. to improve upon the technology, mostly still following the pattern originally established by James Watt with his "Eidograph" and "Diminishing Machine" of 1809 and 1811 respectively.[59] An improved version of Jordan's original machine was marketed by Messrs. J. & H. Gwynne, Engineers, Hammersmith, in 1870, and Jordan himself is said to have brought out a small machine worked by a hand wheel aimed at the amateur carver at about this time.[60]

An important advance in the field came towards the end of the 1880s in the U.S.A. with the so-called "Moore Carving Machine". This machine, which had its counterbalanced cutters operating from the side rather than above, giving considerable advantages in terms of compactness and ease

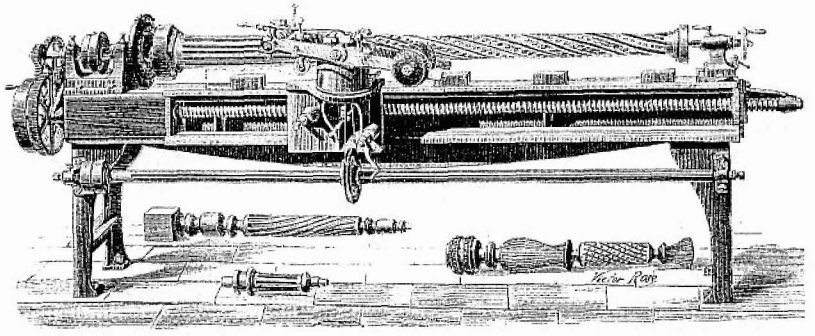


Fig 13: Copying lathe for cutting flutings, F. Arbrey and Co. Paris, from M. Powis Bale, *Woodworking Machinery* (1880)

of operation, was introduced into this country c.1890. It was extensively employed by companies like the Universal Woodcarving Machine Company.[61]

The British industry received a further boost soon after with the importation of two novel techniques. When the first of these, the "Goehring" process (so-called after its inventor Dr Chas Goehring of Allegheny, Pennsylvania), made its debut at the Building Exhibition, London, 1892, it "vividly excited the curiosity, and held the attention of numerous visitors to the show". Apparently it got an equally enthusiastic response at the Chicago International Exhibition of 1893.[62] In this process mouldings were cut out of the solid wood in a variety of patterns by Dr Goehring's geometrical wood moulding (copying) machinery. It was considered particularly suitable for the decorative treatment of ceilings, wall lining, wainscoting, partitioning, etc., and could produce panels of up to 84 x 24 inches in either hard or soft wood (Fig 14). The sole manufacturing rights for "Goehring" were bought by Messrs. Bennett & Sons, Manchester,

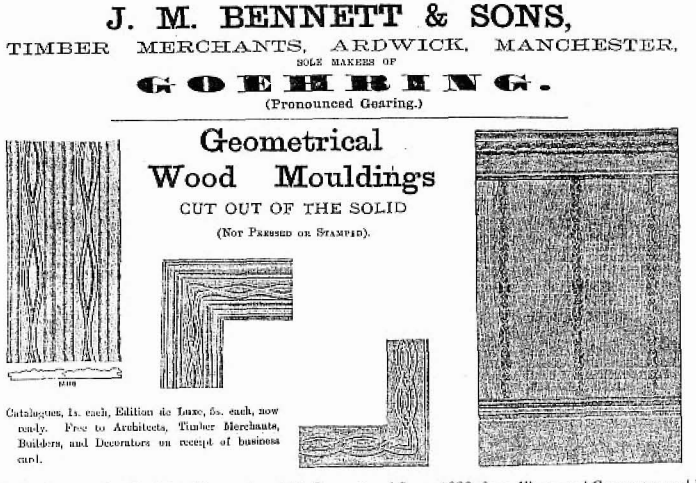


Fig 14: Advertisement for Goehring Decoration, J.M. Bennett and Sons, 1893, from *Illustrated Carpenter and Builder* 10 March 1893.

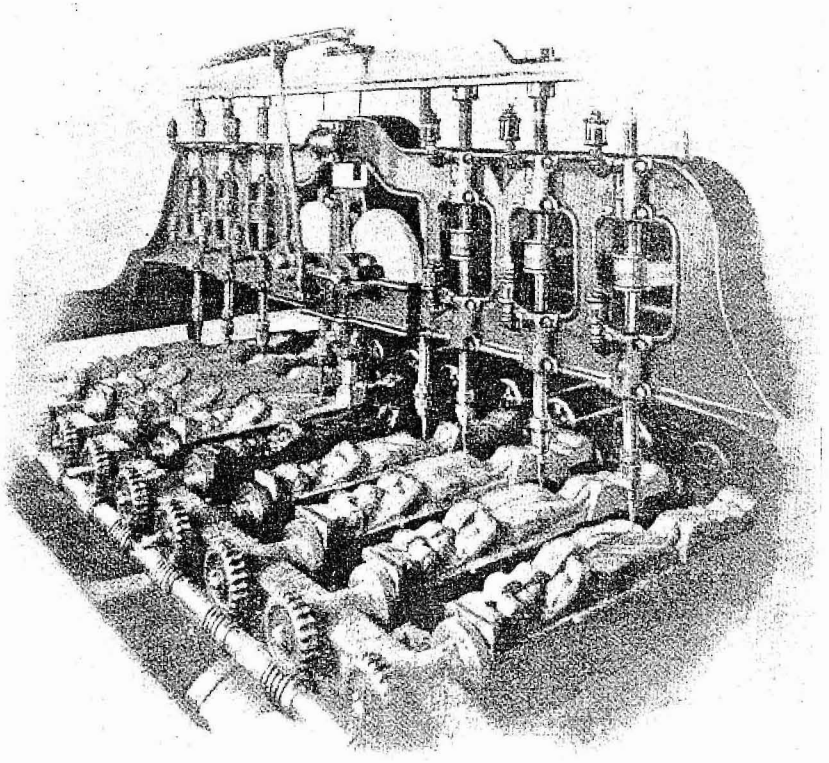


Fig 15: Automatic Carving Machine, from *Illustrated Carpenter and Builder*, 3 April 1903.

owners of one of the largest saw and planing mills in the country. They hailed it as "one of the greatest mechanical triumphs of the day", and claimed that the work could be done at one-tenth of the cost of manual labour.[63]

The second new decorative woodworking process came to England from France towards the end of the century. It was invented by M.A. Guattari of Paris and differed fundamentally from the above mentioned "Goehring" and earlier processes in that it relied on heat and pressure to decorate the woodwork. Red hot cast-iron moulds were used to char the required pattern onto the woodwork in a specially designed press. It could produce designs either in high or low relief in imitation of carved mouldings, brackets, cornices, caryatids, etc., as well as do flat, open or fret work such as foliage and arabesques.[64] It seems likely that the "patent pressing machinery" employed by the Cameo Woodworking company of Leicester and London for producing their exhibits at the Furniture Trades Exhibition in London in 1897 were of this kind.[65] How widespread the use of the Guattari technique became in this country is not known, but the process was apparently very popular on the Continent.

The final stage in the evolution of mechanised woodcarving was reached early in the twentieth century with the introduction of semi-automatic and automatic carvers. The labour saving potential of this type of machinery was enormous. Of the "Marbut Rapid Moulding Carver", exhibited by A. Ransome Co. at the 1900 Paris Exhibition, for example, it was claimed that a single operator could

do the work of 2,000 skilled carvers. It had a chisel action and produced highly finished ornamental mouldings up to 8 inches wide, out of any kind of wood.[66] An "automatic carving machine" illustrated in *Illustrated Carpenter & Builder* three years later (Fig 15) worked on Jordan's principle and could complete eight carved wooden figures 24 x 5 inches within an hour and three quarters completely unsupervised.[67]

To contemporaries the arrival of the fully automated woodworking machine must have made those goals identified by Stafford Ransome for the woodworking engineer (noted above) seem well within reach. This was, however, not the case, and even in 1924 Ransome himself was forced to admit that mission was still unaccomplished. What seems beyond question is that enormous advances had been made in almost every aspect of woodworking technology in the half century that had elapsed since the two great London exhibitions first roused public interest in the matter.

It was not only technical ambition that had motivated this drive towards mechanisation. Great commercial and social forces also were at work. One of these contributing factors was defined by J. Whitfield Harland in 1892. He wrote:

> *"One great factor that has operated in bringing machine tools into more favour is the foreign competition with native labour of those countries whose timber supply is not exhausted as our own is, and whence the freight of finished joinery is considerably less than that of the rough timber itself, which of course presupposes the freight of waste stuff....Our foreign competitors, both in America and Northern Europe, have been eager to adopt all labour-saving appliances in order to export to us at prices that we could not approach...The fact that our competitors used machinery naturally forced us to use it also to keep pace at all with them, and its introduction and extension became general"*[68].

In the third and final part of this paper I shall address this and related questions and explore the controversies which surrounded the apparently unstoppable march of machine technology as it manifested itself in the woodworking trades – both from the point of view of the craftsmen and those who took it upon themselves to champion the cause of the handworker.

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3. John Richards, *Treatise on the Construction and Operation of Woodworking Machines* (London & New York, 1872), pp. 32-3.
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5. Roderick Floud, *British Machine Tool Industry 1850–1914* (Cambridge, 1976), pp.15-7 sees woodworking machinery manufacturers as an early example of specialism within the British machine tool industry, but this definition only holds as far as they concentrated on the conversion processes for a single material, wood. For discussion of the concept of entrepreneur in late nineteenth century Britain, see P.L. Payne, ed. British Entrepreneurship in the Nineteenth Century (Basingstoke, 1988).
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9. J.H. Mansfield, 'Woodworking Machinery: History and Development from 1852 – 1952', *Journal of the American Society of Mechanical Engineers*, 74 (1952), p983.
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12. *Builder* (9 Sept. 1865), p.641.
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14. *Engineering* 14 (1872), p. 342.
15. *Illustrated Carpenter & Builder* (15 Oct. 1886), pp. 267-8.
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22. Quoted in *Illustrated Carpenter & Builder* (11 Oct. 1878), p.227.
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24. *Illustrated Carpenter & Builder* (27 Sept. 1889), p.227.
25. *Illustrated Carpenter & Builder* (29 May 1891), p.378.
26. Mansfield, *American Society*, p.983.
27. *Reports of Artisans selected by a Committee appointed by the Council of the Society of Arts to visit the Paris Universal Exhibition* 1867 (1867), pp. 124-5.
28. The technique was introduced by Manchester engineering firm Joseph Whitworth & Co. Only one woodworking machine, a bandsaw by Messrs. Powis James & Co. had such a frame at the 1862 London International Exhibition. William L. Sims, *Two Hundred Years of History and Evolution of Woodworking Machinery* (Burton Lazars, 1985), pp.28, 37.

29. *Engineering*, 13 (1872), p.26.
30. M. Powis Bale, 'Woodworking machinery at the Paris Exhibition', *Builder* (2 Nov. 1878), p. 1164.
31. G. Richards, 'On recent improvements in Wood-cutting Machinery', *Proceedings of the Institution of Mechanical Engineers* (March 1885), p. 79.
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41. J.R. Brown, 'York, a centre for Planemaking', *Tools & Trades*, 3 (1985), p.71.
42. *Illustrated Carpenter & Builder, Supplement* (4 Oct. 1895), p.5.
43. Gruban, *Illustrated Carpenter*, p.2.
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58. Richards, *Treatise*, p.44, 336, 228, which illustrates a "Duplicating and carving machine" and "Routing Machine", both by Messrs. A. Ransome & Co.

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