

A NOTE ON THE DIFFUSION OF THE AUTOMATIC LOOM WITHIN THE BRITISH COTTON INDUSTRY

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1. Introduction.

In a recent paper reviewing the development of automatic weaving technology [1], the present authors demonstrated that machines capable of producing the simpler types of cotton fabric were available from the turn of the century. Within the next 30 years, the technology could be applied to the bulk of the cotton industry's production. By 1930, therefore, there were few technical constraints on the adoption of automatic weaving machines in cotton textiles. With this in mind, it is the object of this paper to consider some aspects of the process of the adoption of automatic looms by the British cotton industry.

On 20th March, 1834, the British Patent Office granted a patent to John Patterson Reid and Thomas Johnson for a mechanism designed to change shuttles automatically. However, no record of the commercial development of this device has been found.

In 1857, Patrick McFarlane invented what appears to have been the first cop changing mechanism, in which mule spun cops placed in special containers were inserted into the shuttle, by means of a transfer hammer. As far as the British experience is concerned, it is not clear when the loom designed by McFarlane was first commercially available, where it was adopted for the first time, and in what numbers. Nevertheless, it can be gathered from an article published in the "Textile Journal" that these looms were at work in Britain in 1902 and that the idea had been developed in a commercial form by George Hattersley and Son Ltd. It was claimed that the loom was one of the most successful looms at work in Britain [2]. However, no supporting evidence for the claim was submitted.

The first bobbin changing loom in which bobbins, constructed in a similar manner to present day pirns, were transferred into the shuttle, was first patented in 1891 and later modified in 1894. The 1894 loom was immediately marketed by the American textile machinery firm of George Draper and Sons. The loom was named the "Northrop", after its inventor J.H. Northrop, a native of Yorkshire who had emigrated to America. The Northrop loom was first brought into Britain in 1895/6 for demonstration purposes and in 1902, the British Northrop Loom Co. was set up [3]. This improved the availability of the machine in Britain. Previously, U.K. manufacturers had to contact Draper in America in order to purchase Northrop looms, although it was not until 1902, that a British firm purchased its machines in this way. Sandberg has stated that machines obtained from America were charged at the American price (which was about one-third more than the later British price) plus transport [4].

Up to 1902, there is very little evidence of any substantial British experience in the use of automatic looms, although in America many firms had, by then, introduced automatics, particularly of the Northrop type. By 1895, 300 Northrop looms were at work in the United States and orders were in hand for 5,000 more [5]. By 1901, some 46,000 looms had been sold by Draper in the United States and by 1914, American sales amounted to over 286,000 looms. In that year, approximately 40 per cent of all looms in the Southern States were of the Northrop type [6]. At the end of 1933, there were 419,817 automatic looms in place in the United States and that accounted for 70% of the total. By contrast, in Britain there were 17,536 automatics in place (including looms with automatic attachments) and they constituted only 3% of all looms [7].

When the question of introducing automatic looms was being considered by British manufacturers at the turn of the century, it was expected that opposition from the trade unions was likely. In its issue for 15th June, 1895, the "Textile Recorder" pointed out that

"the mechanism [the automatic loom] does the work and has brought within the range of employment an operation long sought for",

but added that

"some trouble may be experienced with the weavers." [8]

In 1906, this view was reinforced by the statement that

"the managers should look forward with some apprehension to the possibility of wage troubles and disputes." [9]

Indeed, by this juncture, attempts to introduce automatic looms were already giving rise to industrial relations problems. Gibson, in his discussion of cotton textile wages in Britain and the U.S.A. [10], has described some of the early British disputes. It is not proposed to restate the detailed circumstances of these disputes, although it is worth summarising the experiences of one of the pioneering firms with a view to identifying the contemporary issues.

2. Early Disputes Over The Use Of Automatic Looms.

In May 1903, the "Textile Manufacturer", in commenting on a trade dispute, expressed the opinion that

"The Weavers Amalgamation [i.e. the Amalgamated Weavers' Association, the Lancashire Weavers' trade union] is trying to crush an expensive experience before it has had a chance to show its worth, and the same dastardly attacks are made on every shed which is adopting an automatic loom." [19]

However, in another article, on the same page of its May issue, the "Textile Manufacturer" reported on the successful introduction of automatic looms by W.H. Guthrie and Co. Ltd. of Todmorden. The following account of a visit to the company is given.

"After twelve months continuous work on a practical scale, this firm can show the exact position and definite capacity of the automatic loom in the Lancashire trade.

The shed contains 160 looms of the Hattersley automatic type (shuttle changing), all being overpick, with the exception of one underpick, which was put down among the others for

observation purposes. The looms were running at 180 picks per minute, although after an alteration of the engine for the purpose of ensuring a more even drive, they are about to be speeded up to 200.

For the last year these looms have been weaving plains, twills, jeannettes and sateens, each weaver minding eight looms.

On the first entrance into the shed, there is nothing different about the looms, although the scarcity of weavers at once strikes the eye. Another matter which becomes evident after being some time in the shed, is the amount of work weavers have to do; they appear to have a very comfortable time.

The quality of the cloth was fully equal to that of an ordinary loom, and there were fewer rather than more faults in the cloth.

A boy collects the full beams and carries them to the piece room. The same boy takes the weft to the weaver and has time also to act as a reacher in when required. There is also a man specifically told off to sweep and oil the looms, so that the weaver is spared all dirty work."

The same article, referring to the issue of union, opposition goes on to add that:

"If other persons who introduce the automatic loom, do it in the same practical manner as Guthrie and Co. have done, and let the weavers share in the advantages offered by its introduction, it may be that the unions will be found clamouring for its introduction rather than its abolition."

According to Gibson, [12], this installation dated from May 1902.

In spite of this auspicious beginning, the firm was involved in a lengthy dispute during 1904. Gibson [13], explains that this was precipitated in 1903 by the firm increasing the speed of its automatic looms from 160 to 186 picks per minute*. In response, the operatives requested an increase in wages from 28 shillings (£1.40) to 32 shillings (£1.60) per week. (Time rates rather than piece rates were in use at this stage).

* There is a discrepancy between the speeds quoted by Gibson based on a report in the "Cotton Factory Times" and the speeds quoted above from the "Textile Manufacturer."

This claim was refused by the company, although an offer of 29 shillings (£1.45) per week, until the end of 1903, was made. However, early in 1904, the firm introduced a piece rate system. In February 1904, a strike was called, and Gibson points out that, while it is not clear exactly when the strike ended, it was still in force in September of that year.

Evidently, the direct causes of the strike were, firstly, that the employers were not prepared to compensate operatives for the increase in loom speed to the extent that had been demanded and, secondly, that the operatives were not prepared to substitute piece rates for time rates. However, as the dispute ran its course, matters were complicated by, amongst other factors, the company's admission that

"The real point at issue is that we do not recognise the weavers' union since we are not members of the employers' union"[14]

and the union's statement that it wanted

"to make a thorough investigation into the merits claimed for these automatic looms"[15]

Several issues emerge from the circumstances surrounding the introduction of automatic looms by W.H.Guthrie and Co. Ltd. First, it is evident that, at the outset, if not subsequently, the company was successful in obtaining the consent of its operatives on the related issues of increasing the number of looms per weaver and determining an appropriate wage rate. Furthermore, the company appears to have accepted the case for the use of ancillary labour to perform less skilled work.

Failure to reach agreement on these matters was not unknown at the turn of the century, when British firms attempted to introduce automatic looms.

So far as the use of ancillary labour is concerned, the following extract from the "Textile Manufacturer" is of interest.

"It is a notorious fact that weavers are the last people in the textile industry to agree to any change unless it is a rise in wages. Our weaving sheds are conducted on the same lines as twenty or

even forty years ago. To judge by the fanatical opposition it has received in many quarters, the automatic loom might mean industrial serfdom, whilst even innocent mechanical knotters have been the cause of not only disaffection, but of strikes. Perhaps the greatest misunderstanding of all has centered around the so-called American methods, only they are what would have been adopted years ago in this county but for the fear of ignorant opposition." [20]

Here, the term "American methods" implies the provision of ancillary labour in order to concentrate the weaver's efforts on the production of fabric. The "Textile Manufacturer's" claim that such arrangements were opposed by the union is probably a reference to a dispute at Burnley in 1903 over the issue of weft and cloth carrying, and the employer's proposal to deduct 3d per loom per week in consideration of what the "Textile Manufacturer" had then, referred to as the "so-called advantage of the American methods". On 11th November, 1903, 146 weavers struck in protest against the proposal, but work was resumed on 16th November, in order to allow further negotiations to be carried on. These proved abortive and work was ceased on 25th November. This time, however, some 460 weavers were reported to have joined in the dispute. In retaliation, the firm concerned obtained outside labour, and in January, 1904, announced that the places of the strikers had been filled [17].

Subsequently, W.H. Guthrie and Co. Ltd. was faced with a number of further issues which, like the ones with which it had coped successfully during the initial stages of its experiment with automatic looms, had precedents elsewhere within the industry. Specifically, the issue of the relationship between loom speed and wage rates emerged and proved difficult to resolve. As the dispute over this issue developed, the question of trade union recognition became a complicating factor. Another issue was raised by the trade union's claim that the merits of automatic looms were not proven.

With regard to the merits of the new technology, in other circumstances employers had expressed similar reservations from time to time. The following extract from the "Cotton Factory Times" is part of a statement issued by the management of Messrs. Ashton Bros of Hyde during their attempts to introduce Northrop looms in 1903. Although

quoted by Gibson, it is worth restating, not least because it links the question of potential of the automatic loom with the matter of operative work loads.

"The trial of these looms is still in the experimental stage so far as their use in this country is concerned, and we are not prepared to commit ourselves to a standard rate till we know more fully the capabilities of the weaver, and of the loom ... our object has been, and is if we find an economy in working the new looms, to give part of the advantage to the weaver... We are told that the British artisan is the best worker in the world, and we believe that there is much truth in this. We therefore, cannot see why he or she should be limited to work a smaller number of looms than is done by the average worker either in America or the continent of Europe, and we cannot consent to it. We have to compete in trade with the rest of the world, and our success is equally important to our weavers as to ourselves. You propose a retrograde step."**[18]**

The suggestion that the capabilities of the automatic loom were not known seems strange for, by the early years of this century, in the U.S.A., where there was considerable experience of the technology, it was consistently reported to be successful, although limited in its application to the production of plain fabrics with a single weft. Furthermore, the "Textile Manufacturer's" report on W.H. Guthrie and Co. Ltd. in May 1903 suggested that this firm was fully conversant with the capabilities of the automatic loom.

Perhaps the major issue raised by the statement above is the magnitude of the economies brought about by automatic looms, principally by allocating more looms to each weaver, and the extent to which operatives ought to share these benefits. In the U.S.A., on average, weavers had obtained a 25 to 30 percent increase in their wages through the introduction of automatic looms.**[19]** Furthermore, as far back as 1895, American weavers tended up to 16 automatic looms, while working conditions were more favourable than in some British firms, in that ancillary labour was provided for battery filling, cloth and weft carrying, sweeping, cleaning, etc.

To reproduce such conditions in the U.K. would have demanded a fundamental revision of the industry's wage arrangements and, in

particular, the abandonment of the piece rate systems incorporated in the Uniform List of 1892 (for the weaving of grey fabrics) and the Colne Weavers' List of 1890 (for the weaving of coloured fabrics). These lists were deficient in that they were based on subjective assessments of workloads and assumed both a static technology in the form of a non-automatic power loom and static working methods. In any event, it was not until 1948/49 that the report of the Cotton Manufacturing Commission [20] paved the way for the adoption of wage arrangements based on the objective assessment of workloads using work study, by high-lighting the inadequacies of the traditional payment systems. It was only at this stage that the prerequisites for assessing workloads and determining wage rates with the minimum of conflict were met. Undoubtedly, this consideration is to some degree relevant in explaining the slow diffusion of the automatic loom in the British cotton industry.

3. The Diffusion Of Automatic Looms In The British Cotton Industry.

In any event, the introduction of automatic looms within the British cotton industry did not proceed at a significant rate until after the Second World War.

There are no continuous and reliable records of the number of automatic looms in place in Britain prior to 1930. However, in 1910, it was reported by the "Textile Recorder" that there were about 8,000 Northrop automatic looms working and it is likely that a much smaller number of automatics from other makers were also in use. These looms represented only 1 per cent of the total available in the industry. By contrast, in the United States in the same year, there were 181,655 Northrop automatic looms in place distributed among 350 firms, which had anything from one loom to 6,110 looms each. These looms accounted for one third of those installed in American industry [21].

Although it was repeatedly mentioned in the textile journals that automatic looms should be adopted in view of the growth of foreign competition, nonetheless, the progress in installing automatic looms continued only very slowly after 1910. Undoubtedly, the trade disputes mentioned above, together with the prospect of trade disputes, were

major factors discouraging the adoption of new technology both before and after the First World War. Furthermore, the generally good trading conditions during the pre-First World War period and the ability of the industry to earn profits using existing machines provided little inducement to consider technological change. In addition, an abundant supply of relatively cheap labour was available and, in this context, the British manufacturers may have behaved quite rationally by continuing to invest in non automatic looms. In 1914, alone, the town of Great Harwood had 1670 new looms, Chorley had 1318 new looms and Blackburn had 933 new looms, although 4,955 new looms were installed in 1913, and 4,670 in 1912. Several other towns had also installed new looms in 1914 in considerable numbers, notably Bury with 771, Nelson 752 and Preston 554. All these looms were of the non-automatic kind [22]. It has been estimated that by 1914, the number of automatic looms in Britain did not exceed 10,000 [23]. At that time, a total of not less than 808,000 looms of all kinds were used in the production of cotton fabrics [24]. Automatic looms, therefore, constituted only about 1.1 per cent of the total number of looms in place at that time.

From 1914, however, some of the factors mentioned above had reversed in favour of automatic looms. Trading conditions had started to deteriorate and, due to the effects of the war, a serious shortage of labour had been brought about. A very fair minded view on the issue of automatic looms was expressed in a paper read by Oscar S. Hall at the annual meeting of The Textile Institute in 1915. Whilst he recognised the scarcity of labour and foreign competition as specific factors working in favour of automatic looms, nonetheless, he was of the opinion that a comprehensive evaluation of the rationality of using the technology was needed. Mr. Hall's discourse continued with a comment on raw material costs. The opinion was expressed that, because better qualities of materials and, therefore more expensive materials, were normally used for automatic looms, it did not follow that automatic looms should be rejected. Attention was drawn to the fact that the increase in unit material cost was likely to be more than offset by reductions in capital cost per unit due to a reduction in yarn breakage rates [25]. While this seems to be rather obvious, it was a fact which, judging from the contemporary trade journals, had escaped the notice

of many authorities within the industry. On the other hand, Mr. Hall mentioned that the reorganisation of working methods on existing machinery could also improve the industry's productivity and efficiency vastly, a line of thought which was revived much later when the industry was in rather a desperate position and badly needed to improve its productivity without incurring great capital expenditure.

The inter-war years were a period characterised by disputes over wages for non automatic looms, many of which arose from the introduction of the new working methods outlined above. It was also a time of rapidly declining exports. Very little was done to improve the industry's technology. By 1931, automatic looms constituted only about 2 per cent of the total number of looms in place [26]. As shown in Figure 1, in 1933, there were 17,536 automatic looms in place, as compared with 570,429 non-automatic looms. By 1936, the number of automatic looms in place in Britain had increased to 20,789 [27], but these looms represented only about 4 per cent of the total available to the industry.

By the 1930's, it seems that, in those mills where automatic looms had been introduced, they were accepted by the weavers and that the employers probably gave reasonable wage rises in response, as no longer was every new installation of automatic looms followed by disputes over wages and work loads. However, as stated above, the use of the technology was far from widespread, and certainly no nationally agreed piece rates were in operation.

As late as 1930, the relative merits of automatic looms were not fully known and in that year [28] a test was started at the Higher Walton mill, near Preston, of the Lancashire Cotton Corporation. This was designed to assess the relative merits of fully automatic looms, ordinary looms fitted with weft replenishing attachments and ordinary non-automatic power looms [29]. Altogether, 320 looms were included in the test. This was made up of the Northrop, Vicker-Stafford and Platt-Toyada automatic looms, 40 each of Whittaker, Fairfax, Gawsworth and Terry weft replenishing attachments and 40 Lancashire looms.

Attempts were made to test each type of loom in the weaving of 117 yards to the piece, of a 34 1/2 inch wide cotton cloth made from 24's cotton count warp and weft with 66 picks per inch and 59 ends per inch, under identical conditions, in so far as this was possible. It had not been decided definitely how many looms a weaver could work, but for looms fitted with weft replenishing attachments, it was expected that the weavers would start on about eight and rise perhaps to sixteen, as they became accustomed to the work; in this event, six or eight looms were assigned to each weaver. It was stated that the Weavers' Amalgamation had agreed to the rates to be paid, and was cooperating with the Lancashire Cotton Corporaion in this experiment [30].

The experiment was a comprehensive one and cost comparisons were given in various issues of the "Textile Manufacturer" and the "Journal of the Textile Institute". Automatic looms in general, showed advantages over the Lancashire loom, in terms of increased efficiency and the quality of fabrics produced. However, whilst the costings showed a definite wage cost advantage for all the automatic looms against the Lancashire loom, the additional expenses arising in the main from the greater interest and depreciation charges and the additional cost of weft preparation for automatic looms could only be offset in full if shift working were adopted. On single shift working the Lancashire loom showed an advantage in total production costs of 3 1/4d per piece (each of 117 yards) over the Northrop loom which had the lowest production cost amongst the automatics. If, however, the automatics ran double shifts, the advantage was 6d per piece in favour of the Northrop. When it is realised that the range of conversion costs was stated to be from 113.69d to 107.81d per piece, it will be appreciated that the advantage attached to the use of automatics on double shift working was marginal.

It must be realised, of course, that the above conclusions only applied to one type of cloth, and that different results were likely for coarser and finer cloths, or cloths of different construction. In particular, there would undoubtedly be a greater advantage in favour of automatic looms in the weaving of coarser wefts, since more frequent pirn changes are required. Furthermore, had more looms been allocated to automatic loom weavers whilst working double or treble shifts, it is possible that the automatic looms might have shown a greater advan -

tage in the total cost of production. Whether such an advantage would have been sufficient to justify capital expenditure in the depressed years of the 1930's, or whether the change in working practices in order to introduce multiple shifts and also bring about a system for allocating more looms per weaver would have been easily attainable, is questionable.

Since the test had been carried out on one particular type of cloth, the Lancashire Cotton Corporation was encouraged by the trade press to carry out further tests on a variety of fabrics [31]. Although it is not known whether such tests took place, this in itself showed that the manufacturers were in favour of extensive tests to establish the capabilities of automatic looms for different fabrics.

It seems that loom makers also were concerned about the slow progress in adopting automatic looms. British Northrop was understandably concerned and was one of the very first to start aggressively promoting automatic looms. During 1929 and 1930, a series of meetings was held between the representatives of the company and a deputation of the Burnley manufacturers, "for the purpose of discussing automatic weaving as a method of reducing costs and increasing demand for cloth". According to the "Textile Recorder", this sudden interest in automatic looms had been brought about as a result of the continuing loss of trade suffered by Lancashire manufacturers, in the later years of the 1920's in particular [32]. It was also stated in the "Textile Manufacturer" that the industry could not carry on except by reducing production costs [33]. However, as stated above, the 1930's were not characterised by large scale adoption of automatic weaving in Britain.

Between 1936 and 1949, only about 6,000 automatic looms were installed in Britain; and, even though the number of non-automatic looms in place in the British cotton industry fell by about 125,000 (almost 25 per cent) during the same period, in 1949, automatic looms constituted only 6.8 per cent of the total number of looms in place.

It was not until the post-Second World War period that automatic looms gained widespread acceptance in Britain. From Figure 1, it can be seen that the 1950's witnessed some increase in the adoption rate, the size of which must be judged against the rapid decline in output which

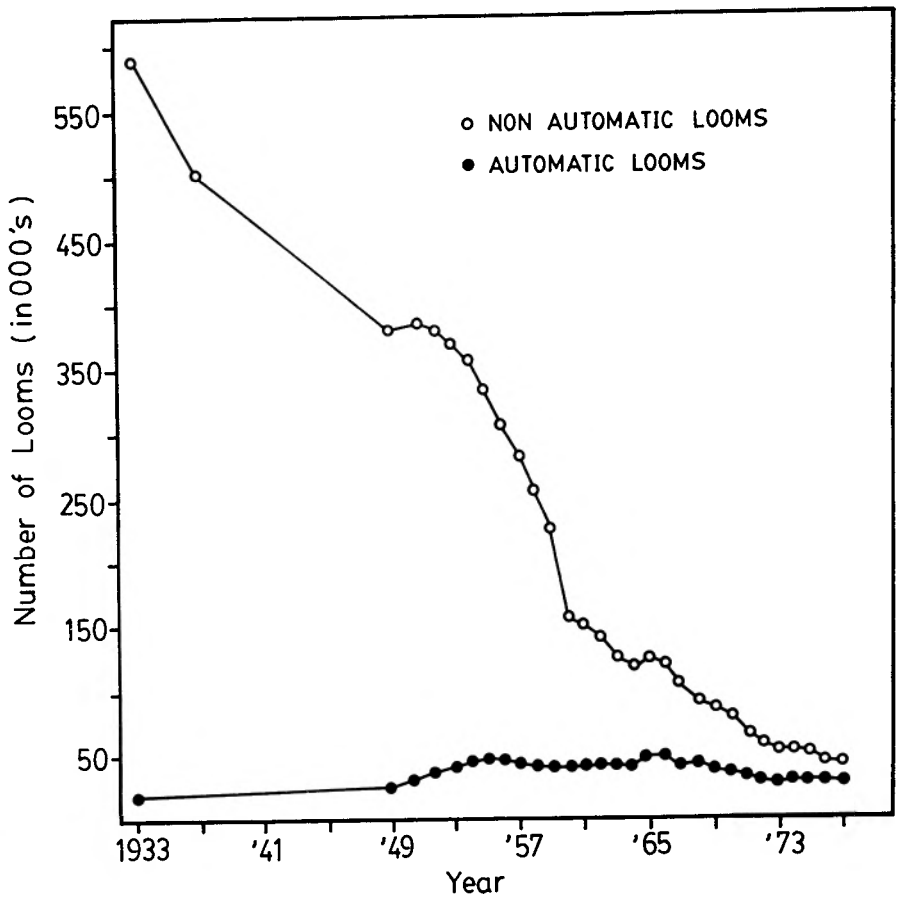


Figure 1. Number of looms in place in the British Cotton Industry.

the industry was then experiencing. The number of automatic looms reached a peak in 1965 but then declined, in the main, because firms went out of business or changed to shuttleless looms. Nevertheless, it is evident from Figure 2 that the number of automatic looms as a percentage of the total number of looms in place continued to increase sharply. It ought to be emphasised that this was due to the fact that the decline in the number of non-automatic looms proceeded at a faster rate than the decline in the absolute number of automatics. The number of automatic looms in place in 1977 was less than in 1949, although, in 1977, the automatic looms as a percentage of total looms was more than eight times of that in 1949.

4. Conclusion.

It is apparent that, while automatic weaving was technically adequate for the manufacture of the less sophisticated cotton fabrics by the early years of this century and for the higher quality fabrics at an early stage within the inter war period, the adoption of automatic looms proceeded only very slowly. This is in contrast to the position in a number of overseas industries, where the introduction of the new technology was achieved more rapidly. In Britain, not until the period after 1945 did the percentage of automatic looms in use advance significantly. Even then, it was not only the introduction of more automatics but also the large scale scrapping of non-automatics which was responsible for the progress made.

In accounting for the slow rate of adoption of automatic weaving in Britain, several of hypotheses can be advanced. Initially, it is perhaps inconceivable that any large scale use of automatic looms would have been evident in the pre-First World War period, in view of the then excellent trading conditions and the abundant supply of cheap labour. Following the First World War, however, the rapid decline of cotton fabric production in Britain must first be considered. It must be recognised that, in responding to these conditions, manufacturers were at least prepared to consider the use of automatic looms as the interest shown in the Lancashire Cotton Corporation experiments in the early 1930's tends to confirm. The fact that this interest did not result in an industry-wide adoption of automatic looms may suggest that the

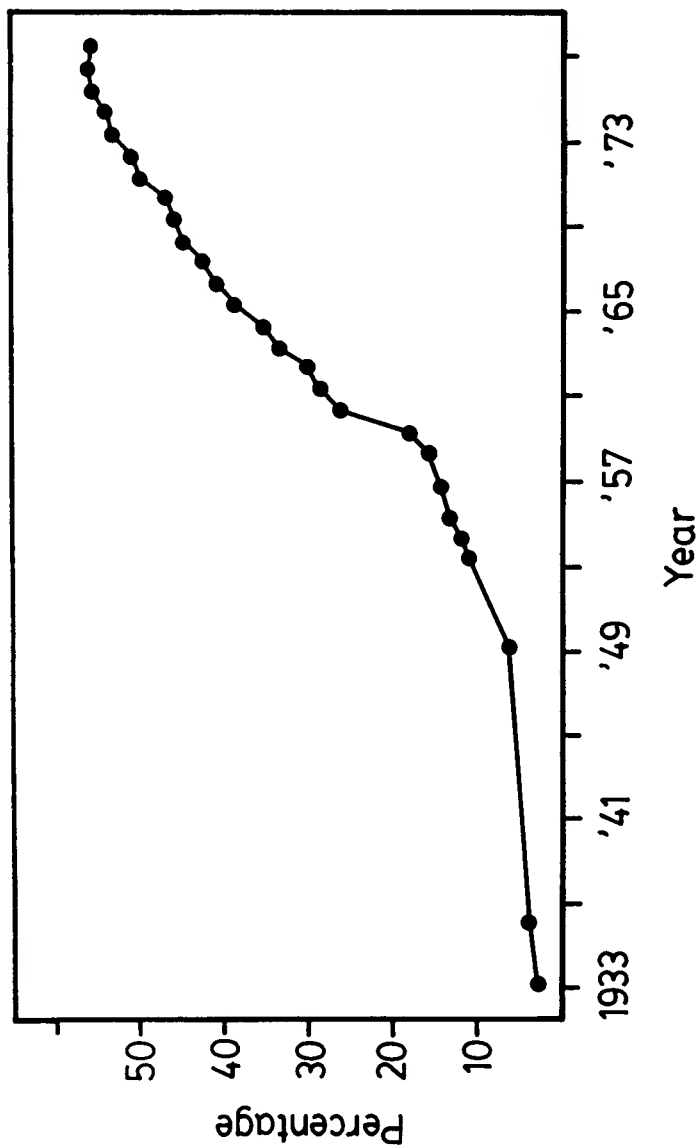


Figure 2. Automatic looms as a percentage of the total number of looms in place in the British Cotton Industry.

savings in labour costs arising from the introduction of automatic looms were insufficient to justify the expenditure on the new equipment. (Although generalisations cannot be made on the basis of the Lancashire Cotton Corporation experiments, since they related only to one fabric construction, it is worth recalling that they indicated only a marginal cost advantage for automatics.) Alternatively, if a net advantage was available, it is conceivable that this was insufficient to confer a significant price advantage on the industry's products in world markets. A third possibility is that, under the trading conditions of the inter-war years and in view of the generally small size of the firms, manufacturers either were not earning the retained profits necessary to finance the adoption of new looms or were unwilling to commit their capital in the face of rapidly deteriorating trading prospects.

However, the early disputes arising from the introduction of automatic looms cannot be ignored. What they reveal is a system of wage arrangements and an associated industrial relations environment which was singularly inappropriate to the introduction of new technology to the weaving process. These conditions persisted until the immediate post-Second World War period and may well have contributed to the low rate of adoption of the automatic loom.

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