

CHAPTER 10

THE JEWS, THE ENGLISH INDUSTRIAL REVOLUTION, TECHNOLOGICAL INNOVATIONS AND THE SCIENCES: FROM ABSENCE TO PREDOMINANCE (a very preliminary empirical research)*

Paul Bairoch (1930-1999)

University of Geneva

1. Introduction

The role of Protestants and Huguenots in the surge of the technological revolution during the Industrial Revolution has filled the discipline of economic history with a profusion of research and polemics. By contrast, the role of Jews has been quite a neglected field and little is known about the importance of their contribution. While among the financiers and the founders of the Bank of England some names are known to be Jewish, there is no research, of which I am aware, that analyzes the role of Jews in the Industrial Revolution. This chapter intends to be a preliminary research on this subject. Analyzing the role of religious or national minorities can be a delicate task. Delicate, since there are few serious empirical studies on the subject and, more specifically, because of the way the results will be interpreted by the non-minority (the majority or at least some groups) ranging from “they eat our bread” to “they contribute greatly to our economy.” It is therefore with some reticence that I analyze this subject.

The role of Jews can be defined in many ways. I will limit myself to a quantitative research where the importance of their role will be measured by their numeric importance in the fields related to the Industrial Revolution: technological innovations and science. The chapter has three parts. The first will deal with the Jews and the English Industrial Revolution. The second and most important one examines the role of the Jews in the history of technology, and the last part will be devoted to a brief overview of the role of Jews in the sciences.

2. The Jews and the English Industrial Revolution: A Surprising Absence

For years, when dealing with the first phases of the English Industrial Revolution, I was surprised that not many Jews were mentioned. This surprise goes back to more than thirty years ago, in fact, in 1956 when I started my research for my Ph.D. dissertation (Bairoch, 1963) on a topic related to industrialization. When studying the Industrial Revolution I was shocked by some analyses, which tended to overestimate the role of certain social and professional classes during the Industrial Revolution without giving adequate proof. The relative contribution of a specific group (e.g., merchants, bankers, noblemen, etc.) was estimated by evaluating their relative size in the economy. This method is not valid. For

example, if one finds that, at the beginning of the nineteenth century, 40 percent of textile entrepreneurs were former farmers, it does not necessarily imply that there was a massive change of occupation among the farmers, since they represented almost 80 percent of the total working population. I decided that the most valid approach, or at least a less arbitrary one, was to check if the relative importance of a specific group during the Industrial Revolution was larger or smaller than its size in the total population. In order to check the role of the Jews, I had to draw up a list of the major actors in the English Industrial Revolution and then check how many were Jewish.

I chose to deal with the first phase of the English Industrial Revolution since this is the most important event in modern world history. The time limits set were between 1690 and 1790, since before 1690 nothing important had yet taken place, but after 1790 the English Industrial Revolution attained a point of no return. In drawing up this list, a quite wide range of books was chosen, although limited by several constraints the most important of which was the availability of an index (a greater problem in French than in English books that deal with that period and that country). Of this wide range of book only 15 were to be analyzed for compilation of this list.¹

A first approach was to find the term Jew (or Jews) listed in the indexes. I was surprised that only three out of the 15 books have the word Jew in their index and even then only in limited occurrence. The index where the term Jew appears the most is in Ashton (1972), where Jew is cited three times, but all concern very minor aspects, almost anecdotal, on the role of Jews. On page 172, Ashton cited the *Gentleman Magazine* of 1763, which stated that the demand for gold was so great that Jews gave four guineas for an ounce. On page 190, speaking of bullion dealers he mentioned that "they were generally spoken as the Jews" and finally on page 222, dealing with the labor condition, he wrote that "the Jews most of them were refugees and were in a weak position in the labor market." He insisted that "it is almost impossible for them to be apprenticed to a Christian. And since they could not work on Saturday (the Sabbath), most employers were unwilling to take them even as unskilled labor. No wonder that so many of them took to peddling, dealing in second hand clothes and uttering false money." Mathias (1983) mentions Jews only twice in his index and finally, Wilson (1984) mentions Jews only once.

The second approach was to review the list of names appearing in these 15 books. In total, those 15 books cite 314 different persons. I examined how many Jews are among those 314 individuals. Probably no more than six, but certainly at least three, among whom the most important being Baron Nathaniel Mayer Rothschild and the second Gideon Samson. To those we have to add Aaron Goldsmid and Nathaniel Kent, totaling four Jews. But, in fact, even Rothschild does not really belong to the list since he arrived in England only in 1799. Gideon Samson was a descendant of a Jewish Hamburg scholar. At first he was very active in Jewish life, but he married out of the faith, his children were baptized, and he gave up his synagogue membership. So if we exclude Rothschild but include Gideon and take into account that I am not very well versed in Jewish toponymy, we can conclude that among the 314 persons listed in those 15 books at least three or as many as six were Jews (less than 2 percent).

How famous were the Jews who are cited in those books? One way of estimating this is to see how many times or in how many books they were cited. In fact, only Rothschild is cited quite often, in six books out of the 15. On average the three other Jews were only cited once while the average citation for the 314 names was 2.5. As many as 28 persons are cited more than six times, even more than Rothschild is. This list of 28 persons includes those

whom I have called the “super stars” of the Industrial Revolution (see Bairoch, 1997). Among them, four names are cited in all the 15 books; three names are cited in 14 out of those 15 books.^{2,3} Lastly, three names are cited 12 times.⁴

Taking into account not only the small number of Jews in this list but also their rather very limited importance, it is completely justified to conclude that Jews played a very limited role in the first phases of the English Industrial Revolution. This leads me to examine the reasons for such a limited role, reasons that are in some respect quite obvious. First, the presence of Jews in England during this period was very limited. We should recall that the Jews were expelled from England in 1290 and their re-entry was permitted in 1656. Even in 1690, the beginning of the period which we cover, their number in England was approximately only 800, and circa 1790 it was approximately 20,000-25,000 representing less than half a percent of the total population. Another reason is that almost all the Jews lived in London or in other large cities; while one of the main characteristics of the Industrial Revolution is that large cities did not play a major role in the fostering of the Industrial Revolution.⁵

But, finally, what may be even more important and what struck me very strongly is the total absence of Jews among the “super stars” of the Industrial Revolution, who were mostly, or if not totally, people linked to technology. This led me to undertake a more important study on the role of Jews in the history of technology in order to check whether this absence of Jews in the English technological innovation was an exception or a rule.

3. Jews and the History of Technological Innovation: 1700-1940

This period, 1700-1940, is the relevant one to investigate since it is during those 240 years that the major innovations that still shape the world of today (or at least up to 1970), were conceived. In this section I analyze the influence of the Jews on technological innovations during this period. Moreover, I check if the findings for this period are also valid for the second half of the twentieth century.

This research is largely based on *The Timetables of Technology. A Chronology of the Most Important People and Events in the History of Technology* edited by Bunch and Hellemans (1993), and was completed by three other important sources which will be dealt with later.⁶ This book is very useful because it has a very detailed and extensive index including 1930 names for the studied periods. However, the number of names related to the history of technological innovation, excluding medicine, is 907, still a large sample. Out of the 907 names 40 had a possibility of being Jewish representing only 4.4 percent of this sample, although after a very elementary check this list included a large number of people who were not Jewish. For example, the list included Isaac Singer and Joseph Kestner. Isaac Singer who was the inventor (or at least is regarded as the inventor) of the best first sewing machine, was not Jewish. Joseph Kestner is less well known in the history of technology. I was “attracted” by him during my research on the history of technology because he was a very original figure, since he founded the first modern polytechnical school where he was a professor of mathematics. (This polytechnical school was in Austro-Hungary, in Prague and not, as it is generally believed, in Germany). Because he was such an unorthodox person he may have been Jewish; however, on investigation, it seems that he was not.

After having checked all the 40 names I came to the conclusion that among the large list of 907 persons, 11 names were almost certainly Jewish, representing only 1.2 percent of the sample. Those 11 persons are the following: Leo Arons, Herta Ayrton, Emil Berliner, Johan

Goldschmidt, Fritz Haber, Moritz Herman Jacobi, Felix Klein, Artur Korn, Otto Lilienthal David Schwarz and Chaim Weizman.⁷

I then examined the other three books on the history of technology from which I drew a list of possible Jewish names. Gille (1978) cites for the same period 353 names of which only 11 appeared to be Jewish, which represents 3.1 percent of the sample -- less than the list of possible Jewish names in Bunch and Hellemans (1993). The second French source was the dictionary of inventions edited by de Galiana and Rival (1996). Despite the fact that a picture of Einstein was on the cover, out of 360 names only seven could be Jewish, which represents a ratio of 2.2 percent; that is even less than the previous one. Finally the third and largest source is the *Biographical Dictionary of the History of Technology* of Day and McNeil (1996). The presentation of the book prevented me from concentrating on that period alone so that contemporary period is also included. Out of a total of 2,160 names only 57 could have being Jewish, representing a ratio of 2.6 percent, less than the ratio derived from Bunch and Hellemans (1993).

If one postulates that the share of genuine Jews among those retained as possible Jewish names in those three books is more or less similar to the one I arrived at in the sample derived from Bunch and Hellemans, the conclusion is that approximately 0.7-1.2 percent of the technological innovations were made by Jews. In order to interpret this data it should be compared to the share of Jews in the total population. I only examine the proportion of Jews in the total population of *developed* countries since during this period almost all innovations were made in this part of the world. Circa 1750, Jews represented around 1 percent of the population of developed countries and by 1913, around 2 percent, giving an average of approximately 1.5 percent. Therefore the share of Jews contributing to technological innovations is lower than their share in the total population.

However, one has to take into account that during the period investigated, contrary to the first phases of the English Industrial Revolution, almost all innovations were made in cities. I therefore have to compare it to the share of Jews in the urban population of developed countries. On the basis of the data from Leitenberg (1999) I have estimated that around 1750 probably 1.1-1.5 percent of the urban population of developed countries were Jews while circa 1913 this had increased to some 4.1-4.3 percent, which on average for the period comes to roughly 2.6 percent. Thus the share of Jews in technological innovations is two to four times lower than their share in the urban population.

I have shown that the numbers of Jews is negligible, but could it be that these Jews are among the famous innovators? In order to investigate this problem, I have checked how many times Jews are cited in books that study the history of technology. Starting with Bairoch (1997), where two and a half chapters are devoted to the history of technology, I found that none of the above mentioned 11 names which were considered as being certainly Jewish in Bunch and Hellemans' book (1993) were cited. Eight other books specializing in technology and inventions were checked.⁸ In these eight books, the 11 names were cited on average 2-4 times, but this average results from a very wide spread ranging from one citation to 11, 11 refers to Otto Lilienthal. The next most often cited Jews are Moritz Jacobi, cited seven times, then Fritz Haber and Emil Berliner who are cited five times. Concerning Lilienthal, the *Encyclopedia Judaica* (1971) states that it is uncertain if he was Jewish, and that both Jacobi and Haber left the Jewish faith. Only Berliner can be claimed of being totally Jewish, and he was not only Jewish but also a Zionist, active on behalf of the Hebrew University of Jerusalem. He was born in Germany but immigrated to the United States at the age of 19.

To summarize, I have found that Jews were not often cited. None of them are among the “big stars,” but these four mentioned were still “important.” It is obvious that such a method of measuring the impact of Jews in the history of technological innovation needs some reservation, since some persons get emphasis for various factors, e.g., personality, that are not always related with their genuine impact on technology. To give just one example, in my last book (1997) I put the emphasis on Frederic Koenig who is the inventor of the modern printing press in 1811 and is often called the second Guttenberg. However, he is cited only in seven books while people like James Watt, James Briedley and other outstanding innovators, not to mention Thomas Edison, are cited in all 11 books.

This brings me to the conclusion that not only were there few Jews among the innovators of technology nor were they outstanding in their accomplishments. The question now arises as to how this phenomenon can be explained.

While the absence of the Jews in the English Industrial Revolution is not a new finding, and is generally recognized as Rubinstein (1996, p. 65) wrote: “Jews stood at the fringe of the Industrial Revolution,” the absence of the role of Jews in the history of technology has never been stressed. On the contrary, in his classic book, Cecil Roth (1938, pp. 171-88) *emphasizes* the role they played. He even mentions Singer (one of the inventors of the sewing machine) as being Jewish although this is not the case. As seen above, this chapter is a preliminary research that may rectify this impression and assess the absence of the Jews in technological innovations.

I will now make a very rough attempt to explain this absence of Jews in the history of technology. Probably the major explanatory factor is found in the theory that links technological innovations to the knowledge about bottlenecks affecting various industrial sectors. The pioneering work in this aspect is of Schmookler (1966). Indeed, very few Jews were working in sectors that were extensively using technology. It must not be forgotten that already in the eighteenth century Jews were not admitted to guilds and that even in the nineteenth century and part of twentieth century their presence in activities linked to technology was rather limited.

Another explanation which can be put tentatively forward is linked to mentality. Jews have generally been oriented more towards speculation than to technical research. And going back to pre-Talmudic period, it appears that even in this period Israel was less advanced in technology than in other fields of science and philosophy. But obviously, this question needs more research and this is the reason why I have given this chapter a subtitle limiting its scope. We have to be aware that the results are dependent on periodization and regional analysis (for instance, among the 11 Jews who played a role between 1700-1940 some 90 percent produced their major innovation after 1887).

4. The Jews and the Sciences: A Very Massive Presence

A good indicator for the presence of Jews in the sciences is the prestigious Nobel Prize award, since due to its notoriety, there are good statistics on the Nobel nominees as well as on the share of Jews among them. From 1901, the Nobel Prizes have been awarded in three scientific disciplines: physiology or medicine, chemistry and physics, and two additional Prizes in non-scientific discipline: peace and literature, and from 1969 there has been a Nobel Prize in economics. Taking into account the entire period, 1901-1995, it appears that one fifth of the Nobel laureates were Jewish.⁹ Two questions arise: has there been an evolution over time? And are there differences according to sciences? In both cases the answer is positive.

As can be seen in table 1, the evolution of time clearly shows an increase of the percentage of Jews in the total of the three sciences. This proportion went from 14.1 percent for 1901-1914 to a peak of 24.3 percent for the 1960-1969 period, thereafter decreasing a little bit for the more recent period. For the 1901-1995 period, analyzing the percentage of Jews in the various fields of science, the lowest share is chemistry where Jews represent only 12.7 percent of all the Nobel laureates; one should keep in mind that chemistry is also a field which is the closest to technology. The two highest shares are in physiology or medicine where the share is 28.7 percent and physics where the share is 19.8 percent.

TABLE 1

Historical Evolution of the Percentage of Jews among Nobel Laureates in the Sciences
(percent)

Period	Physics	Chemistry	Physiology or Medicine	Total of the Three Sciences
1901-14	11.1	21.4	18.8	14.1
1915-29	22.2	18.2	8.3	12.1
1930-44	16.7	6.7	29.4	12.9
1945-59	12.0	0.0	27.6	12.0
1960-69	41.2	12.5	21.7	24.3
1970-79	20.8	13.3	30.8	23.3
1980-89	14.3	22.7	38.1	23.9
1990-95	20.5	12.1	53.8	16.8
1901-95	19.8	12.7	28.7	17.5

Notes: For the 1901-95 period the percentage of Jews is 10.8 for literature and 6.5 for peace.

For the 1969-95 period the percentage of Jews is 37.0 for economics.

We should compare this ratio to the proportion of Jews in the population of developed countries. Around 1913 Jews represented 1.9 percent of that total population, and circa 1995 the proportion declined to 0.9 percent, which for the whole period represents an average of 1.4 percent. This means that there were 15-16 times more Jews among Nobel laureates than their share in total population. However we must also take into account that most of the innovations in the scientific field are due to people living in urban areas. Although there is a dearth of very good statistics about the share of Jews in the urban population of developed countries, it is likely to be between 3 to 4 percent. This means that Jews were 6-7 times more numerous among the Nobel Prize winners compared to the total urban population of the developed countries. In order to examine whether the high proportion of Jews in sciences for the 1901-1995 period is also valid for the second half of the nineteenth century, a very preliminary and crude check was made. From Daumas' (1957) *Histoire de la science*, a list of scientists (excluding demography and psychology) who were born between 1800 and 1850, was drawn up. This yielded me 431 names for which after a preliminary check I concluded that probably 16 to 20 percent of those were Jews. This proportion is very close to that for the Nobel Prize in sciences for the first 95 years of the twentieth century.

5. Conclusion

The short and very preliminary research presented in this chapter confirms that there is an unequal balance between Jews engaged in economics and business, and those in

intellectual fields. While in the first phases of the British Industrial Revolution, one sees an almost total absence of Jews, it is known that Jews played a more important role in the subsequent stages of the Industrial Revolution, (not analyzed in this research) more specifically in finance and textile. Moreover, in the first phases of the Industrial Revolution in other Western countries, the role of Jews was more important than it was in England.

However, the small presence of Jews in technological innovations seems a robust empirical regularity, at least for the Western world and for the last three centuries. By contrast, the role of Jews in science, in the last one and a half centuries and in the same geographic place, has been primordial, compared to its size in the total population. Moreover, if one considers only the “super-stars” in science, medicine and philosophy, the Jewish predominance would probably be even greater than the one underlined in this chapter.

This research is only a first attempt to analyze, on a macro-level, the role of Jews. I would like to stress again, as indicated in the subtitle of this paper, its very preliminary and empirical (not to say speculative) character. More research is needed and the refinements along this road are numerous. For instance, one would have to focus on regions and fields that are the most crucial during the industrialization, and restrict the analysis of the impact of Jews to these regions or fields. Another would be to analyze if the role of Jews in the technological revolution (computers) of the end of the twentieth century is of a different impact. However, this is beyond the aim and scope of this research.

Notes

* I am venturing into a field entirely new to me. The main and obvious reason is because I am Jewish, but another reason is the encouragement of my friend, Willy Bock, director of the Martin Buber center at the University of Brussels. This chapter is based on the presentation I gave at his center on the subject.

1. Ashton (1972), Ashton (1948), Berg (1994), Chapman and Chambers (1970), Deane (1965), Flinn (1975), Landes (1969), Mantoux (1959), Marx (1970), Mathias (1983), Mokyr (1993), Rostow (1975), Verley (1985), Verley (1997) and Wilson (1984).

2. Matthew Boulton, Samuel Crompton, Abraham Darby and James Watt. To those four we could add Young but he was excluded from this list as being more an “author” than an “actor” of the Industrial Revolution.

3. Richard Arkwright, Henry Cort and John Kay.

4. Edmund Cartwright, James Hargreaves and Lord Townshend.

5. For the role of cities during this phase, see Bairoch (1988, ch. 15-16) on the links between cities and economic development.

6. Day and McNeil (1996), De Galiana and Rival (1996), and Gille (1978).

7. However, as I show later, Lilienthal was probably not Jewish.

8. Cardwell (1994), Daumas (1962-1975), Derry and Williams (1960), Giscard d’Estaing (1995), Messadieu (1988), Pacey (1990), Rival (1993), and Singer and Williams (1954-1984).

9. This information is based mainly on the *Encyclopedia Judaica* (1971).

References

- Ashton, T.S. [1955] 1972. *An Economic History of England, The Eighteenth Century*. London: Methuen.
- Ashton, T.S. 1948. *The Industrial Revolution, 1760-1830*. Oxford: Oxford University Press.
- Bairoch, P. 1963. *Révolution industrielle et sous-développement*. Paris: Société d’édition d’enseignement supérieur.

- Bairoch, P. 1988. *Cities and Economic Development. From the Dawn of History to the Present*. Chicago: University of Chicago Press.
- Bairoch, P. 1997. *Victoires et déboires. Histoire économique et sociale du monde du XVI^e siècle à nos jours*, (three volumes). Paris: Gallimard.
- Berg, M. [1985] 1994. *The Age of Manufactures. Industry, Innovation and Work in Britain, 1700-1820*. Totowa, NJ: Barnes and Noble.
- Bunch, B. and A. Hellemans, eds. 1993. *The Timetables of Technology. A Chronology of the Most Important People and Events in the History of Technology*. New York: Simon and Schuster.
- Cardwell, D. 1994. *The Fontana History of Technology*. London: Hammersmith.
- Chapman, S.D. and J.D. Chambers. 1970. *The Beginning of Industrial Britain*. London: University Tutorial Press.
- Daumas, M., ed. 1957. *Histoire de la science* (Volume 5 of the *Encyclopédie de la Pléiade*). Paris: Presses Universitaires.
- Daumas, M., ed. 1962-1975. *Histoire générale des techniques* (five volumes). Paris: Presses Universitaires de France.
- Day, L. and I. McNeil. 1996. *Biographical Dictionary of the History of Technology*. New York: Routledge.
- Deane, P. 1965. *The First Industrial Revolution*. Cambridge: Cambridge University Press.
- Derry, T.K. and T.L. Williams. 1960. *A Short History of Technology*. Oxford: Oxford University Press.
- Encyclopaedia Judaica*. 1971. New York: Macmillan.
- Flinn, M.W. [1963] 1975. *An Economic and Social History of Britain since 1700*. London: Macmillan.
- de Galiana, T. and M. Rival, eds. 1996. *Dictionnaire des inventeurs et inventions*. Paris: Larousse.
- Gille, B., ed. 1978. *Histoire des techniques*. Paris: Gallimard.
- Giscard d'Estaing, V.A. 1995. *Le livre mondial des inventions 96*. Paris.
- Landes, D.S. 1969. *The Unbound Prometheus. Technological Change and Industrial Development in Western Europe from 1750 to the Present*. Cambridge: Cambridge University Press.
- Leitenberg, L. 1999. *The Jewish Population of European Cities 1750-1930*. Geneva, forthcoming.
- Mantoux, P. [1906] 1959. *La Révolution Industrielle au XVIII^e siècle*. Paris: Génin.
- Marx, R. 1970. *La Révolution Industrielle en Grande-Bretagne, dès origines à 1850*. Paris: Armand Colin.
- Mathias, P. [1969] 1983. *The First Industrial Nation. An Economic History of Britain, 1700-1914*. London: Methuen.
- Messadieu, G. 1988. *Les grandes inventions de l'humanité jusqu'en 1850*. Paris: Bordas.
- Mokyr, J., ed. 1993. *The British Industrial Revolution. An Economic Perspective*. Boulder, CO: Westview Press.
- Pacey, A. 1990. *Technology in World Civilization*. Cambridge, MA: MIT Press.
- Rival, M. 1993. *Les grandes inventions*. Paris: Larousse.
- Rostow, W.W. 1975. *How It All Began*. New York: McGraw-Hill.
- Roth, C. 1938. *The Jewish Contribution to Civilisation*. London.
- Rubinstein, W.D. 1996. *A History of the Jews in the English-Speaking World: Great Britain*. London: Macmillan.
- Schmookler, J. 1966. *Invention and Economic Growth*. Cambridge, MA: Harvard University Press.
- Singer, C. and T.I. Williams. 1954-1984. *A History of Technology* (eight volumes). Oxford: Clarendon Press.
- Verley, P. 1985. *La Révolution Industrielle, 1760-1870*. Paris: Editions MA.
- Verley, P. 1997. *La Révolution Industrielle*. Paris: Gallimard.
- Wilson, C.H. [1965] 1984. *England's Apprenticeship, 1603-1763*. London: Longman.