NOTES

The Economic Exploitation of Man and Nature in the Production of Salt: the Case of the Southwest German Salines in the Eighteenth and Nineteenth Centuries.

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The English economic historian Eric Hobsbawm calls the Industrial Revolution "the most fundamental transformation of human life in the history of the world recorded in written documents" (HOBSBAWM 1968, 1). Though the author mentioned above is referring primarily to the changes in production methods and social life in the late XVIIIth and the early XIXth century in England, he later on includes the process of a socio-economic change — perhaps not in every respect a spectacular one, but on the whole, however, both a profound and grave one. This change occurred in many parts of West and Middle Europe only slightly later than in England.

There is almost no scientist who could close his mind to a similar estimation of the aforesaid historical events — though such judgements are generally less emphatic than Hobsbawm's. But there we are right in the midst of the problem: if one has a closer look at the numerous and various scientific studies on the first great industrial revolution in the history of the world — studies which for an individual are very difficult to survey — the problem arises of gaining a proper definition of the aforesaid phenomenon. At first sight there seems to be no great difficulty as to a scientific identification, but at closer sight there is no sufficiently clear or, rather, no sufficiently short characterization.

This diagnosis is also recorded in systematizing treatises and in textbooks on the Industrial Revolution. In most cases the reason for this deficiency is seen in the fact that treatises on the process of industrialization before and after 1800 usually emphasize its particularly outstanding factors or they even confine themselves to such factors; that is just the case when, for example, the economic change is reduced to its technical and organizational dimension or, when special aspects — such as the mechanisation, the growing manufacturing output of the

firms, the acceleration in the growth-rate of per capita income etc. — are stressed for the sake of the identification of the First (sometimes even called the Great) Industrial Revolution.

Even if this transformation process is understood as a structural change of society as a whole, i.e. as a transformation of the social production system, including the political and institutional preconditions and consequences of the change, the problem of giving an analytically precise definition of the process has not yet been overcome automatically. With this approach, which is predominant in the literature of today, it is true that the focus of scientific attention is taken up by other features such as the changed economic and social differences, living and environmental conditions, production and sales cycles, domestic and foreign trade interdependencies, etc.; however, while such an approach has a strong research function from a *programmatic* point of view, namely of accepting the term 'industrial revolution' for a process — in this case a historical one — only if the whole economic or social development of a country is influenced by it, it can occasionally have an even more retarding effect from an *analytical* viewpoint.

In view of both these difficulties, and of fundamental reflections, more attention has lately been drawn to the sectoral as well as to the regional dimension. In this way, according to some historians and economists, the phenomena which are recorded by the term 'industrial revolution' are more accurately defined than by regarding their efficiency for a whole country or society.

It is of no great importance, however, how one treats the matter: the approaches and presentations may be narrow or broad, limited or comprehensive; but what might be easily ignored or forgotten by any of these approaches is that the term 'industrial revolution' is a theory-related one, meaning that it is a term which only makes sense in connection with offers of interpretations that are (more or less explicitly) understood as theoretical ones. In a word: there is much demand for incorporating the historical occurrences of the named transformation process into a theory that attempts to describe and explain the systemic interrelationships of the real pattern of circumstances. If this is overlooked there is a very real danger — as has been pointed out by the economic historian Carlo Cipolla — of the term 'industrial revolution' becoming a label that at best is used as a proper name for the historical occurrences in XVIIIth-century England (see Cipolla 1976, p. 18).

It is not my intention in the following to extend the preceding short and general reflections on this subject, but rather to make them more concrete by means of a selected case. The case study has the advantage of representing the 'normal' way to an early industrialization, which deserves the name 'industrial revolution'. My attempt to describe analytically the (economic) phenomena of an industrial revolution refers to processes within the salt sector in southwest Germany before and after 1800. At the end of the XVIIIth century there were about a dozen salt plants of various sizes in that area and in the adjoining western and southeastern parts of the Old Reich. (As to the localities of these

plants see BECK 1989, fig. 1, p. 327, HOCQUET 1985, map 3, p. 512, or MULTHAUF 1978, map p. 237.)

The yearly output of these salines showed big differences. Schwäbisch Hall with an average output of about 90,000 Ztr. (1 Ztr. = 1 centner = 50 kg) was followed at a great distance by Bruchsal and Sulz a.N. with about 5,000 Ztr. each, Offenau and Weißbach-Niedernhall with about 2,300 resp. 2,100 Ztr., Mosbach and Wimpfen with about 900 Ztr. each; Gerabronn with about 200 Ztr. of salt was last in the order of rank.

In the west were the salines of Dürkheim with an output of 7,500 Ztr. and Kreuznach with more than 27,000 Ztr., and in the southeast were the Bavarian salt-works of Reichenhall and Traunstein which together had a yearly output of nearly 400,000 Ztr. (The Lorraine salines produced the same large quantity of about 400,000 Ztr. of salt.) And the saline of Nauheim north of Frankfurt a.M. showed a similar output capacity to the saline in Schwäbisch Hall.

Because of the good sources available for all listed salines in the southwest I want to confine my treatise chiefly to these enterprises. Should the occasion arise however the other salines will serve as examples.

The eight Southwestern German salines were situated on the edge of the vast salt deposit of the Middle Muschelkalk, where salt-water came from natural break lines, clefts and joints. Most of these saline waters had been known and used for centuries. Gerabronn, Mosbach and Wimpfen are exceptions, because it is not known for sure if the salt-waters there were in use before the middle of the XVIIIth century.

At about that time the search for and the further development of already known salt-springs and salty ground waters were intensified in southwest Germany (and not only there). The question is: what were the reasons for such an intensified search for salt?

The people in power in the XVIIIth century, who had the sovereignity over the production and distribution of salt in their territories, knew from experience that trade in such a product, leased to private persons as a rule, was a very remunerative transaction. On the other hand there was also the practical knowledge that at the same time the principalities under absolute rule and the territories of the Imperial Cities showed an increasing need for money. It was fiscal reasons which mainly called for an intense search for salt (and not a shortage of salt) in the middle of the XVIIIth century.

In comparison to former undertakings this process showed something new — at least in all its clarity. The investments even of the small and the smallest territorial powers were carried out with the intention to start production and to press ahead with it, aiming at eliminating competitors from the market at the same time. Bearing in mind that competition for the Southwest German market in the XVIIIth century between the Bavarian and the Lorraine salt-works (both having the highest production and sales volumes) and the saline of Schwäbisch Hall had become stronger, it will be clear that because of the existing competitive situation before the middle of the century the development of

salt-water deposits had to be started at a high outlay. Whenever the hoped-for results failed to materialize or when they did not come up to close expectations additional capital investments had to be made.

Apart from this there was a specific phenomenon for the salines in the southwest, and it was known to other salt-works, too, whose production was based on spring or borehole salt-water: Except for the saline of Schwäbisch Hall (with a production of 50,000 Ztr. at about the middle of the century, and stepping up to yearly 80,000-90,000 Ztr. towards the end of the century) the original output volume decreased drastically in the course of the years:

Table 1
DEVELOPMENT OF OUTPUT FROM THE MIDDLE TO THE END OF THE XVIIIth CENTURY

		From about (Ztr.)		To about (Ztr.)
Schwäbisch Hall:		50,000		90,000
Weißbach-N'hall:	more than	4,000		2,000
Sulz a.N.:		8,000		5,000
Bruchsal:		14,000		4,000
Offenau:		9,000		2,500
Mosbach:	more than	4,000		1,000
Wimpfen:		1,500		860
Gerabronn:	(1781:)	288	(1791:)	178

How can this decrease in the output of salt be explained? The aim was to recoup with profit — and that means with the highest possible profit — the monetary capital that was invested in every enterprise in question. The consequence of these endeavours was in each case an overuse of the salt-wells. The excessive and increasing intensity of pumping the spring and borehole salt-water usually let fresh water ('Wildwasser' as they were called in Germany) into the wells to a higher degree. This spoiled the brine and at least lessened its concentration. Further investments were necessary which aimed at an improvement of the profit situation. Further boring tests or the deepening of old brine-wells usually brought a temporary recovery of the former concentration of the brine.

The consequence of all these undertakings, showing a considerable intensification of the input of capital, was a strongly developed *economic exploitation of nature and man*. The result of all this was a clear order of precedence as to the fixed capital and the wage capital among the salines in the southwest.

In other words, the need for initial capital expenditure which was subsequently even intensified because of the competition between the salt-works, led to a highly positive and moreover systematic correlation between the fixed capital and the wage capital of the enterprises mentioned.

I want to prove step by step my intermediate thesis which is to lead to a conclusion about the peculiar course of an early industrial revolution by way of illustration of a selected sector and a selected region.

Verification of the expressed proposition about a close correlation between the ranking of fixed capital and the ranking of the wage capital requires a considerable amount of empirical work. Even if one does not ask for an appreciation in terms of value, we ought perhaps to produce at least a monetary estimation of the fixed capital and the wage capital with every single saline.

Are there really valid data, that is to say historiographically established, and historically relevant facts to support the enquiry? That difficulties arise when dealing with a project like this is well known to every one who has worked on the XVIIIth or early XIXth century. There is usually — if at all — sporadic and scattered and moreover rather incomplete information of a monetary type. (There are a few exceptions, and the Bavarian salt-works and the saline of Lüneburg are two of them.)

I would like, therefore, to adopt a different method, but an equally adequate one, to have facts and circumstances described and contrived utilising with a special technique. It is a method which may lead to a conclusion that is either for or against my claimed thesis.

If one wants to find out the size of investments in the salines one must direct one's attention to the material components which are part of the value of fixed or wage capital, and then carry out a measurement by size in value or in monetary terms by approximation of those components.

As to the fixed capital in the salt mining and in the saline economy of the XVIIIth century the following components mainly make up the investment value:

(1) the number and the depth of wells and pits with brine extraction and brine transport equipment;

(2) the number and the size of graduation houses with the necessary hydraulic structures;

(3) the number and the size of pan-houses and salt-pans;

(4) the consumption of fire-wood.

In the matter of wage capital it is a little easier. In this case it is the number of employees that is the decisive material component.

Table 2
ORDER OF PRECEDENCE RELATING TO THE FIXED CAPITAL OF THE SALINES IN SOUTHWEST GERMANY TOWARDS THE END OF THE XVIIIth CENTURY

Salt-works	Schw. Hall	Weiß b. N.	Sulz a. N.	Mosbach	Offenau	Wimpfen	Bruchsal	Gerabronn
Fixed capital								
Wells, pits etc.	3	2	1	8	7	5	4	6
Graduation houses	2	5	4	8	3	6	1	7
Pan-houses, salt-pans	1	4	2	6	5	7	3	8
Firewood consumption	1	5	2	6	4	7	3	8
Rank sums	7	16	9	28	19	25	11	29
Ranking position	1	4	2	7	5	6	3	8

The tabulation of the order of precedence relating to the investment of fixed capital results in a final ranking of the salt-works with Schwäbisch Hall in top position and Gerabronn at the bottom. The ranking is concordant to a rather high degree as regards the order of precedence. KENDALL's coefficient of concordance provides a factor of 0.78. (That means that the variance of the rank sums is 78% of the highest possible variance, being the ordered series of 4, 8, 12, ..., 32.)

Table 3
NUMBER OF EMPLOYEES AT THE SALINES IN SOUTHWEST GERMANY TOWARDS THE END OF THE XVIIIth CENTURY

Saline	Position (acc. to tab. 2)	Employees		Annotation comment
		Number	Year	
Schwäb. Hall	1	(100-130?)	1797	Number of 'panclaimants': 236
Sulz a.N.	2	70-80	1809	Of them 32 in the salt-mine
Bruchsal	3	32	1768	Without casual workers
Weißb.-N'hall	4	(25-30?)		1812: 10 employees
Offenau	5	23	1772	1762: 35 employees 1808: 26 employees
Wimpfen	6	11	1787	
Mosbach	7	7	1800	
Gerabronn	8	?		

Comparing the final ranking position in Table 2 with the ranking of the salines according to their number of employed persons one will recognize the high (positive and) systematic correlation claimed in my intermediate thesis. Missing pieces of information are to be taken into consideration (e.g. data of the number on employees in the salt-works of Schwäbisch Hall, Weißbach-Niedernhall and Gerabronn). It is, however, important to allow for the possibility that data as yet missing can be found: meanwhile we must rely on judicious estimates. Moreover it would be useful to classify the employees on the management and supervisionary staff, the master workmen, the labourers and the casual workers.

The correlation between the fixed capital and the number of employees is — as claimed — a positive and a systematic one. The correlation which is essentially based on ordinal scales does not, of course, say anything about the absolute monetary values and differences between the capital investments of the salines. It would be of great advantage if we had such units of measurement because they could give us an insight into the structures and alterations in the ratio of capital and labour.

An examination of the available historical documents does provide monetary values here and there. By integrating them into the intermediate result a picture will arise that suggests the course of a correlation curve built upon absolute, i.e. metrically-scaled proportions.

The documents show that the leaseholders of the saline at Bruchsal managed to re-coup the investment costs of 225,000 fl. (florin) during a 40 year lease (1746-1785), earning a 2 % rate of return.

The total revenue of 550,000 fl. from the saline Offenau during the 40

years from 1756 to 1796 made in the end no profit as noted by the relevant sources. The costs for the salt-works in Wimpfen amounted to 225,000 fl. in the 20 years from 1759 to 1774. The enterprise of the Gerabronn salt-works is said to have cost the government half a million fl. in the 40 years (1752-1792) since the foundation of the undertaking.

I could offer a great number of other though fragmentary pieces of information about monetary data; cautiously used, in the aggregate, they would support the following correlation curve [figure 1 (lower graph)]:

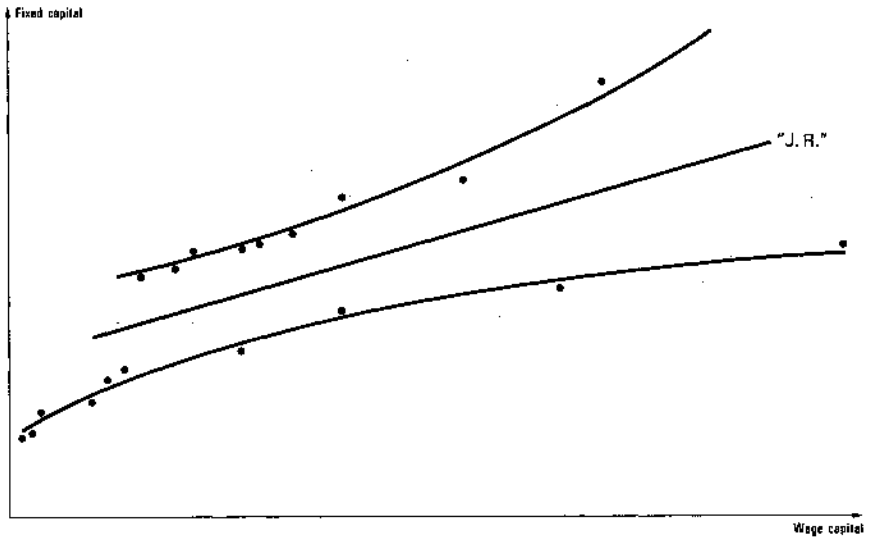

Figure 1: **The "Industrial Revolution"-Process Pattern**

(Apart from the eight southwestern German salines, plotted as points = values, there are specifications of the salt-works of Reichenhall and Traunstein; they can be found on the right hand side of the lower curve. During those 13 years between 1786 and 1798 an almost complete reorganization of the salines in Reichenhall and Traunstein took place with a total outlay of about 1.2 million fl. [For details see SCHREMMER 1979.])

The lower graph shows the (mainly ordinally scaled) estimated values, concerning the fixed capital of each saline, lying together more closely than the values of wage capital. Hence a curve follows which I like to regard as typical for the pre-industrial period (i.e. the period prior to the industrial revolution) in the salt economy of the German Southwest. The 'major' salines (i.e. the ones with a higher capacity of production) differ from minor salines (i.e. the salines with a lower capacity of production) by employing a far larger amount of workers.

A further sliedy concerned with the period after 1830 provides a result that is based on a similar approximation.

This time, however, by application of available monetary data (taken from balance sheets etc.) and by enlisting estimated values based upon the same material components of fixed capital or wage capital [Figure 1 (upper graph)] one can deduce from the graph that the major salines believed in the investment of fixed capital far more intensely than the minor salines.

The upper curve is far more plausible than the lower one. For we understand that the size of a firm has something to do with the amount of its fixed capital. This, however, does not yet explain how such curve came about. On the other hand the graph raises quite a number of questions, among them the question of financing the widened capital investments.

There is still another utility in both curves [Figure 1 (middle graph)]: As indicated in the subtitle of the paper the utility lies in the conceptualization of the *industrial revolution*-process as a 'turning point', or even better: of a 'turning line', or even better: of an 'area' around a turning line ("I.R.") lying between the upper and the lower graph.

The question will certainly arise, to what degree this straight line "I.R." complies with not only an *ideal,* but also with a *real* ratio between fixed and wage capital in each saline. There are different signs after all that it is not only an imaginary correlation curve. Among them are direct signs, based upon monetary estimation of capital investments, and indirect signs.

The following fact is considered to be one of the latter: in spite of the extraordinarily intense business competition in the 1820s between the leading salt-works none of them showed a decline in fixed capital. According to the sources I used this is due to the fact that the 'organic composition' of enterprise capital, i.e. the ratio fixed capital/wage capital, was the same in these leading salt-works.

As to the regional-economic dimension of the industrialization process in the salt economy in the southwest there was a characteristically different figure between the prior and the later situation (compared with the correlation curve "I.R."), this time relating to the earnings position and the market areas of the salines.

Let us first look at the figure that deals with the years prior to 1820 (see Fig. 2).

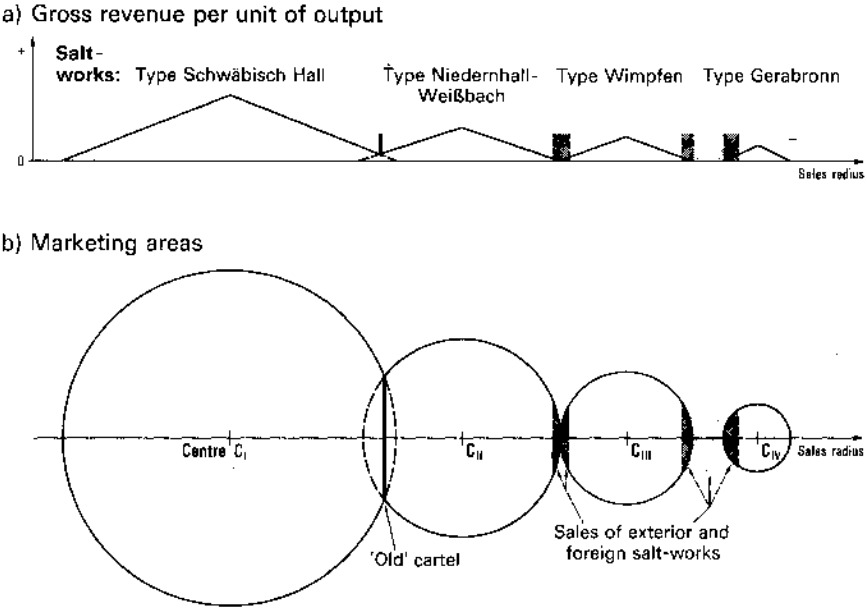

Figure 2: Revenues and Markets before 1820

Explanatory note: The salines are classified into different types. There is a distinctive hierarchy as to the gross revenues as well as to the market areas of the salines. Furthermore the evolvement of so-called 'old' cartels is shown. They point to a demarcation of spheres of influence without a regulation of prices, even though the regulation of prices was not the principal aim. Exterior salines (from other territories) or foreign salines (from other countries) push forward into the market gaps of the salines with lower production capacity.

The earnings situation and the market areas after 1830 developed rather differently (see Fig. 3).

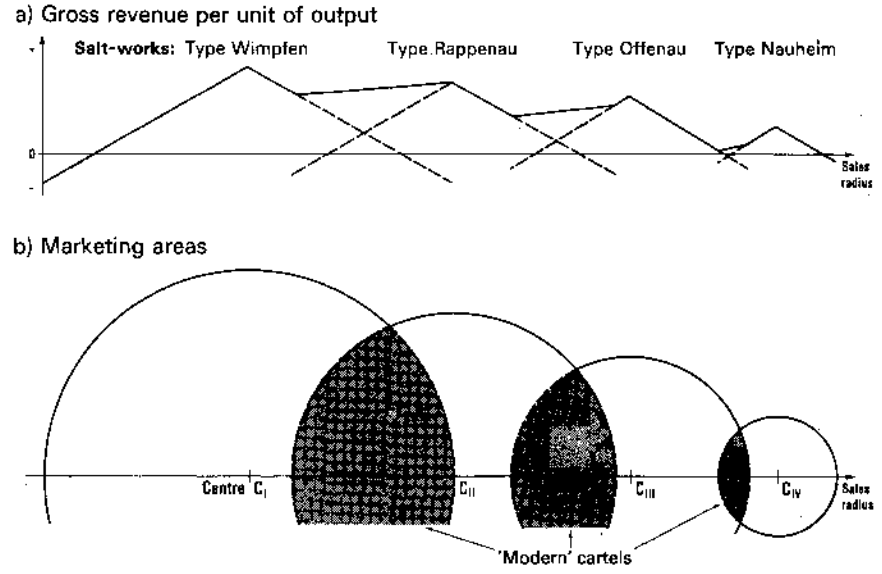

Figure 3: Revenues and Markets after 1830

There are again four types to distinguish. The situation after 1830 may be characterized as follows:

(a) The gross revenues per unit of output are substantially higher than before 1820. Because of higher outputs the market radius of each saline reaches far into the area of competing salines.

(b) It is no mistake in the drawing that in parts of the particular market areas the gross revenues per unit of output could even be negative (Fig. 3a). This happened on the basis of a strategic consideration of the enterprise management of the salt-works that a higher capacity utilization of production facilities would cut down the product costs per unit of output, with the result that an even higher gross revenue could be realized than by a reduction in output. Of course such a sales strategy was of advantage only in non-cartelized areas.

(c) The phenomena shown in (a) and (b) are also the result of 'modern' cartels, which soon after 1830 covered almost the whole German market. Because of higher profits in the cartelized areas it was possible to extend the sales radius widely.

To sum up: the approach of a conceptual description of the *industrial*

revolution-process, demonstrated by a selected case study, refers to the initially stated idea of this process as a profound (socio-) economic transformation. The approach has an operational advantage at the same time, that is, it allows for a rather precise empirical determination of this historical process and its identification compared with other occurences in respect of factual, chronological and territorial circumstances.

REFERENCES

Note: The present text is part of a more comprehensive planned treatise on the salt economy in the stage of the industrial revolution (see BECK 1993). The references to the data and the literature used can therefore be confined to a few items.

Beck, G. (1989), Produktionsintensivierung und Marktausweitung in der vorindustriellen Salzwirtschaft des deutschen Südwestens im 18. Jahrhundert. In: C. Lamschus (Hg.), *Salz — Arbeit und Technik — Produktion und Distribution in Mittelalter und Früher Neuzeit*. (De Sulte 3) Lüneburg, 178-197, 327-330.

Beck, G. (1993), Der Prozeß der Industrialisierung in der Salzwirtschaft Mitteleuropas. Überlegungen zur analytischen Erfassung und begrifflichen Bestimmung der industriellen Revolution als eines sektoralen und regionalen Phänomens. (In preparation.)

Cipolla, C.M. (1976), Introduction: The Industrial Revolution. In: C.M. Cipolla (ed.), *The Fontana Economic History of Europe. Vol. III: The Industrial Revolution 1700-1914.* London, 7-21.

Hobsbawm, E.J. (1968), *Industry and Empire. An Economic History of Britain since 1750.* London.

Hocquet, J.-C. (1985), *Le Sel et le Pouvoir. De l'an mil à la Révolution française*. Paris.

Multhauf, R. P. (1978), *Neptune's Gift. A History of Common Salt*. (John Hopkins Studies in the History of Technology; N.S. 2) Baltimore and London.

Schremmer, E. (1979), "Saltmining and the Salt-trade: a State-Monopoly in the XVI-XVIIth Centuries. A Case-Study in Public Enterprise and Development in Austria and the South German States" in *The Journal of European Economic History*, 8, 291-312.