British Technologies and Polish Economic Development 1815-1863

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Thesis submitted for the Degree of Doctor of Philosophy

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December 1995

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Abstract

After the restoration of peace in 1815, several European countries sought to transform their economies by the direct borrowing of British technologies. One of these was the semi-autonomous Kingdom of Poland. The Kingdom's technology transfer initiatives have been largely ignored by foreign researchers, while Polish historians have failed to place developments in the Kingdom within a wider context of European followership.

The varying fortunes of Polish transfer initiatives offer valuable insights into the mechanisms and constraints of the transfer process. A close study of attempts to introduce British technologies in mechanical engineering, metallurgy, railway construction, textile production and agriculture contradicts most Polish scholarship by establishing that most of the transfer initiatives were either misplaced or at least premature. The thesis also reexamines the relationship between the Russian empire and the Kingdom of Poland, and suggests for the first time that general Russian attitudes towards industrial development *per se* were as much a hinderance to the Polish economy as the more familiar Russian hostility to the Poles, although it was Russian interference which suppressed the most promising initiatives in agriculture.

The Polish case offers excellent illustrations of supply driven transfers resulting in inappropriate technological choices, premature initiatives and technologies bearing little relation to the size and nature of the markets they were designed to satisfy. At the same time, demand driven transfers in the Kingdom's textile industries resulted in successful diffusion of end user technologies, particularly among cotton producers. However, even failed initiatives witnessed a successful transmission of skills and knowledge, suggesting that technology transfer is a far more complex issue than most historical case studies allow. Furthermore, nineteenth century Poland offers an excellent example of a case study where economic performance was heavily distorted by complex political factors. In such a case, theories of economic development or technology transfer are rarely sufficient to explain the course of history.

In the absence of a satisfactory conceptual framework within available scholarship on historical technology transfers, the thesis utilizes concepts from contemporary developmental economics, concepts which allow a much more sophisticated and coherent analysis of transfer case studies.

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£1 = 40 - 42 Polish złotys

£1 = 6.3 silver roubles

1 silver rouble = 6 złotys 20 groszy (1 złoty = 30 groszy)

Acknowledgements

Above all I wish to thank my supervisor, Professor Alan Milward, for his encouragement and seemingly infinite patience, support and ability to keep a straight face while reading earlier drafts of my work.

I am also very grateful to other members of staff at the department who gave priceless moral support at crucial moments, particularly Dudley Baines, Paul Johnson, Bob Edwards, Max Schultz and Theo Barker. I would also like to thank Linda Samson for all the help and encouragement she has given since I arrived at the department.

I wish to thank British historians outside the School for their help and support, particularly Patricia Crimmin at Royal Holloway and Gillian Cookson at York. I am extremely grateful to several historians in Poland, particularly Jerzy Szczepański and Wiesław Caban at Kielce, and Józef Śmiałowski at Łódż, for the valuable opportunities to present my ideas to staff and students at those universities.

Finally, I wish to thank Alexis and Bella for everything, all my fellow students in the department, and all my special friends: Liz Waller, Richard Challoner, Valerie Wall, Julian Duffus, Joy Hemmings, Vivienne Hemingway, Virginia Bainbridge, Lesley and Jonathon Delamont, Delyth Keane and Brenda Lees, for their goodwill and vibrant humour, and for putting up with me during many exhausting and turbulent times.

I also wish to acknowledge the financial support from the Economic and Social Research Council, without which this thesis might never have appeared.

Introduction

The contribution of British technologies to the industrialization of Europe and the United States has attracted much attention in recent decades. However, historical case studies of technology transfer have tended to concentrate on the successes, while paying little attention to initiatives which failed to live up to initial expectations. The formidable difficulties which continue to confront less developed economies seeking to benefit from advanced technologies in the twentieth century suggest that our understanding of the conditions of success is far from complete. A widening of the range of historical case studies to include unsuccessful or partly successful initiatives should contribute to a fuller comprehension of the issues involved.

One such neglected case which deserves to be rescued from obscurity is that of the Congress Kingdom of Poland after 1815, a semi-autonomous state within the Russian empire. The lack of Polish political independence between 1795 and 1918 has meant that economic developments in the Kingdom have been ignored by most non-Polish researchers, at best earning sporadic references in works devoted to Russian economic history. This is an oversimplification which ignores a large measure of economic autonomy enjoyed by the Kingdom for half a century after 1815, during which several Polish groups including the administration, the Bank of Poland and the landowning elites all sought to transform the Kingdom's economy by the direct borrowing of British technologies, with the minimum of reference to St. Petersburg. While there was little that was unique about the Polish initiatives, and nothing remarkable about the modest degree of success they achieved, the Polish case proves valuable in many respects by offering many insights into the mechanisms and constraints of the transfer process.

The thesis aims to fill several gaps in the historiography of Polish economic development and of nineteenth century technology transfer. At the crudest level, the thesis should fill the geographical gap alluded to above, by drawing the attention of English language researchers to numerous initiatives in the Kingdom which predated the industrialization of Russia proper by several decades.

The thesis also seeks to address different misunderstandings on the part of historians in both Britain and Poland. For Polish researchers, the Kingdom's early economic development has been treated as just another episode in Polish history, with almost no attempt to place it in a broader European context. The thesis will use other European examples to challenge many assumptions of Polish historiography. Many British historians seem to assume that

Polish development owed much more to German influences than British. While there were particular reasons why certain Polish institutions and initiatives assumed a peculiarly Germanic flavour, it is important to stress that it was Britain and British technologies which attracted Polish interest: a phenomenon which lasted for half a century.

From the point of view of technology transfer, a study of the Polish initiatives can widen our understanding of many aspects of the topic which have been neglected by historical case studies. The concentration on successful transfers has already been mentioned. The Polish efforts can hardly be described as successful, and offer useful evidence on the myriad constraints affecting the transfer process. Secondly, while the debate on post-1815 transfers from Britain has tended to concentrate on formally codified technologies such as machine construction, the Poles not only sought uncodified industrial technologies such as puddling, but also uncodified and virtually uncodifiable pre-scientific agricultural technologies. Moreover, whereas most researchers have tended to avoid case studies where economic development was heavily affected by unquantifiable political factors, much of the course of events in Poland can be properly understood only with reference to the fluctuating political relationship between the Kingdom and Russia.

For a conceptual framework and terminology, the thesis utilizes concepts formulated by contemporary developmental economists. After all, both the terminology of technology transfer and the idea itself were the work of developmental economists rather than economic historians. Even the best works of economic history fail to offer a satisfactory framework which would allow a standardized approach to both contemporary and historical transfer initiatives.

The thesis seeks to assess the Polish initiatives as a case study in the transfer of British technologies to a backward European follower in the decades following 1815. The start date saw both the creation of the Congress Kingdom which led to the transfer initiatives, in the very year that British industrial predominance had been demonstrated to the whole of Europe as never before. Polish efforts were thus part of a broader European phenomenon of catching up. Another point frequently ignored by economic historians was the passing of the Corn Laws in the same year, a move which posed a different but equally threatening challenge to the agriculture of eastern Europe, particularly Poland.

The closing date of 1863 saw a hopeless insurrection against the Russians which finally ended every last vestige of Polish autonomy, the culmination of a turbulent period which had seen the ending of the last specifically Britophile transfer initiative, Zamoyski's

Agricultural Society. Polish interest in British technologies certainly did not end in 1863. Once market prospects improved, trade with Britain flourished as never before, thanks mainly to heavy investment in British capital equipment. As elsewhere in Europe, the success of the Polish textile industry after 1863 owed much to equipment from the Platt Brothers and elsewhere in Lancashire, while agricultural mechanization also relied heavily on British suppliers. Nevertheless, the world had changed by the 1860s. Although Britain was still the most advanced economy in the world, its technological leadership in many industries had received serious challenges from the United States and Europe. Britain was thus no longer the sole technological supplier for the rest of the world, as firms and individuals from other western European countries became important agents of transfer.

Structure of the thesis

The thesis is divided into five chapters. Chapter I will offer definitions of technology and its transfer. The initial section will introduce the parameters essential to the description and analysis of transfer initiatives with reference to the contemporary situation. This will be followed by a section charting the international response to the British Industrial Revolution in an attempt to demonstrate both the similarities and the differences between transfers at the beginning of the nineteenth century and the end of the twentieth.

The second chapter will describe the background to the introduction of British technologies into the Congress Kingdom, emphasising how closely Polish initiatives conformed to the general European pattern for the first decade and a half after 1815, and later deviated considerably from that pattern as a result of political events. An analysis of the political factor, i.e. the variable relationship between the Kingdom and Russia, will seek to demonstrate that Russian attitudes towards Polish economic development owed as much to the changing political and economic priorities of St. Petersburg as they did to any intrinsic hostility to the Poles. The final sections of the chapter will describe features of Polish transfer initiatives common to the European followers such as the creation of specialist training institutes and the utilization of British personnel.

Chapter III will concentrate in detail on initiatives to introduce British technologies in four industries: engineering, metallurgy, railway transport and textile production. In each of these main industries, Polish efforts produced a different combination of outcomes. Promising early developments in engineering failed to bear full fruit in the worsened circumstances after 1831, during which time investment in metallurgy and railway

construction resulted in expensive fiascos. Polish textile production never aspired to anything more than basic end-user capabilities, but became the most important industry in the Kingdom by the 1860s.

The fourth chapter is devoted to initiatives involving British agricultural technologies. In terms of market outlook, Polish landowners had less in common with most of their European counterparts, particularly as the Kingdom suffered more than most as a result of the Corn Laws. For several decades, initiatives involving mainly British technologies were limited to a handful of progressive landowners but eventually culminated in the creation of one of the most energetic and coherent agricultural reform movements anywhere on the continent.

The final chapter considers the aftermath to the 1815-63 period, with an analysis of the Kingdom's industrial and agricultural performance up to 1914. This is followed by an assessment of possible alternative development paths as represented by transfer initiatives which failed to materialise. With such abortive proposals as that of John Cockerill, one of the most successful agents of technology transfer anywhere in Europe, it is worth considering whether such initiatives could have changed the course of Polish economic development.

A note on sources

The thesis offers new interpretations rather than huge amounts of new information. Much of the narrative will be new only for non-Polish speakers. The huge losses sustained by Polish archives and the thorough utilization of surviving records by Polish historians after 1956 meant that little new archival research in Poland was necessary. Direct use has been made, however, of Polish archival documents not hitherto used by economic historians, such as the correspondence relating to the Polish missions to Britain in 1825-26, and of archival sources insufficiently researched, such as the surviving records of the Białogon factory.[1] Of primary sources elsewhere, Foreign Office and Board of Trade documents in the Public Record Office have yielded much valuable information not available to previous Polish researchers. Many of these documents shed light on microeconomic activities by Britons in Poland, giving detailed insight into patterns of recruitment, previous employment, pay, working conditions and competence unavailable from any other source. Of equal

1. Archiwum Główne Akt Dawnych, Warsaw, Akta Komisji Rządowej Przychodu i Skarbu: 1449; Archiwum Państwowe, Kielce: Akta Kieleckiej Fabryki Pomp w Białogonie; Akta Dozorstwa Hutniczego w Białogonie.

importance are the Consular despatches, which offer priceless information on levels of business confidence in the Kingdom thanks to the close connections between successive consuls and British manufacturers in Warsaw. There is also the 1837 Report on the State of Poland, drawn up by the British consul in Warsaw, which remains one of the most informative documents on life in the Kingdom in the darkest days of the post-1831 repression.[2]

Other British archival sources offer useful complementary information on such topics as machine sales or visits by Poles. Some new material has been unearthed, including the notebooks of a Scottish engineer resident in Poland.[3] Much new information has also been obtained from British contemporary printed sources. Of huge importance is information relating to Andrzej Zamoyski's attendance at the Holkham sheep shearings, a fact which allows crucial new interpretations of his long advocacy of British farming methods.[4]

The widespread destruction of Polish archival sources mentioned above presents considerable difficulties for the researcher of the Kingdom's early economic development. Poland has been far less fortunate than most countries regarding survival of records. The country's turbulent history has resulted in the destruction of many irreplaceable documents. Although the main damage was sustained during the Second World War, the destruction of records started very early in the period under review. For example, the estate papers of General Pac, an agricultural reformer responsible for the introduction of several hundred Scottish settlers after 1815, disappeared into Russia after the confiscation of his estate in 1834.[5] Many documents belonging to the government Eastern Region mining department were lost during fighting in 1863. Among archives lost during the destruction of Warsaw in 1944 were the complete records of many bodies directly responsible for introducing British technologies: most of the records of the pre-1830 Mining Department together with the archives of the Bank Polski and the last Agricultural Society. The records of the key industrial plants utilizing British specialists were also decimated: those of the Evans Brothers

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2. Public Record Office, FO392/7, Report on the State of Poland.

3. Notebooks of Alexander Kedslie - copies have subsequently been deposited at the Scottish Record Office, Edinburgh.

4. R.N. Bacon, *A Report on the Transactions of the Holkham Sheep Shearing* (Norwich, 1821).

5. J. Bartyś, 'Działalność gospodarcza i społeczna Generała Ludwika Paca w dobrach Dowspuda na Suwalszczyźnie', *Rocznik Białystocki*, 9 (Białystok, 1970), p. 35.

and the Solec works were destroyed entirely, while most of the Białogon factory records were lost during liberation in early 1945.

Considerable use has been made of the Polish technical press from the period under review. This includes pre-1830 periodicals such as of *Izys Polska* (18 volumes, 1821-28), and the less technical *Piast* (18 volumes, 1828-29). The former periodical contains particularly valuable material regarding the state of the Kingdom's economy, Polish perceptions of Britain and Western Europe, and lists many practical economic initiatives undertaken in the Kingdom. The 21 volumes of the Warsaw Society of the Friends of Science also contain some material of interest to the economic historian, particularly the contributions of Stanisław Staszic, later to become one of the chief advocates of state promotion of industry after 1815.

By far the most important periodical being analyzed is the *Roczniki Gospodarstwa Krajowego*, appearing in 42 volumes between 1842 and 1864. This was to become the mouthpiece of the Britophile reform movement led by Andrzej Zamoyski, which was to advocate the reorientation of Polish agriculture on Western European (particularly British) lines. This periodical contains a vast amount of information about the state of the Kingdom's agriculture during this period, and chronicled numerous attempts to introduce reforms and improvements to Polish farming. The *Roczniki* was an extremely well written publication which remains the most reliable source for agricultural initiatives in the Kingdom, and because of its pro-British orientation it is of immense value to anyone interested in European perceptions of the British economy in the first half of the nineteenth century.

The problems with Polish archival sources mentioned above mean a heavy reliance on two groups of secondary sources. The first group includes several books written before 1939 based on archives destroyed or decimated during the war. These include works on early state mining initiatives, the Bank of Poland and the Agricultural Society.[6] The unavailability of the records on which these books were based has turned the works into *de facto* primary sources, a regrettable but unavoidable situation.

The second group includes a large number of books dealing with the history of Polish capitalism, written after 1956. These were invariably narrative or descriptive works making thorough use of surviving records, but suffered from a rigid Marxist framework. Despite the

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6. H. Radziszewski, *Bank Polski* (Warsaw, 1910); N. Gąsiorowska, *Z dziejów przemysłu w Królestwie Polskim* (Warsaw, 1965); W. Grabski, *Historia Towarzystwa Rolniczego 1858-1861*, 2 vols (Warsaw, 1904).

passing of Stalinism in the mid 1950s the need to toe the official line remained paramount. Thus even the best of these works dealing with industrialization praised the 'methodological significance of the works of Marx and Engels', but declared that the works of such writers as Clapham, Ashton and Henderson were based on 'unacceptable assumptions', although they still possessed 'factographical value'.[7]

Despite the unsatisfactory approach of the post-1956 literature, the thorough use of surviving data makes these works indispensable to researchers. Thus for certain narrative details and statistical data, the thesis has relied heavily on such books as that of Łukasiewicz, Jedlicki and Missałowa on industry, Bartyś on agriculture and agroindustries, and Jezierski on foreign trade.[8]

The use of Polish statistical data requires some prior explanations. Unlike Prussia or even Britain, the Congress Kingdom was much less diligent regarding the collection of official statistics. Even when data were collected, they were often unreliable, a problem once readily admitted by a minister responsible for a national census, and equally applicable to many other official statistics.[9] Complete statistics from 1815 to 1863 exist only for foreign trade (1815-1850 for Russia).[10] Even here problems abound: although the statistics were compiled with great accuracy, they reflect only legal trade, failing to take account of the considerable amount of smuggling occurring between the partitions.

Further problems arise with statistics dealing with industrial and agricultural output. Data for the entire period is sparse and unreliable, although things improved during the 1850s. National statistics were not collected regularly until that decade, and even then involved frequent switches of methods of calculation. Industrial production was usually expressed in terms of value rather than volume. Although the absence of inflationary pressure allows the comparative use of data expressed in current prices, such statistics have orientation value only. Data on agricultural produce also leaves much to be desired, though data on

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7. J. Łukasiewicz, *Przewrót techniczny w przemyśle Królestwa Polskiego 1852-1886* (Warsaw, 1963), p. 6.

8. J. Jedlicki, *Nieudana próba kapitalistycznej industrializacji* (Warsaw, 1964); G. Missałowa, *Studia nad powstaniem łódzkiego okręgu przemysłowego 1815-1870*, 2 vols (Łódź, 1964); J. Bartyś, *Początki mechanizacji rolnictwa polskiego* (Wrocław, 1966), A. Jezierski, *Handel zagraniczny Królestwa Polskiego 1815-1914* (Warsaw, 1967).

9. W. Jacob, *Report on the Trade in Foreign Grain* (1825), p. 67; the admission referred to the 1817 census.

10. Jezierski, *Handel zagraniczny*, pp. 34, 37.

volume of output is available for selected years before 1830 and most years from the 1840s onwards. Needless to say, it would be unwise to attempt any precise quantitative statements about the Polish economy up to 1863, and all numbers must be treated with caution. Nevertheless, relevant statistical data will be supplied when appropriate.

Definitions of Poland

As the Commonwealth of Poland and Lithuania disappeared from the map in 1795, and Poland did not regain its independence until 1918, it should be stated that for the purposes of the thesis the terms "Poland" or "Kingdom of Poland" will refer *only* to the Congress Kingdom as created in 1815. Where specific reference is made to other regions of pre-1795 Poland outside the Kingdom they will be strictly defined as the Prussian or Austrian partition, or the Russian "western provinces" which refer to that territory of the Commonwealth which passed into Russian hands without being included in the Congress Kingdom, i.e. Lithuania and the lands east of the river Bug. The term "Polish lands" will sometimes be used as a blanket term referring to all Polish-speaking areas where Poles retained some autonomy of action. For the purposes of the thesis, this refers to the Kingdom and other areas where Polish landowners conducted activities which were influenced by, or had influence on, similar initiatives in the Kingdom. Thus mention will be made of reformist landowners in the Posen province of the Prussian partition and in the Russian western provinces. This research will not follow the questionable practice of much post-war Polish writing, which has often sought to portray developments in all regions currently within Polish borders as having a place in Polish economic history. Thus Silesia, now in Poland but always firmly part of Prussian industry, will not be discussed.

Currencies used

The sole unit of currency in use in the Kingdom up to 1841 was the Polish florin or złoty. In 1841 this was replaced by the Russian silver rouble. However, it is clear from journals in the Polish language that most Poles continued to think in both currencies as late as the 1860s. Where relevant, both currencies are given, sometimes with sterling equivalents for particularly large amounts. For long term indicators, złotys have been converted into silver roubles (for the purposes of this work, the term rouble shall be synonymous with silver rouble). A currency conversion table is included on page 5.

Chapter 1

The evolution of technology transfer

Technological progress has been one of the major components of economic development throughout history. It has therefore proved fortunate that such progress has not been limited to the economic context of its original invention, but has been able to move and prosper in new economic contexts elsewhere. Such movements of processes and products between nations are known as technology transfers. Few countries have remained untouched by this process. Even the most advanced economies owe a large degree of their success to the skilful adaptation of technologies developed elsewhere rather than their own inventive efforts, and many underdeveloped countries have also been able to achieve some economic success through such borrowings.

Nevertheless, such success has never been automatic, and the history of technology transfer is replete with countless failed initiatives and occasional expensive disasters. That several obstacles need to be overcome before a technology can thrive in a new context was a lesson which should have been obvious from nineteenth century experience. A wave of optimism after 1945 saw technology transfer as a grand solution to poverty and underdevelopment, but as early as 1970 Rosenberg could rue the naivety of such hopes and write of 'present moods of disillusion'.[1]

An assessment of the impact of British technologies on the Polish economy requires the prior clarification of two points. Firstly, it is necessary to explain the concept of technology transfer, a term frequently used imprecisely to describe a wide range of activities. Secondly, to place Polish developments in the proper historical and geographical context, it is essential to highlight the wider phenomenon of international responses to the challenge of the British Industrial Revolution. The following chapter comprises a survey describing the main features of the transfer process, based on studies of the post-war experience, followed by a detailed analysis of the transfer and diffusion of British technologies from 1700 to the middle of the nineteenth century.

Two points should become apparent from comparisons between the periods. Firstly, the organizational framework in which transfers have occurred has undergone considerable evolution, to a large extent mirroring the increasingly complex framework in which all economic activity is conducted. Secondly, despite this growing complexity of both the

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1. N. Rosenberg, 'Economic Development and the Transfer of Technology', *Technology and Culture*, 11 (Chicago, 1970), p. 550.

institutional framework of transfers and the technologies themselves, the determinants of success and failure have changed little over the last two and a half centuries. Considerations of both obstacles to transfer and their possible solutions suggest revealing parallels between the historical transfers and their contemporary counterparts.

1.1 Contemporary Technology Transfer

a) Definitions and parameters

The transfer of technology is a topic which continues to suffer from a lack of general consensus regarding terminology and structure. One author has bemoaned the 'mushiness' of the subject.[2] While researchers of present day transfers invariably concentrate on the motives and actions of organizations undertaking transfer initiatives, mostly avoiding the actual process itself, historical case studies have tended to contain narratives of transfer related events and analysis of outcomes with frequent recourse to economic theories but little reference to concepts devised by contemporary developmental economists. A combination of both approaches should allow a more standardized method of both describing and assessing transfers, both in the past and in the present.

An obvious starting problem has been the inconsistent use of the term technology itself. Several writers have defined technology in the narrowest sense, in terms of machines and tools, but clearly a wider concept is called for. Most definitions view technology as a body of skills and knowledge connected with the production of goods, which can be embodied within processes, products or people. The UNCTAD study of technology transfer, the first attempt at a systematic codification of the subject, disaggregated technology into capital goods, human skills and labour, and information which may be open or proprietary.[3] Robinson distinguishes between technology which is 'embodied', i.e. hard goods in the shape of capital equipment and final goods, and 'disembodied', which can be transmitted either orally or in written form.[4] Dahlman and Westphal take a different approach, defining technology as a 'method for doing something' comprising three elements: information about

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2. R.D. Robinson, *The International Transfer of Technology* (Cambridge, Ma., 1988), p. 3.

3. H.V. Perlmutter and T. Sagafi-nejad, *International Technology Transfer* (New York, 1981), pp. 5-6.

4. Robinson, *International Transfer*, pp. 4-5.

the method, means of carrying it out, and understanding of the method, of which the third is the most crucial. They assert that much of the confusion over the essence of technology transfer arises from a definition of technology containing only one or two of these elements.[5] A concept in universal use is that of the best practise, i.e. a product or process which offers clear advantages over its predecessors. This study will adopt the broadest definitions of technology, seeking to make eclectic use of all the aggregate elements mentioned above.

Inkster has defined technology transfer as the 'movement of a technology or product from the context of its original invention and diffusion to a different economic context', i.e. another country. A transfer comprises two essential elements, the initial introduction of a best practice into the receptor economy, and its subsequent diffusion within that economy. The latter may not necessarily follow the former for a variety of reasons.[6] Wilkins defines successful diffusion as the process by which a technology is not only adopted or adapted by the host economy but also becomes the dominant technology within the relevant sector of that economy.[7]

A different perspective is offered by Dahlman and Westphal. They suggest three levels of technological capability, defined by the degree of skill acquisition gained by the receptor economy through the transfer process. These levels of capability are: operational - the ability to run and maintain a plant; investment - the ability to create new productive capacity; and innovative - the ability to modify and improve processes and products. All three capabilities have to be created before the receptor economy can be said to have acquired complete mastery of the technology.[8]

Whereas the emphasis on diffusion as a measure of success concentrates on the quantitative results, i.e. the speed and extent of adoption of a new product or process, the focus on levels of capability stresses the qualitative outcome of the transfer process, in terms of mastery of a technology and new likely sources of further innovation. Both approaches can give a partial picture of the results achieved - widespread diffusion of a

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5. C. Dahlman and L. Westphal, 'The Transfer of Technology', *Finance and Development*, 20, no. 4 (Washington, 1983), p. 6.

6. I. Inkster, *Science and Technology in History* (1991), pp. 20, 55-57.

7. M. Wilkins, 'The Role of Private Business in the International Diffusion of Technology', *Journal of Economic History*, 34 (New York, 1974), p. 171.

8. Dahlman and Westphal, 'Transfer of Technology', p. 7.

product or a process may have huge economic significance for an economy but need not imply subsequent indigenous improvement of a technology, and even innovative capability associated with a small but ultramodern industry may have little significance for a large undeveloped hinterland. Thus wherever possible, both approaches should be employed to assess the outcome of a transfer attempt.

Contemporary case studies of technology transfer have utilised a variety of terms to identify the features of the process. As with many other aspects of the subject, attempts to define the parameters often suffer from the 'mushiness' already alluded to above. Thus most authors offer vague combinations of agents and mechanisms, often failing to differentiate between the two. The most detailed breakdown of 'actors and factors' in the transfer process has been suggested by Perlmutter and Sagafi-nejad. Considering technology transfer as a complex interaction of suppliers and recipients within specific sociopolitical contexts, they offer the following parameters to describe the process: a) the impetus for transfer - the motivations of the agents; b) the mode of transfer - the formal and legal arrangements within which transfer takes place; c) the actors - otherwise known as agents, being the organizations responsible for the transfer; d) the content - the technology itself; e) method - the precise means by which transfer occurs; and 6) impact - the outcome of the transfer process, assessed from the point of view of all the participating agents.[9]

Such conceptual neatness may be possible for an individual study, but is difficult to sustain for a survey of historical and contemporary transfers. The high interdependence of all the above mentioned factors make a separate consideration of each both problematic and somewhat artificial. The survey will therefore concentrate on the relationship between agents and mechanisms, with special reference to the activities of agents within the receptor economy, and will also include brief discussions of other aspects of technology transfer often ignored or taken for granted - the concept of 'appropriate technologies', and the nature of information flows.

b) Agents and mechanisms

Transfer agents have usually been normally divided into donors and recipients, a terminology which conveys a somewhat misleading picture of the transfer process. It suggests a harmonious flow of technology from the leaders to less developed organizations

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9. Perlmutter and Sagafi-nejad, *International Technology Transfer*, pp. 12-13.

and countries, with the initiative firmly in the hands of the former. It will be shown that neither the post-war experience nor historical case studies confirm the notion of a smooth handing over of technological know-how - if anything the interplay between the two sets of agents has been fraught with distrust. Furthermore, the term recipient suggests passivity, whereas the idea of the less developed economy playing a solely passive role is only correct for some less significant cases. Greatest success has been achieved where the recipient agents have been active - even aggressive - seekers of technology rather than passive.

Contemporary donor or supply agents have been divided into four groups: a) public international bodies such as United Nations agencies; b) governments and government controlled organizations; c) non-profit organizations such as universities, charitable agencies and foundations; and d) private firms. Usually the first three types of agents are simply channels for technology provided by the private firm. For each of these groups the impetus for transfer will normally be different. Private firms are generally motivated by expectations of profit, whereas government action can frequently be linked with political objectives, though impetus for all types of supply agents can often involve an ambiguous mixture of motives.[10]

Recipient agents can be divided into three groups, similar in nature to their counterparts in the donor economy. These are private firms, government and government owned agencies, and a range of non profit organizations such as charities or educational establishments. As with their opposite numbers on the supply side, private firms within the receptor economy are likely to be motivated primarily by expectations of profit.[11] The decisions of recipient governments can be influenced by a variety of factors, of which some may conflict with economic rationality. Projects undertaken for military purposes or to enhance national or organizational prestige may have little economic justification, particularly if a preoccupation with new technologies results in inappropriate choices. Another aspect of transfer initiatives not normally considered by authors is the possibility of corruption forming the main impetus for a project, in which case the motivation of the recipient agents would conflict heavily with the objective needs of the recipient economy.

The institutional arrangements by which technologies are made available reflect the respective aims and contributions of donor and recipient agents. Most authors limit their

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10. Robinson, *International Transfer*, pp. 23-24.

11. Ibid., pp. 61-62.

discussion to the standard transfer modes such as direct foreign investment, joint ventures and licensing agreements, tending to emphasise the role of supply agents. Dahlman and Westphal suggest three basic ways by which less developed countries can acquire technologies, involving differing levels of contribution between the donors and recipients. Thus technology can be provided by the donors, who retain ownership - as in direct investment by multinationals; it can be purchased by the recipients - as in various forms of licensing and know-how agreements, or it can be acquired by the less advanced economy through indigenous efforts. They make the broad distinction between cases where foreigners i.e the donors play an active role, and those in which the agents of the receptor economy take the initiative, stressing that although modes involving the donors receive the most attention, the second category also constitutes an important channel of transfer.[12] This statement deserves further emphasis, as developments both in the nineteenth century and the post-war period prove that it is the activities within the receptor economy, specifically initiatives taken by recipient agents which ultimately decide success in both assimilating foreign technologies and stimulating indigenous innovative capabilities.

Although the majority of transfers occur between industrially advanced countries of similar technological attainment, it is the so-called North-South transfers, where technology is transferred from advanced to underdeveloped economies, which claim most of the attention of analysts. Much of this stems from controversies surrounding perceived imbalances between the respective agents. The standard transfer modes have given rise to tensions between donor firms and recipients within the less industrialized countries. The power of supply organizations, and the existence of enforceable legal arrangements concerning the protection of proprietary technology have enabled donor firms to reap large rewards by controlling the modes and extent of technology transfer. This degree of control has fuelled fears that transfers largely reflect the interests of the donors rather than those of the recipients. Such perceptions have been articulated as various dependency theories, which underline the unequal relationship between Western technological donors and the underdeveloped recipients.[13]

Transfer modes initiated by donor agents have traditionally taken the form of direct investment within the host country, usually involving the setting up of a wholly owned subsidiary firm or a majority owned affiliate. The extent of such arrangements can be

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12. Dahlman and Westphal, 'Transfer of Technology', p. 7.

13. For a discussion of such views see K.Z. Poznanski, 'Technology Transfer: West-South Perspective', *World Politics*, 37 (Princeton, 1984), pp. 134-152.

inferred from estimates which claim that 30% of all world trade takes place between corporations and their international affiliates.[14] Most authors have singled out direct foreign investment as one of the most crucial modes of transfer, with one work even suggesting that its importance for the spread of modern industrial technology can hardly be overemphasised.[15] Others are less sure. With direct investment, host nation participation may be limited to the provision of an unskilled workforce. Transfers of technology to a foreign subsidiary have been labelled internal by one author, as opposed to external transfers involving receiving agents not controlled by the donor.[16] Others have raised doubts as to whether a shift of location alone constitutes an authentic transfer, given that little control may pass to recipient agents.[17] Internal transfers ensure that control of the technology is retained by the donor firm, thus enabling maximum returns. Most multinationals have been reluctant to allow advanced technologies to pass outside their control. Until recently, such firms were generally unwilling to release a technology until late into its life cycle - it has been shown that technologies transferred by American multinationals to uncontrolled recipients have been much older than technologies made available to their subsidiaries.[18]

In recent decades the relative importance of direct foreign investment within lesser developed countries has diminished. This has mainly arisen as a result of governmental action within the recipient countries, aimed at reducing the cost of imported technology by regulating the actions of donor firms. Thus governments have often pursued policies deliberately excluding direct foreign investment, encouraging transfers via such arrangements as joint ventures, licensing agreements and turnkey contracts. Thus instead of the internal transfer of bundled technology or complete packages, many unbundled elements of technology are being made available to recipient firms.[19]

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14. *North - South: A Programme for Survival* (1980), p. 188.

15. A.G. Kenwood and A.L. Lougheed, *Technological Diffusion and Industrialisation before 1914* (1982), p. 61.

16. Robinson, *International Transfer*, p. 38.

17. C.T. Stewart and Y. Nihei, *Technology Transfer and Human Factors*, (Lexington, 1987), p. 7.

18. J. Baranson and R. Roark, 'Trends in North-South Transfer of High Technology', in *International Technology Transfer: Concepts, Measures and Comparisons*, ed. N. Rosenberg and C. Frischtak (New York, 1985), pp. 32, 34.

19. Ibid., pp. 30-31, 33-34.

Nevertheless, the gradual decline in direct foreign investment does not mean that donor firms are no longer able to profit from transfers. International patenting still protects property rights of inventors and organizations, offering them returns on the trade of proprietary knowledge without the necessity of forfeiting control over such knowledge. Where possible, suppliers will seek to impose restrictions on the use of their technology in order to achieve maximum profits.[20] Thus despite the apparent strengthening of the position of the recipients, the conflict over control of technology continues on another level.

It would be an oversimplification to present the evolution of transfer modes simply in terms of the relative bargaining positions of technological donors and recipients. Obviously, the characteristics of a particular technology will also influence the choice of transfer mode. Nevertheless, the frequent disagreements between both sets of agents underline different perceptions of the nature of technology. Should it be perceived as a common good, therefore freely available to all, or is it rather another commodity for which supplier firms are entitled to reap maximum returns?

The answer lies somewhere between these views. The notion of a common pool of technology may seem reasonable enough considering the rapid advances in science and technology, and the subsequent growth of the amount of codified knowledge theoretically available to potential users. However, it is also apparent that a proportion of technological knowledge utilised by innovating firms is generated within the firms themselves, and depends more on in-house skills than a general pool of knowledge. Such skills embodied within firms cannot be easily codified, and cannot therefore be regarded as a common good.[21] For supply agents, this consideration would justify the desire to obtain suitable returns on technology as a commodity. For the recipients, it lends further emphasis to the need to develop local capabilities if advanced technologies are to be assimilated.

c) Creating indigenous capabilities

Given the arguments over control of technology, it is highly significant that the two economies which have benefitted most from innovations developed elsewhere, notably Japan and the United States, both 'retained indigenous control over the technologies which

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20. Dahlman and Westphal, 'Transfer of Technology', p. 6.

21. K. Pavitt, 'Technology Transfer among the Industrially Advanced Countries', in *International Technology Transfer*, ed. Rosenberg and Frischtak, pp. 5-6.

they imported from abroad'.[22] For the United States during the nineteenth century, this was not the result of any deliberate policy but a consequence of the relative ease with which such a vibrant economy could both acquire and attract unbundled technology from Britain during the early period. Few later industrializers were as fortunate as the United States - for these the acquisition of foreign technologies on favourable terms required prudence and single-mindedness, as reflected in a variety of deliberate policies to foster development.

Rosenberg has emphasised the early emergence of an indigenous technological capacity as the crucial factor determining the success of technology transfer.[23] Supply agents can provide a degree of skill transmission, but it is the actions of the recipients themselves which ultimately decide the levels of technological capabilities created within their economies, as these capabilities will not 'accrue as a matter of course to passive recipients of technology; each requires an increasing level of effort'.[24]

Recipient agents, especially governments, can increase the likelihood of success in two major areas. Firstly, there are general policies to increase the absorptive capacity within an economy by improving the quality of education, both general and technical, and by the founding of efficient institutions for both the creation and dissemination of knowledge. Capabilities above the basic operational level require an understanding of the technology which can only be provided by increasing levels of general and specialised knowledge.[25] The best results have been achieved where such general education policies have been accompanied by aggressive strategies for skill and knowledge acquisition, involving both the utilisation of foreign experts and instructors under strict local control with rapid replacement by local personnel, and the placement of nationals within leading firms and institutions abroad.

Governments and their agencies within receptor economies can increase the chances of successful transfers by specific policies influencing both the choice of technologies acquired and the ways in which these acquisitions occur. Objectives for such policies should

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22. N. Rosenberg, 'Technological Progress and Economic Growth', in *Technical Change, Employment and Investment* (Lund, 1982), p. 11.

23. N. Rosenberg, *Inside the Black Box: Technology and Economics* (Cambridge, 1982), p. 271.

24. Baranson and Roark, 'Trends', p. 27.

25. Stewart and Nihei, *Technology Transfer*, pp. 3-6.

include: the choice of the most appropriate technologies, the choice of most advantageous transfer modes, the ensuring of local participation to increase local technological capability, and the use of local rather than foreign sources wherever possible.[26]

Such objectives can be difficult to pursue in a world where the possessors of technology still have far greater bargaining power than the would-be recipients. Nevertheless, the increasing ability of governments to ensure a larger proportion of transfer via licensing agreements rather than through direct foreign investment has already been noted. The Japanese experience has shown that despite the difficulties, it is possible to acquire foreign technology on reasonable terms, and to improve upon foreign innovations thanks to vigorous research and development programmes based on a sound understanding of the technologies involved.

Japan has been the model recipient in every respect, and the country's success has owed much to the intelligent and determined implementation of the measures listed above. Ever since 1868, Japanese transfer agents - first the government, but increasingly the private sector - have been eclectic in their choice of sources of technology, but have shown single-mindedness in their choice of modes. Always careful to maintain total control over the transfer process, Japan was able to acquire the technology it needed mainly through licensing agreements, with almost no reliance on either direct foreign investment or even foreign capital. Foreign personnel were employed in large numbers from the start, with some 3,000 being employed by the government alone between 1868 and 1912. However, anxious to avoid prolonged reliance on foreign skills, the Japanese were particularly successful in replacing foreigners with locally trained personnel. Thus the turnover of foreigners was rapid - whereas over 500 foreigners were employed by the state in the peak year of 1875, this number had dropped to 155 a decade later.[27]

The unique degree of control over the course of transfer is impressive enough, but it was the subsequent exploitation of the technologies which has marked out Japan as the most successful recipient. The high priority accorded to general and technical education, and to the internal dissemination of knowledge created an environment highly conducive to the rapid assimilation of technology. Where necessary, skills and knowledge were acquired by

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26. Dahlman and Westphal, 'Transfer of Technology', p. 9.

27. Rosenberg, *Inside the Black Box*, p. 271; W.J. Macpherson, *The Economic Development of Japan c.1868-1941* (1987), p. 36; see also *Foreign Employees in Nineteenth-Century Japan*, eds E.R. Beauchamp and A. Iriye (Boulder, 1990), and F. Fujita, *American Pioneers and the Japanese Frontier* (Westport, 1994).

Japanese students at leading institutions and private firms in the west. The creation of research institutions and demonstration plants in industry further accelerated the diffusion of technology within the country, despite some initial problems.[28]

Thus the foundations of Japan's formidable post-war performance were laid during the Meiji period, but the country's success has also been dependent on sustaining high levels of technological effort. Japan has maintained a high commitment to research and development, and retains an avid interest in developments occurring abroad. Thus even when Japan has overtaken the West in so many areas of technology, it still devotes considerable effort to the pursuit of knowledge from elsewhere. Thus in 1978 40,000 Japanese visited the United States to 'study and acquire American technology', as opposed to 5,000 Americans travelling in the opposite direction for the same purpose.[29] This proves the point that successful technology transfer is not a single transaction but a continuous process. The possession of excellent human resources, the importation of unbundled technology, and relentless research and development programmes have resulted in significant technological advances. Although the first notable breakthroughs occurred in the field of improvement engineering - the perfection of technologies developed elsewhere - it is likely that Japan will become an increasingly important source of major innovations.

The case of Japan demonstrates what can be achieved via technology transfer. Transfers to Japan have been relatively unusual in that they have almost solely served the needs of receptor agents rather than the agents of supply. In fact it seems strange to speak of donors and recipients when describing the Japanese experience, where the activities of supply agents were of little significance compared with the impressive efforts of Japanese governments and firms, which constituted aggressive acquisition rather than mere recipience. In this respect eclectic Japanese borrowings bear some resemblance to European and American efforts to secure British technologies after 1710. It was the European governments who pioneered the role of active recipients in the eighteenth century, a role which both governments and individuals continued to play - with varying degrees of success - right up to the middle of the nineteenth century.

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28. Inkster, *Science and Technology*, pp. 123-128, 197-202.

29. L.H. Lynn, 'Technology Transfer to Japan', in *International Technology Transfer*, ed. Rosenberg and Frischtak, p. 256, fn. 4.

d) Appropriate and adaptive technologies

One of the factors in the remarkable success of the Japanese economy has been the intelligent choice of technologies acquired. As technological advances reflect particular factor endowments of the originating economy, they will often have little relevance for economies with contrasting endowments. The 'appropriateness' of a technology cannot be reduced to any single formula, but depends on the presence or absence of several factors. Kenwood and Lougheed have listed nine determinants of technical diffusion, ranging from demand and capital to resource base and language barriers.[30] All of these factors are also determinants of the appropriateness of a given technology to an economy. Obviously, the term will invariably have different meanings for suppliers and recipients. Normally viewed from the perspective of the receptor economy, appropriateness depends on the priorities of the recipient agents. From the economic point of view, an appropriate technology is one which would allow the use optimum use of available endowments and produce the highest net benefit, but the choice is rarely simple. Government policies which distort factor prices may encourage unsuitable choices, while excessive protection or monopolies may discourage the search for the most cost-effective technologies.

For less developed economies, labour-intensive and capital-stretching adaptations are generally regarded as more appropriate, but the nature of the technology itself may limit the amount of factor substitution that can be achieved. Technologies relying on a highly specific resource base may have little relevance where such resources are absent. For some technologies, alternatives may not be readily available - where the superiority of a new process or product over an older alternative is overwhelming, only the new can ensure competitiveness. In many cases, economically unjustified decisions have arisen from noneconomic priorities, especially where considerations of military strength or national prestige are involved. The newest and most advanced technologies, especially within heavy industries, have traditionally been sought by governments eager to enhance their status, often resulting in spectacular failures.

The two major success stories of technology transfer, the United States and Japan, both owe much of their success to the skilful adaptations of technologies initiated abroad. In the American case, abundant supplies of natural resources and capital led to significant modifications of British technologies, while Japanese capital scarcity coupled with labour abundance gave rise to contrasting but equally creative adaptations. In more recent times,

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30. Kenwood and Lougheed, *Technological Diffusion*, p. 12.

less developed economies have occasionally been successful not only in adapting technologies to suit their own needs, but also in transferring such technologies to similar economies.

Occasionally, such adaptations have found their way back to the originating economy, in the form of so-called reverse flows. Single instances of reverse flows prove little. Many of the most significant adaptations may have little relevance to the originating economy for precisely the same reasons which made the adaptations necessary in the first place - the differences in factor and resource endowments. Furthermore, it is not necessary to achieve significant innovative capability for reverse flows to occur. The Polish modifications to British reaper design, to be described in detail in chapter 4.1, prove that reverse flows do not necessarily carry economic significance, but tend to be well publicised in order to enhance the reputation of the modifying firm. Rather than overstressing the importance of single reverse flows, it would be more meaningful to concentrate on the long term significance of contributions made to technological progress by non-initiating economies.

Whereas all the above points concentrate on supply factors, the demand side is equally important in determining the appropriateness of a new technology. There is much justification for the suspicion that the supply side has received the most attention from researchers concerned with technology transfer and diffusion.[31] The extent of demand can affect both the rationale of introducing new technologies and the capabilities to be sought. Where a technology is scale-specific it may not be appropriate where the local market does not warrant large scale production, and there may be little point in developing anything more than operational capability if a market is small and sluggish. Only large or rapidly growing markets are likely to warrant investment in higher levels of capability.[32]

The securing of suitable markets has frequently required efforts as vigorous as the acquisition of the technology itself. New productive capacities must be capable of offering a competitive product if the transfer is to be an economic success. Without product marketability even innovative capability will remain an unrealized capacity.[33] Although markets for such output have often been created by such manipulations as protective tariffs, the real winners in technology transfer have not only developed and maintained significant innovative capabilities but have also been able to fulfil the potential of such

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31. Ibid., p. 7.

32. Dahlman and Westphal, 'Transfer of Technology', p. 7.

33. Baranson and Roark, 'Trends', p. 31.

capabilities via aggressive marketing, a factor which explains the success of many firms in the United States, Japan and Germany.

For small economies, the problem of demand and marketability are even more critical given the limitations of the home market. In such cases, foreign demand plays a major role in absorbing the output of newly created capacities. In both industry and agriculture, small economies have achieved considerable success via the securing of specialized markets for high quality products. In manufacturing, the engineering industries of Switzerland and Belgium have been notable successes.[34] The export of high quality agricultural products and processed foods was a developmental path followed by several economies in the nineteenth and twentieth centuries. For some small economies, the huge effort to master higher technological capabilities has brought immense benefits within a very short time, as demonstrated by the huge achievements of Israeli agriculture.[35] Unfortunately, such an effort has all too often proved beyond the means of many small economies.

e) Channels of transfer

Studies of contemporary transfers tend to concentrate on modes while virtually ignoring the methods employed. The unprecedented rate of scientific and technological progress over the last century has resulted in the formal codification of increasingly wider areas of knowledge. Thus, in contrast to the pre-scientific and partly illiterate world of the British industrial revolution and its aftermath, huge amounts of information can be transmitted by such impersonal means as blueprints or formulae. The beginnings of the transition away from the human agent as the sole means of transmission will be charted in detail below. However, it would be quite mistaken to suppose that personal knowledge transmission has been superseded by abstract forms of information. The latter are more likely to suffice where the technological gap between donors and recipients is insignificant, as between firms of similar capabilities. In such cases, usually involving firms within industrially advanced countries, impersonal channels are a major source of transmission, especially where the transfer of information takes place without the consent of the supplier firm, as in reverse engineering and industrial espionage. Where the gap is more considerable, as

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34. Kenwood and Lougheed, *Technological Diffusion*, pp. 54, 62.

35. F. Meissner, 'The give and take of technical cooperation: the case of Israeli agriculture', in *Industrial Development and Technology Transfer*, ed. D. Soen (1981), pp. 117-118.

with most transfers to less developed countries, human transmission still retains its crucial role.

Much of the continued importance of personal transmission can be explained by the increasing complexity of technological solutions employed within leading firms. It has already been noted that firms have become increasingly reliant on in-house skills as much as on a common pool of technology. Personal transmission remains crucial for uncodified elements of technology not encompassed by the common pool, and instruction at the workplace remains an important part of training at all levels. Rosenberg has pointed out the inadequacy of the idea of a 'set of blueprints' representing a technology if divorced from the human inputs who utilize it, while Inkster stresses that 'blueprints do not transfer easily'.[36] Where technology is embodied in the firm, it is the human element in the shape of teams provided by the firm - or teams placed within the firm by a recipient agent - which acts as the transmission channel.

1.2 Britain and the followers

Rosenberg's oft quoted observation on the significance of adapted technologies is equally true for the British economy both before and during the industrial revolution. Despite the country's more than creditable performance as a source of inventions, Mokyr seems correct in asserting that 'Britain's relative role in invention was smaller than its corresponding role in implementation'.[37] In the late medieval period Britain had been a relatively underdeveloped country, and for several centuries remained a technological debtor, drawing heavily on foreign innovations in industries such as metallurgy and engineering - precisely those sectors in which the country became preeminent by the end of the eighteenth century. Not only in industry was Britain a recipient of ideas from the Continent: most of the agricultural advances of the seventeenth and eighteenth centuries, including several which were to draw so much praise from European observers of the British new farming, had been copied directly from the Low Countries.[38]

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36. Rosenberg, 'Economic Development', p. 555; Inkster, *Science and Technology*, p. 21.

37. J. Mokyr, *The Lever of Riches* (Oxford, 1992), p. 240.

38. A.E. Musson, 'Continental Influences on the Industrial Revolution in Great Britain', in *Great Britain and her World 1750-1914*, ed. B.M. Ratcliffe (Manchester, 1975), pp. 71-85; N. Riches, *The Agricultural Revolution in Norfolk* (1967), pp. 21-24; G.E. Mingay, *The Agricultural Revolution: Changes in Agriculture 1650-1880* (1977), p. 20.

The British success in responding to ideas from abroad was one of the most remarkable features of the country's economic rise, and this process did not cease after the British had outdistanced the rest of the continent. Even when European industrialisation had begun in earnest, it was still Britain which provided the most rewarding environment for many inventions conceived on the continent. These often reached their fullest development in Britain rather than in their country of origin, as typified by French inventor Philippe Girard, who experienced the frustration of seeing the British take full advantage of machines he had invented but was unable to develop in his own country.[39] At the 1851 Great Exhibition, the supreme expression of British industrial achievement, the sensation caused by American reaping machines led to rapid responses from British manufacturers, who were able to recapture much of the initiative and play an important role in the subsequent development of reaper technology.[40] There seems to be much truth in the general belief that the absence of such decisive responses to foreign developments was a major factor contributing to the decline of British industrial performance in the second half of the nineteenth century.

a) Impetus and anti-impetus

With contemporary transfers of technology, the motivation behind the actions of the various transfer agents are usually clear cut. Benefits for the suppliers, in the form of extended markets or rent payments, and the developmental possibilities for the recipients offer tangible incentives for both sides. Such a situation did not exist between the possessors of best practices in eighteenth century Britain and the would-be recipients on the continent. Whereas the latter displayed an obvious interest in British advances long before the industrial revolution, many on the British side felt little inclination to share their secrets with the rest of Europe. Like many technological leaders in later periods, Britain was to discover that the lead could not be maintained indefinitely. Unlike later leaders Britain sought to preserve its preeminence not so much by controlling the extent and scope of transfers but by attempting to prevent them altogether.

European governments were already aware of British developments as early as the first quarter of the eighteenth century. The desire to first identify, and then secure new products and processes from Britain led to a series of government sponsored activities to

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39. C. Ballot, 'Philippe de Girard et l'invention de la filature mécanique du lin', *Revue D'Histoire Economique et Sociale*, 7 (Paris, 1914-19), pp. 135-195.

40. G.E. Fussell, *The farmer's tools: a history of British farm implements, tools and machinery 1500-1900* (1981), pp. 130-139.

be discussed below. Most of these efforts were undertaken by the French government, and formed merely one part of the wider Anglo-French rivalry in that period. From the French point of view, depriving the British of technological advantage was another weapon in a ceaseless mercantilist struggle, complementary to the frequent wars between the two nations throughout the long eighteenth century.

For Europe as a whole, the real turning point came with the restoration of peace and trade in 1815. The sudden influx of British goods into European ports demonstrated the gulf which had opened up between manufacturing industry on both sides of the Channel. The range, quality and price of the British exports bore testimony to a technological superiority which threatened to kill off industry throughout the continent. In such circumstances both the economic threat from across the Channel and the clear benefits of technological progress gave several European governments an obvious stimulus to develop their own industries. Thus began another series of measures which were to bring different results to different parts of the world, but would assist several countries in not only emulating, but also overtaking the British economy before the century was out.

If technology transfer has occurred ever since technology itself has existed, it is also true that controversies over the possession and control of technology have raged ever since the benefits of technological leadership have become apparent. The institutional arrangements by which the technologies of the British industrial revolution found their way to Europe and elsewhere, and the climate in which this occurred can only be understood in the light of British determination to retain sole possession of its expertise, as expressed by government measures specifically designed to prevent such transfers.

Even before the industrial revolution, government and many manufacturers in Britain identified technological leadership with national interests, and consequently regarded foreign efforts to secure British skills as a threat. Thus major government legislation was enacted as early as 1719, marking the beginning of a century and a quarter of official prohibition of the outflow of British skills. In the long run these measures proved ineffective, but the legal restraints they created dictated a particular course for subsequent transfers, in which agents representing the technological recipients played the more aggressive role, with the supply being provided by a small number of enterprising individuals rather than the leading firms of the time.

The 1719 legislation followed agitation resulting from two separate operations conducted by foreign governments. French attempts to recruit substantial numbers of British

workmen, and Russian efforts to acquire skills on the spot by entering into apprenticeships were the most extensive and well organised examples of the new threat, and caused considerable alarm to both manufacturers and government in Britain. The resulting Act placed restrictions on the emigration of British workers, but was directed at recruiting agents, being primarily designed to thwart French efforts in this field.[41] In 1750 penalties for recruiting agents were increased, and in that year the prohibitory legislation was extended to cover the exportation of machinery. By 1782 a series of Acts had forbidden the exportation of all tools and machinery connected with textile manufacturing, and between 1785 and 1795 all tools connected with the Birmingham metalworking trades were added to the list.[42]

Such measures sought to preserve the British lead by criminalizing technology transfer. The hopes were to prove misplaced, as the prohibitions were largely ineffective. Not only were the laws increasingly difficult to enforce, but their application was often inconsistent. Furthermore, the restrictions on machine exports were selective, with steam engines and machine tools not included in the legislation. Increasing evasion of the laws, together with mounting agitation for their repeal, resulted in the gradual dismantling of the legislation after 1815. As the Board of Trade admitted in 1819, the 1719 Act against artisan emigration had always proved particularly ineffective when applied to artisans, and was repealed in 1824. Restrictions on machine exports were relaxed in 1825, and finally ended in 1843. As Jeremy has pointed out, the legislation may have hindered or foiled several transfer attempts, but could not stem the outflow of technological information via men and machines.[43]

Despite the failure of the legislation, the criminalization of technology transfer had a delaying effect, not only on transfer itself but also on the institutionalisation of technological supply by forcing both donors and recipients to engage in clandestine transactions. Thus individual transfer episodes, while following similar general patterns, often took a bizarre course because of official interference, with tales of moonlit escapes and pistol exchanges between recruiting agents and government officials more reminiscent of smuggling than of

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41. J.R. Harris, 'The First British Measures against Industrial Espionage', in *Industry and Finance in Early Modern History*, ed. I. Blanchard, A. Goodman, J. Newman (Stuttgart, 1992), pp. 205-208.

42. J.R. Harris, 'Industrial Espionage in the Eighteenth Century', *Industrial Archaeology Review*, 7 (1985), p. 129.

43. Public Record Office (hereafter PRO); BT5/27, pp. 337-338; D.J. Jeremy, 'Damming the Flood', *Business History Review*, 51 (Harvard, 1977), pp. 18-23, 28-34.

labour force recruitment. Nevertheless, the relationship between the legal framework created by the prohibitive legislation and the changing forms of donor agents has been oversimplified in the historiography, and requires some clarification.

The repeal of machinery exports in 1843 unshackled British capital goods firms, and their activities in Europe have been described as a response to the repeal of the prohibitions.[44] However, the reverse argument seems much more compelling. Musson's detailed analysis of the machinery export debate has pointed out how, amid all the inconsistent and often contradictory views expressed by politicians and manufacturers, it was changing perceptions of self interest which formed the main determinant of manufacturers' policies.[45] Once a small group of firms servicing the textile mills, the capital goods producers had developed into a separate industry which sought its own markets. More important was the fact that it was precisely in the two decades before 1843 that the capital goods industry began to outgrow the home market. The eagerness of such firms to supply the European market during the mid 1820s was largely driven by the slump at home. Petitions to the Board of Trade, seeking permission to export prohibited machinery, underline the depression of the home market. An 1827 petition to export power looms to Poland bemoaned the fact that the firm was then employing a mere hundred mechanics instead of the five hundred employed in previous years.[46] With the growing importance of foreign markets to the expanding capital goods sector, it was the increasing evasion of the prohibitions by such firms which made the legislation progressively irrelevant. As Farnie has pointed out, the 1843 repeal merely gave legal sanction to what had become standard practice.[47]

It can be further argued that for as long as the home market remained buoyant, British machine producers showed little interest in expanding their foreign activities. In the face of the legislation it was obviously unnecessary to risk heavy fines in such circumstances. However, the prohibitions do not explain the whole picture. The same apparent indifference to foreign markets can be detected in an area not subject to restrictions, namely steam

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44. K. Bruland, *British Technology and European Industrialization*, (Cambridge, 1989), p. 4.

45. A.E. Musson, 'The "Manchester School" and Exportation of Machinery', *Business History*, 14 (1972), pp. 17-50.

46. PRO, BT1/233, Petition of Richard Ormrod, March 21, 1827.

47. S. Farnie, *The English Cotton Industry and the World Market, 1815-1896* (Oxford, 1979), p. 56.

engine exports. A study of the beginnings of steam engine production at the Cockerill works in Seraing, the continent's foremost machine making establishment, showed a conspicuous absence of any export drives by British producers. Not only were Cockerill's engines were more expensive than those produced in Britain, but in the first years they were plagued by numerous problems of construction, which elicited several complaints from Cockerill's clients. Despite such an unauspicious start, Cockerill had little difficulty in cementing his position in the absence of British competition.[48] The reasons for such apparent indifference before 1825 can be inferred from the experience of Count Wolicki, who sought to purchase steam engines for the Polish government in the autumn of that year. He found that all the major engine manufacturers had full order books for the next two years.[49] It is hardly surprising that so few manufacturers felt the need to pursue foreign markets while such conditions persisted.

Thus, in sharp contrast to most later transfers, the transmission of British best practices to the follower economies owed relatively little to the originators of those practices. Fears about the loss of British technological preeminence played an obvious part. A static perception of leadership, and an inability to distinguish between levels of capability led some to regard any leakage of technology as detrimental to the national interest. The alarmist tone of warning letters passed on to the Board of Trade, detailing attempts to breach the prohibitions, gives a good indication of the gravity with which such challenges to the British position were viewed. One correspondent described his intervention to foil such an attempt as being of comparable importance to that which unmasked the gunpowder plot.[50]

To a certain extent, such attitudes were no more than an extensions of the internal secrecy which had prevailed among many British manufacturers since the beginnings of the industrial revolution. Given the stark imperfections of the patenting system, secrecy was often regarded as a more secure means of protecting an innovation than a patent. Tales of factories surrounded by high walls or staffed by a Welsh-speaking workforce are only the most curious examples of a general obsession with secrecy.[51]

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48. T.B. Hodges, 'The Iron King of Liege: John Cockerill', unpublished Ph.D. Thesis, University of Columbia (1960), pp. 390-396, 409-411.

49. Archiwum Główne Akt Dawnych (hereafter AGAD, Warsaw: Akta Komisji Rządowej Przychodów i Skarbu (hereafter KRPS), 1449, Wolicki to Lubecki, Nov. 10, 1825.

50. PRO, BT1/129, f. 182; Anonymous to Society of Arts, Jan. 16, 1819.

51. H.I. Dutton, *The Patent System and Inventive Activity* (Manchester, 1984), pp. 110-111; Harris, 'Industrial Espionage', p. 132.

Nevertheless, it would be too simplistic to claim that British possessors of technology were uniformly obsessed with secrecy. At the other extreme, there are numerous cases which demonstrate a complete lack of concern over the maintenance of secrecy. The case of James Nasmyth, who believed that engineering knowledge was a common good is well known, but several other examples can be cited. Most puzzling is the readiness with which British machine tool makers passed on information to John Cockerill. In 1817 Murray, partner in the Leeds firm of Murray and Fenton gave Cockerill several plans, models and blueprints while on a visit to Liége. During visits to Britain in 1819 and 1828, Cockerill was a welcome guest at several factories and foundries. Given that Cockerill's reputation on the continent was already high as early as 1817, it seems surprising that such eminent engineers as Murray and Maudsley did not appear to view Cockerill as a potential rival.[52]

In an excellent study of the Yorkshire textile engineering industry, Cookson found that both secrecy and openness were common among machine makers, with numerous examples of engineers and manufacturers sharing information even with potential rivals, while others were careful in guarding their secrets. A definite hardening of attitudes did become noticeable from about 1830 onwards, partly connected with the emergence of larger specialized firms.[53]

Whatever the divergent views on secrecy, it was clear that by the 1840s British firms began to actively court overseas markets, displaying a new eagerness to demonstrate new products to prospective customers. Britain had lagged behind the continent in the holding of industrial exhibitions, but in the changed climate of the 1840s the potential of such a showpiece became clear, resulting in the first international exhibition at Crystal Palace in 1851.[54] Instead of the distrust which many British manufacturers once displayed towards foreigners, all the leading British firms were now positively friendly to visitors from abroad. Sharp and Roberts, one of the firms most interested in foreign markets, welcomed large numbers of foreign visitors in the 1840s, including private businessmen and government officials from most European and many American countries.[55] Both the visitors and the purposes behind such visits differed little from trips made to Boulton and Watt and similar

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52. Hodges, 'Iron King', pp. 172-174.

53. G. Cookson, 'The West Yorkshire Textile Engineering Industry 1780-1850', unpublished Ph.D. Thesis, University of York, 1994, pp. 161-166, 191.

54. K.E. Carpenter, 'European Industrial Exhibitions before 1851', *Technology and Culture*, 13 (Chicago, 1972), pp. 466-467.

55. Science Museum Archive Collection, MS 368.

firms half a century before - it was the universality of the welcome they received which was markedly different.

Neither secrecy nor fears about the loss of technological leadership had ever played any significant role in one sector which has remained unjustly neglected by historians of technology transfer - the 'new farming' publicised by many leading aristocrats. Whereas the list of foreign pilgrims to Britain's industrial shrines has attracted considerable attention over recent decades, the equally impressive number of visitors interested in the new farming remains largely ignored in British writing. For many European observers - not only the agrarian elite - British agriculture progress was as worthy of emulation as the more spectacular advances in industry, and a visit to Holkham, Tiptree Hall or one of the Lothian farms was as important as a tour of the manufacturing districts. The best example of this is Albrecht Thaer, whose visits to Britain in the 1790s had considerable effect on the course of developments throughout central Europe, thanks to his writings, based on his observations of the new farming, and his later activities at Möglin. After his death a compatriot was to claim that a 'new age of German agriculture began with Thaer's description of British farming'.[56] Similarly, the visit of the young Andrzej Zamoyski to Holkham and the Lothian farms dictated the course of the agrarian reform movement in Poland. For many European landowners and agricultural experts, the new farming provided the supreme gauge of progress, against which the backwardness of their own agricultures could be measured.

As with many industrial manufacturers, there was little desire on the part of British landowners or farmers to act as deliberate supply agents, but latest developments in agriculture were free for all foreign visitors to admire and study. Indeed, the aristocratic propagandists of the new farming were only too eager to give public displays of their success to anyone who cared to enquire. After all, British agriculture was not only producing solely for the home market, but enjoyed considerable protection for its chief products thanks to the Corn Laws. Foreign competition was hardly perceived as a threat. Moreover, the great landowners were men secure in their political and economic status. Thus the great agricultural shows, beginning with the Holkham Sheep-Shearings, were as much a celebration of aristocratic achievement as they were of technological innovation. The last of the Holkham gatherings in 1821 was attended not only by all the luminaries of

56. [K. Garbiński] K.G., 'Gospodarstwo angielskie', *Roczniki Gospodarstwa Krajowego*, 5 (2) (Warsaw, 1844), p. 136.

the new farming, but was also open to interested parties from Europe and North America.[57]

Apart from such great aristocratic showpieces as the shearings at Holkham or Woburn, dozens of local societies held their own events, and annual national shows were organized by the Royal Agricultural Society after its formation in 1838. Such shows encouraged the dissemination of information, with open discussion of new methods and their results.[58] Even if large numbers of industrialists were far less obsessed with secrecy than is commonly supposed, the overwhelming readiness to pass on information on agricultural best practices still offers an interesting contrast. Government attitudes also showed a complete lack of concern over foreign visitors to British farms, with no anonymous letters warning of fiendish plots to secure information on crop rotations or turnip cultivation. Thus, for continental agrarian reformers looking to Britain, espionage was hardly a necessary means of acquiring information, and an account of the diffusion of farming techniques to the continent would contain none of the cloak and dagger elements of industrial technology transfer.

Although British capital goods firms came to play an increasingly important role as a supplier of machinery and expertise to foreign customers, it should be remembered that their primary motive was to sell products rather than to transfer technology for its own sake. Rosenberg is correct in asserting that the capital goods industry institutionalized internal pressure for the adoption of a new technology.[59] However, it should be remembered that capital goods firms direct their attention towards end users rather than potential rival producers. Even with the case of technological convergence in the tool industry towards the end of the nineteenth century, when many machine tool makers supplied capital goods firms with interchangeable components common to the production of a wide range of commodities, this was still a case of a firm supplying end users rather than potential rivals.[60] Therefore, while such firms do indeed have a vested interest in hastening the diffusion of certain technologies, they have little interest in creating anything more than operating capability among end users. Even when technological packages were supplied, from the consultancies of Matthew Boulton to the detailed operational information supplied by textile

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57. R.N. Bacon, *A Report of the Transactions at the Holkham Sheep-Shearing* (Norwich, 1821), pp. 58, 116-117.

58. J.V. Beckett, *The Aristocracy in England 1660-1914* (Oxford, 1989), pp. 164-167.

59. Rosenberg, 'Economic Development', pp. 565-566.

60. Ibid., pp. 556-557.

machinery firms such as the Platt Brothers, these were almost entirely directed towards end users, and were linked with machinery sales. For the creation of higher technological capabilities it is the recipient agents and the individual British experts who took the initiative rather than the British capital goods industry.

Even though British firms dealt mainly with end users, the distinct possibility that their capital goods could be copied was a regrettable risk in a world where the enforceability of proprietary rights over technology was still problematic. Boulton and Watt were the first major British firm to attempt to prevent the pirating of their products by the use of foreign patents. Nevertheless, their considerable efforts in this area proved unsuccessful - the protection afforded by the patents proved insufficient, and a French manufacturer was able to produce copies without legal hinderance.[61] Half a century later Robert Stephenson had much better luck with his patent long boiler locomotive, for which he received sizeable royalties from French makers.[62] With regard to enforceable international patents, Inkster seems correct in asserting that the 'nineteenth century patent system would bear some further investigation as both a measure and mechanism of technology transfer'.[63]

Given the inconvenience of tariff barriers erected against British goods, and the almost universal desire to expand manufacturing industries throughout Europe, it is surprising that British firms were slow to take advantage of new transfer modes, particularly direct foreign investment through the setting up of subsidiaries abroad. The companies owned by John Cockerill constituted the first de facto multinational manufacturing concern, but by the last quarter of the nineteenth century several European firms had established foreign empires, most notably the Solvay and Nobel companies, the latter possessing over 70 plants throughout the continent. This period also marked the beginning of the influx of several large American firms into Britain and Europe, spearheaded by the arrival of the Westinghouse engineering company in 1879.[64]

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61. J. Tann, 'Marketing Methods in the International Steam Engine Market: The Case of Boulton and Watt', *Journal of Economic History*, 38 (New York, 1978), pp. 366-371.

62. J.G.H. Warren, *A Century of Locomotive Building by Robert Stephenson & Co.* (Newton Abbot, 1970), p. 101.

63. Inkster, *Science and Technology*, pp. 160-162.

64. A. Milward and S.B. Saul, *The Economic Development of Continental Europe 1780-1870* (1973), pp. 183-184.

Few British firms took the same path. Of 14 British firms with major manufacturing capacity abroad in 1914, only one represented heavy industry.[65] The period which witnessed the growth of direct foreign investment also marked the heyday of British overseas investment. After 1870 British foreign investment rose from 4% of national income to 7% by 1914. Such vast sums, mainly flowing towards overseas extractive industries, transport infrastructures and public utilities, inevitably involved technology transfers on a huge scale. However, unlike growing trends elsewhere, these transfers were channelled via portfolio investment. Thus not only was British technology passing abroad on an unprecedented scale, it was being supplied unbundled, with few restrictions being imposed on the recipients.[66]

b) Active transfer agents

It has been shown that British firms took little initiative in transferring their expertise before the middle of the nineteenth century, and even then showed minimal interest in transferring anything beyond operational capability. Until then it was foreign governments and individuals who were the most important agents of transfer, often in conjunction with individual Britons aware of the opportunities presented by foreign determination to acquire British skills. It was precisely such a combination of foreign government and expatriate Briton which led to the first significant attempt to obtain technology by enticing large numbers of British workers to France. This was the John Law scheme of 1718-20, which sought to recruit skilled workers from a wide range of key industries. This was the campaign which caused so much alarm throughout Britain, leading to the 1719 legislation.[67] It was the first of many.

The economic activities of many Britons emigrating to Europe and the United States have been covered by several works, of which the account by Henderson remains the broadest.[68] These accounts show a huge number of individual Britons playing a crucial

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65. Kenwood and Lougheed, *Technological Diffusion*, p. 157.

66. Rosenberg, *Inside the Black Box*, pp. 260-262.

67. Harris, 'First British Measures', pp. 211-225.

68. W.O. Henderson, *Britain and Industrial Europe 1750-1870* (2nd ed., Leicester, 1965); other useful accounts include: J.R. Harris, 'Michael Alcock and the Transfer of Birmingham Technology to France before the Revolution', *Journal of European Economic History*, 15 (Rome, 1986), pp. 7-57; D.J. Jeremy, *Transatlantic Industrial Revolution* (Oxford, 1981); A. Klima, 'The Beginning of the Machine Building Industry in the Czech

role in exporting technologies. Only two examples need be mentioned here: one to demonstrate the versatility and persistence of some individuals, and the other to show that the foremost British entrepreneur on the continent had institutionalised the transfer of British technologies long before most British capital goods firms turned their attention to overseas opportunities.

Most individual Britons left their mark on one foreign country, but the little known but eventful career of Edward Thomas provides an excellent example of a Briton attune to opportunities existing throughout the continent, in his case in four different countries. Once based with John Cockerill at Liége, he later moved on to found a small workshop in Western Germany, but by the beginning of 1819 he had joined forces with the pioneering German entrepreneur Friedrich Harkort, in order to found a steam engine factory at Wetter in the Ruhr. The recruitment of British workmen for this venture was monitored by the authorities thanks to a warning from a particularly well informed source, but the plant was soon in operation. After six years at Wetter, during which time he erected several steam engines in the German states and Bohemia, he parted company with Harkort in 1825. Most authors quote Harkort at this point, claiming he next went to Bohemia, but in fact he returned to Britain, where by the end of 1825 he had entered into negotiations with the Polish agent Count Wolicki and Philippe Girard. He agreed to move to Poland to set up another steam engine factory, and spent most of 1826 in company with Girard, selecting machines and recruiting workmen for service in Poland. For unknown reasons Thomas left Poland in 1827 before completing these plans, and in 1829 he turned up in Prague. There he obtained state aid in founding a factory which became Bohemia's foremost machine making venture. Thomas enjoyed lasting success in introducing British machine making skills into Bohemia, and it was largely thanks to his efforts that the province earned the nickname 'Little England' by the end of the 1830s. The career of Edward Thomas suggests that there were many able Britons not only aware of opportunities abroad, but actively making successful careers out of technology transfer, not only via their own work, but also by acting as recruiting agents and technical advisors. It will be seen in the next chapter how Thomas persuaded the Polish government to upgrade its ambitions in a vital sector - that of steam

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Lands in the First Half of the 19th Century', *Journal of European Economic History,* 4 (Rome, 1975), pp. 49-78; E. Robinson, 'The Transference of British Technology to Russia 1760-1820: a Preliminary Enquiry', in: *Great Britain and her World 1750-1914*, ed. B.M. Ratcliffe (Manchester, 1975), pp. 1-26.

engine production - by opting for investment capability instead of mere operational capability as originally planned.[69]

Special mention must be made of the greatest of the British entrepreneurs based in Europe, the remarkable John Cockerill. He was the youngest son of William Cockerill, a Lancashire joiner whose various European wanderings culminated in successful textile machine factories at Verviers and Liége, founded while the Belgian territories were part of the French Empire. The achievements of the elder Cockerill were enough to place him among the most important Britons active on the continent, but they were dwarfed by those of his son, who became not only the most eminent industrialist in Europe, but also the most important agent of transfer of British machine making skills to the continent.

Cockerill was unusual in acting as both a receiving agent of skills and knowledge from Britain and as a unselfish supplier of expertise to customers throughout the continent. As a recipient agent, Cockerill had little trouble in securing skilled personnel from Britain. The generous advice he received from British machine makers has already been noted, but Cockerill also sent his own agents to Britain. Cockerill's proud boast was that he could obtain any innovation from Britain within ten days of its appearance.[70] Such a statement might be dismissed as hyperbolic self-publicity, but it is evident that British products and processes could be replicated at Seraing with surprising rapidity.

As a supplier, the Cockerill companies were the most important source of British-type machines for continental customers. Any textile machinery which could not be smuggled out from Britain could be purchased from Cockerill's factories at Liége or Berlin. In time the main works at Seraing developed precision engineering skills which allowed the plant to become the most important locomotive builder on the continent. Furthermore, Cockerill played an important role as a supplier of trained personnel to various European enterprises. His loan of puddling instructors to the Remy brothers in 1824-25 is well known, but of much greater long term significance was the supply of foremen and workmen with machine making skills, amounting to technological assistance far beyond the customary provision of

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69. AGAD, KRPS, 1449, Wolicki to Lubecki, Dec. 5, 1825, Jan. 31, 1826; PRO, BT 1/132, p. 82; BT 1/228, J.P. Bell to Treasury, Oct. 13, 1826; C. Matschoss, 'Friedrich Harkort', *Beiträge zur Geschichte der Technik und Industrie*, 10 (Berlin, 1920), p. 4; R. Kotewicz, 'Próby utworzenia w Tomaszowie', *Rocznik Łódzki*, 37 (Łódź, 1987), p. 144; Klima, 'Beginning of the Machine-Building Industry', pp. 60-70.

70. BPP 1839, XLII, *Report of the Select Committee on Handloom Weavers*, p. 157.

machine erectors.[71] It is not possible to quantify the returns Cockerill would have received on such transactions. It is evident that Cockerill gained a huge amount of prestige and goodwill from the assistance given to governments and entrepreneurs all over Europe, though it can be argued that such generosity was hardly in accord with his long term interests. However, from 1815 until his death in 1840, Cockerill was not only the most respected entrepreneur in Europe, but his name was far better known to the average European than any competitor within Britain itself.

The undeniable success of so many Britons abroad should not obscure the fact that the main impetus for transfer came from the follower economies, and it is the efforts of agents within these economies that were to prove decisive in the long run. If British technologies were exported first by supplier individuals, then by firms, the recipients also differed from contemporary agents. At first, technologies were acquired by governments and a handful of individual entrepreneurs, rather than recipient firms. Where private enterprise was vigorous, as in the United States, individual entrepreneurs rather than governments took the lead. Where the private sector was either weak or even non-existent, as with much of Europe well into the nineteenth century, governments had to take the initiative, playing a far more active role than their modern counterparts. State activities could be crucial in backward economies, or complementary to private enterprise in countries where economic development was already occurring. As with industrialization in general, the more successful follower economies witnessed a gradual shift away from the state as main recipient agent to private firms as the nineteenth century progressed.

The experience of Japan since 1868 has demonstrated the decisive contribution which the state and its agencies can make to the diffusion and adaptation of foreign technologies, but direct state involvement in technology transfer dated back to the eighteenth century, and was a logical consequence of policies to foster economic development. State activities can be broadly divided into four main categories: 1) it could act as a transfer agent by acquiring technology for state sponsored industries; such knowledge could also be made available to the emerging private sector; 2) it could offer support for supply agents - in this period invariably British entrepreneurs or engineers - wishing to set up in business; 3) it could assist the development of industries at home via protective tariffs or other forms of import restriction; 4) it could establish institutions for the assimilation and creation of knowledge, and bodies for the dissemination of information, such as industrial exhibitions and a technical press.

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71. Hodges, 'Iron King', pp. 219, 279-280.

State attempts to induce economic development were hardly an unqualified success. Many state activities resulted in costly failures or delayed development by hindering the emergence of the private sector.[72] Nevertheless, early forms of entrepreneurial substitution could be effective vehicles for transfer. The most notable success of such a policy was achieved by the Prussian government in Silesia, where strategic considerations led the administration to develop a substantial metallurgical sector based on local mineral resources. Despite its favourable endowment, Silesia had been an underdeveloped backwater: sparsely populated, heavily forested, with a primitive agriculture. Given the absence of capital and skilled labour, and poor communications with the rest of Prussia, Silesia would have held little attraction for private enterprise.

Under the technocrat von Reden, the state mining department successfully acquired and applied the latest British innovations in mining and metallurgy. Visits to Britain resulted in the recruitment of key experts such as William Wilkinson and John Baildon, and the introduction of coke smelting and the steam engine. Von Reden's achievements were epitomised by the *Königshütte*, for many decades one of the largest and most efficient ironworks on the continent. The Silesian metallurgical complex remained technologically superior to anything that German private enterprise could initiate for over half a century. Similarly, the creation of the steam engine works at Gleiwitz demonstrated a significant acquisition of investment capability. The development of heavy industry in Silesia demonstrated how an efficient and intelligent administration could apply and replicate British innovations. The achievements make a stark contrast with similar attempts by the French government before 1789. The French experiment was a dismal failure, despite access to the same British innovations and even the same personnel (Wilkinson) as the Prussians.[73]

Few state projects could even approach the scale (or the success) of the Silesian undertaking, but the intense interest of foreign governments in developments in Britain can be deduced from the large numbers of agents sent to the leading industrial and agricultural centres of Britain. Because of a lack of understanding of the principles underlying the various advances in technology, most journeys to Britain resulted in an enhanced awareness of the possibilities of the new technologies, rather than their transfer. However, despite the fact that many visits to Britain accomplished little by themselves, both the frequency and

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72. S. Pollard, *Peaceful Conquest: The Industrialization of Europe 1760-1970* (Oxford, 1992), pp. 159-163.

73. N.J.G. Pounds, 'Economic Growth in Germany', in *The State and Economic Growth*, ed. H.C.G. Aitken (New York, 1959), pp. 189-200; F. Redlich, 'Leaders of the German Steam Engine Industry', *Journal of Economic History*, 4 (New York, 1944), pp. 122-125

nature of such visits offer a good indication of the determination with which governments sought to master the technologies rather than simply to satisfy a curiosity.

The latter category would probably include the apparently random activities of Dr Hamel, 'collector of scientific information for the Russian Government', whose mission seemed to consist of taking note of anything useful encountered in Britain. In 1819 his travels to Scotland resulted in a report on British windmill construction. A quarter of a century later the doctor was still on the lookout for useful information, turning up at Sharp & Roberts in Manchester.[74] Apart from the private visits of aristocrats or officers driven more by curiosity than any specific aim, such a leisurely approach was unusual, and makes a striking contrast with the single mindedness shown by Prussian officials such as Bückling and Stein when seeking to obtain data on Boulton and Watt steam engines.[75]

Some missions to Britain sought information alone, usually resulting in the preparation of detailed reports on practices within such industries as metallurgy or railways by experts with background knowledge.[76] Other trips were concerned not only with general information about the new technologies but also the means of transferring them, which meant the acquisition of machines, workmen or blueprints. This category contains most of the best known industrial espionage episodes of the eighteenth and early nineteenth centuries.[77] Many state sponsored missions involving espionage produced no tangible results in terms of technology transfer, but offer not only an excellent illustration of the lack of an organizational framework for transfers, also underlining the one-sidedness of the impetus for transfer in the early period. As the nineteenth century progressed, the number of visitors to Britain increased considerably, but such trips were generally conducted in a

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74. W.G., 'Wiatrak Szkocki od Ministerium Spraw Wewnętrznych w Rossyi dla użytku zalecony', *Izys Polska*, 1823/24 no I (Warsaw, 1823), pp. 300-302; Science Museum Archive Collection, MS 368/3.

75. Redlich, 'Leaders', pp. 122-126.

76. Harris, 'Industrial Espionage'; M.J. Chevalier, 'La Mission de Gabriel Jars dans les Mines et les Usines Britanniques en 1764', *Transactions of the Newcomen Society* (hereafter *TNS*), 26 (1953), pp. 57-65; E.A. Forward, 'Report on Railways in England in 1826-27', *TNS*, 29 (1958), pp. 1-10; M.W. Flinn, 'The Travel Diaries of Swedish Engineers of the Eighteenth Century as Sources of Technological History', *TNS*, 31 (1961), pp. 95-109.

77. Accounts of highly organised missions are given in Henderson, *Britain and Industrial Europe*; for France, various works by Harris: 'Industrial Espionage', 'Michael Alcock' and 'First British Measures'; for Prussia: Redlich, 'Leaders'.

more conventional manner as government and firms in Britain abandoned policies of secrecy.

By this time most visitors were private entrepreneurs rather than governments, and this aspect of state involvement in transfers was invariably the first to give way to the private sector wherever the latter was vigorous. However, the other state activities could not be taken over so easily. With regard to British entrepreneurs seeking to enter business on their own account, the state was able to create favourable conditions for transfer in two contrasting ways. Entrepreneurs were encouraged to establish ventures through the provision of grants, loans, tax or other concessions, thus making such an undertaking considerably more attractive for the would-be manufacturer. In return for such encouragement the authorities could ensure that the new plant would act as a platform for diffusion within the host economy by providing demonstrations for native entrepreneurs or training for the local workforce. The generous help given by the Dutch king to John Cockerill is the most notable example of such a reciprocal arrangement. State support proved crucial to Cockerill at many stages of his career, but in return the government ensured that Seraing would act as a demonstration plant by requiring Cockerill to allow local ironmasters access to the works.[78]

The question of tariffs and other restrictive measures is a complex one. Although most economies saw the birth or expansion of new industries as a result of the exclusion of foreign - primarily British - competition, this did not in itself guarantee either technological mastery or even efficient production. Where conditions were conducive to economic growth, industrialization and technological assimilation were well underway before protectionism became widespread, as in the United States before 1861 and Japan up to 1899. Protectionism certainly gave breathing space for the more backward economies without ensuring success in acquiring new technologies. As Kenwood and Lougheed have pointed out, the increased trend towards protectionism towards the end of the nineteenth century stimulated direct foreign investment as a means of crossing tariff barriers. This undoubtably led to the creation of productive capacity within the host economies.[79] As with home grown industries within the protectionist economies, such foreign investment did not necessarily make any great contribution to the creation of indigenous capabilities.

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78. Hodges, 'Iron King', p. 127.

79. Kenwood and Lougheed, *Technological Diffusion*, p. 200.

In the long term, one of the most significant government moves was the promotion of institutions for education and research. Inkster's survey of the most successful industrializers suggests that international transfers of knowledge between industrial nations before 1914 were 'facilitated by the prior or contemporaneous development of institutional structures which hastened the creation and diffusion of knowledge within nations'.[80] Much has been written about the relative merits of such formal institutions as the École Polytechnique, the Freiberg Bergakademie or the *Technisches Hochschulen*, mainly in an attempt to compare their respective contributions to the growth of science and industry. Whatever the long term achievements of each, a full appreciation of many post-1815 state initiatives requires the stressing of another point. Although individual institutions were founded to serve a wide range of purposes, the general institutional approach came to be regarded as an essential part of government strategies for catching up. Thus European governments copied not only the general approach but also the institutions themselves. Henceforth, not only was scientific and technical training provided in a variety of institutions across Europe, but a modicum of such training was increasingly seen as a vital requirement for the new government sponsored technocrats, usually in conjunction with a period of practical skill acquisition. Thus promising students would not only be sent to a British firm, ironworks or coal mine, but would often supplement this with a spell at one of the new educational establishments, preferably one of the more prestigious French or German institutions.

The success of the British economy drew a wide range of responses from the follower economies, depending on the particular circumstances of the followers themselves. Nowhere is this diversity more apparent than in the Sharp and Roberts visitors' book dating from the 1840s. The list of interested foreigners comprised representatives from both traditional circles and the new entrepreneurial groups. While visitors from Europe included aristocrats and officers more reminiscent of the eighteenth century, a substantial number of continental manufacturers and engineers was appearing. The institutional approach was represented by several professors from the German states and elsewhere, whereas the vigour of the American private sector was demonstrated by the presence of several entrepreneurs and engineers, together with the conspicuous absence of state officials. The same phenomenon can be found in the visitors book of the farm at Tiptree Hall, the most successful showcase of High Farming, where visitors from several European countries included professors of various agricultural academies.[81]

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80. Inkster, *Science and Technology,* p. 90.

81. Science Museum Archive Collection, MS 368; British Library, Add. MS 30 015.

c) Channels of transfer

The study of transfer methods before the middle of the nineteenth century is an area where some confusion continues to prevail. Simplistic statements have been made about form of knowledge transmission, and several authors of historical case studies have failed to distinguish between agents and methods. Landes was nearest the truth when stating that skill transmission occurred primarily as a result of on the job training coupled with wider investment in human capital via general and specialised education. His statement that 'the greatest contribution of these immigrants [i.e. British workmen] was not what they did but what they taught' identifies both the means and the method by which operational capability was created within the follower economies.[82]

The first major attempts to secure British technologies - the Law scheme involving the recruitment of British workers, and Peter the Great's scheme placing Russians as apprentices within British firms - illustrate the two alternative forms of personal skill transmission. The extensive technological aid given to end users by British capital goods firms after 1843 also relied heavily on such methods.[83] Post-war transfers have inevitably involved one or both forms, demonstrating the continued importance of personal transmission. Nevertheless, the nineteenth century witnessed the increasing importance of new impersonal information channels, in such forms as blueprints, models, plans or formulas. By the middle of the century it was possible to transfer elements of some technologies by impersonal means alone, leading one recent historian to go as far to suggest that personal transmission was becoming increasingly redundant during this period.

Jeremy's claim that the 'locus of technology' had 'shifted from men to machines' between 1825 and 1843 demands some clarification. Jeremy was particularly concerned with the free exportation of new machine tools, which allowed greater precision in metal working, replacing many handicraft skills. Such tools made the construction of machines from blueprints and drawings considerably easier, allowing Jeremy to suggest that the possession of the new equipment rendered traditional craftsmen redundant as carriers of technology.[84] Some evidence could be offered to demonstrate that in many cases impersonal means were indeed sufficient to convey enough information to allow a skilled recipient to replicate

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82. D.S. Landes, *The Unbound Prometheus* (Cambridge, 1991), pp. 150-151.

83. For the definitive study of the relationship between British capital goods firms and end users abroad see Bruland, *British Technologies and European Industrialization.*

84. Jeremy, 'Damming the Flood', p. 21.

machinery. Foreign visitors to Seraing in the 1830s were assured that the local workforce could reproduce any British machine from models alone.[85] Even where the local workforce could not boast the high standards of excellence of Seraing, most British made machines could be replicated via reverse engineering, as testified by several Polish examples to be discussed in a later chapter.

Nevertheless, it would be a gross oversimplification to generalize about shifts in the locus of technology on the basis of such examples. Numerous cases could be cited to prove the opposite. Rosenberg has described two particularly instructive examples concerning the introduction of advanced machinery to a part of the world not normally associated with technological backwardness - London in the 1850s. When the British government acquired American gun-making machinery for use at the Enfield Arsenal, it became apparent that the equipment could not be worked without the aid of American machinists and supervisors. Shortly afterwards Samuel Colt, the leading American firearms manufacturer, founded a factory in London, hoping to produce weapons using American machinery and British workers. The London venture proved a total failure because of the difficulties experienced by the British workers when confronted by unfamiliar American equipment.[86] Such examples from the very heart of the 'workshop of the world' seem to offer scant support to the idea that personal transmission had been superseded.

Furthermore, the undeniable importance of the capital goods sector as a vehicle for transfers has tended to limit the debate to machine construction, whereas large numbers of Britons were active in Europe and elsewhere in countless ventures unconnected with machines. Puddlers, blast furnace constructors, civil engineers, even farmers and agricultural advisors were among those who played vital roles in transferring technology from Britain. In many of these trades, the role of personal transmission was even more decisive than in machine making, as the processes involved were harder to codify than simple machine construction.

The case of puddling illustrates this point. From the 1820s onwards, British puddlers in Europe became as famous as their machine building counterparts, but it was the nature of the puddling process itself which made British instructors indispensable. Fremdling has emphasised the lack of a proper scientific understanding of puddling, with the process defying all attempts at formal codification. With a bewildering range of subjective terminology, often using metaphors from the baking trade, the skill resembled a craft and

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85. Hodges, Iron King, p. 234.

86. Rosenberg, 'Economic Development', p. 554.

could be transmitted only by direct instruction at the puddling furnace. Attempts to master puddling via a theoretical approach proved unsuccessful, and even verbal information provided by puddlers themselves was insufficient to transfer the ability to puddle. In such circumstances direct recruitment of puddlers was the only feasible option for foreign transfer agents.[87]

Whereas puddling may be regarded as an extreme case, it underlines the fact that many skills were resistant to codification and thus could be acquired only at the workplace. However, the undeniable increase in the significance of impersonal forms of transmission demands an explanation. Advanced machine tools did indeed eliminate the need for many of traditional craft skills, allowing for the easier replication of many simpler machines via reverse engineering or even blueprints in many cases. It would thus seem that the new tools might have had a levelling effect, negating the technological leadership enjoyed by the foremost firms of the time. However, this would require sharing the static view of technological progress taken by many observers within Britain before 1843, a view not borne out by subsequent developments.

Opportunities offered by new equipment allowed leading firms to develop increasingly complex processes and products, resulting in the creation of a new body of skills. These new skills still had to be acquired via direct participation in the production process, with direct transmission remaining the primary channel, although some element of formal training also came to play an increasingly important role. However, the elimination of many traditional skill requirements meant not only that a workforce could be trained more rapidly, but that the diffusion of basic skills became less reliant on foreign personnel, whose role henceforth concentrated on the transmission of more complex expertise.

The increasing complexity of technology was paralleled by the growing sophistication of enterprise in general. Only leading firms could now embody the wide range of expertise necessary to transfer whole areas of technology, and this expertise was supplied in the form of packages so ably described by Bruland. Whereas individuals still retained an important role as transmitters of highly specialised knowledge and skills, the middle period of the nineteenth century saw the passing of the older type of individual combining the roles of agent of transfer and transmission. Where individuals such as Samuel Slater and Edward Thomas could once provide both the impetus for transfer and the majority of skills required

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87. R. Fremdling, 'The Puddler. A Craftsmen's Skill and the Spread of a New Technology in Belgium, France and Germany', *Journal of European Economic History*, 20 (Rome, 1991), pp. 531-537.

to construct a plant, it gradually became the norm for technology to pass between firms. Personal transmission thus continued, but in a changed organizational framework. Henceforth the functions of agents (otherwise the firm) and transmitters (the individuals or teams employed by the firm) became permanently separated.

d) Measuring the success

The success of the follower economies in acquiring British technologies during the nineteenth century varies according to the criteria chosen. End user technologies such as textile production diffused widely in a variety of countries, particularly as a result of protectionism and other import restrictions, but few economies saw the creation of significant innovative capabilities. The majority of nineteenth century transfer initiatives made little lasting progress beyond the operational level. Much of Europe had little to show for its efforts, preempting by a century the third world failures which caused Rosenberg to write of disillusionment.

Few of the newly created industrial plants as yet affected the international balance of technological leadership. Most thrived by supplying protected local markets. International competitiveness was not an initial priority for most transfer agents, and rarely seems to have been seriously considered. The best known example of close attention to this aspect comes from John Cockerill. Despite such a cavalier attitude towards machine engine prices before British manufacturers began to make themselves felt, Cockerill was far more aware of British competition when proposing the setting up cotton mills. The venture was preceded by the collection of information on costs and prices of British firms, with the realization that the new mills would have to be able to compete with the best British producers.[88]

The firms which were able to thrive in international markets were those which were successful in achieving mastery of particular technologies. Numerous engineering firms, first in Belgium and Switzerland, and later in the United States and Germany, were able to compete on grounds of quality, while several continental firms prospered as producers of specialist equipment for such industries as sugar refining or flour milling. Even where British preeminence was still strong as in textile production, astute entrepreneurial decisions led to the securing of niche markets for distinctive goods such as Swiss cottons.

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88. R. Demoulin, *Guillaume I^er^ et la transformation économique des Provinces Belges 1815-1830* (Liége, 1938), pp. 386-387.

The economies which were to gain the most from foreign technologies, particularly the United States and eventually Japan, were those which were able to adapt and improve upon best practices from abroad, employing factor substitution where possible, and not wasting resources by acquiring inappropriate technologies. Early successes within Europe, particularly Belgium and Switzerland, also involved wise selection of appropriate technologies, utilising substantial reservoirs of skills in metal and precision working within both countries, and in the Belgian case, a fortunate natural endowment allowing the rapid option of British coal based technologies. The slow diffusion of the latter technologies in economies not possessing the right endowment has often been taken as a symptom of backwardness, but the introduction of new technologies without a suitable base of skills or resources has proved a far greater folly, both in the nineteenth century and the post-war world.

Although British technologies had prospered in only a very narrow number of economies, technological leadership was passing away from Britain after the middle of the nineteenth century. Overall, the British economy was still far in advance of the American or German, but both were beginning to catch up in key industries. The persistence of traditional practices in many sectors in these economies was less important in the long run than the fact that the best practices in the most dynamic industries were beginning to press ahead of the British, and by the end of the century both had made huge contributions to technological progress. In 1854-55 a trio of reports on American manufacturing industries warned that Britain was falling behind in key practices.[89] Even the European followers were catching up. An observer at the Paris Exposition of 1867 noted the general opinion that Britain was no longer as inventive as once was the case, while praising industrial education on the continent.[90] Both comparisons would have been unthinkable fifty years before. By this time Britain was no longer the sole technological supplier for the rest of the world, as firms and individuals from other Western European countries and the United States began to supply expertise and equipment in areas that had previously been British preserves. Henceforth, after an unusual period where the majority of technological outflows originated from one economy, technology transfer once more became the complex multidirectional process it remains to this day.

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89. For the full text of the reports, see *The American System of Manufactures*, ed. N. Rosenberg (Edinburgh, 1969).

90. Quoted in Mokyr, *Lever of Riches*, p. 264.

Chapter 2

The Background to Polish Transfer Initiatives

The attempts to utilise British technologies for the economic development of Poland after 1815 were part of a wider European phenomenon described in the previous chapter. The Kingdom pursued a path typical for the more backward follower economies on the continent, subject to certain peculiarities resulting from its relationship with Russia. This will be demonstrated by a description of the background to the Polish transfer initiatives, concentrating on four parameters of the transfer process: impetus, agents, methods and modes.

2.1 Impetus and Agents

a) The Kingdom of Poland

The Kingdom of Poland, otherwise known as the Congress Kingdom, resulted from a new partition of Poland agreed at the Congress of Vienna, amounting to a reallocation of Polish lands following the liquidation of Napoleon's puppet Duchy of Warsaw (see map 1 overleaf). An autonomous unit within the Russian empire, under the rule of the Tsar as constitutional monarch, the Kingdom was responsible for its own internal and economic policies, possessing both administration and army. The new entity comprised an area of 127,000 km^2, roughly equal to that of the United Netherlands created by the same treaty.[1] Straddling the middle reaches of the river Vistula, the Kingdom was entirely landlocked, as the whole Danzig region containing the old Commonwealth's sole trading port remained in Prussian hands.

The combination of political and geographical factors made the Kingdom one of the most backward areas in Europe. The territories of the old Polish Commonwealth had been one of the least developed regions in Europe, a fact which contributed to the loss of independence in 1795. Its exports had consisted entirely of unprocessed agricultural produce, particularly wheat for the British market, while the majority of manufactured goods had to be imported in the absence of industries at home. If the situation had already seemed hopeless before 1795, further dislocation resulting from the partitions, boundary changes, and a decade of war entailing huge losses of resources and manpower left the

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1. N. Davies, *God's Playground: A History of Poland* (Oxford, 1981), II, pp. 306-307.

Map 1: The Kingdom of Poland and the partitioning powers

Polish lands in a state of complete ruin. Moreover, the first year of the new Kingdom's existence saw the virtual disappearance of the country's prime export commodity with the passing of the Corn Laws.

Table 2.1 shows the general population growth after 1816. A period of rapid initial growth also fuelled by immigration came to an end with the uprising of 1830-31, when population declined as a result of wartime casualties, emigration and forced deportations to Siberia. After a fifteen year period of recovery population remained stable for almost two decades until further rapid growth ensued after the upheavals of 1863-64. Population density per km^2 rose from 22 in 1816 to 49 by 1870.[2]

Table 2.1 Population of the Kingdom of Poland and city of Warsaw 1816-1870 (000s)

Year	Kingdom	Warsaw	Year	Kingdom	Warsaw
1816	2,717	81	1840	4,488	139
1819	3,439	99	1846	4,867	165
1820	3,520	100	1850	4,811	164
1825	3,911	126	1855	4,674	157
1829	4,138	139	1860	4,840	164
1831	3,762	124	1863	4,986	212
1835	4,188	135	1870	6,079	265

Sources: *Zarys historii gospodarstwa*, II, p. 323; S. Siegel, *Ceny w Warszawie w latach 1816-1914* (Poznań, 1949), p. 5; T. Sobczak, *Przełom w konsumpcji spożywczej w Królestwie Polskim w XIX wieku* (Wrocław, 1968), p. 13.

The population was overwhelmingly rural, with 78.5% living in the countryside in 1827, falling only to 75.8% by 1858.[3] Nevertheless, the suggestion that 21.5% of the population was 'urban' in the 1820s paints a flattering picture of Polish society, owing more to the definition of towns then in use than to any significant degree of urbanization. Apart from Warsaw, the country possessed few real towns in the British sense. According to 1824 statistics, the Kingdom possessed 553 'towns', but of these only 60 had more than

2. *Zarys historii gospodarstwa wiejskiego w Polsce*, ed. S. Arnold (Warsaw, 1964), II, p. 323.

3. *Zarys historii gospodarstwa*, II, p. 323.

3,000 people.[4] A contemporary account of a 'fair specimen of second rate towns all over Poland' described a 'long street of.. huts of wood.. presenting a general appearance of the most squalid misery', apparently more wretched than the traveller had seen anywhere else in Europe.[5]

The poor level of urbanization in the Kingdom can be further gauged from the fact that apart from Warsaw, only three towns had populations of more than 10,000 in 1824, while only one in eight 'urban' houses in that year were made of brick.[6] As late as 1842 it was estimated that half of the Kingdom's urban dwellers made their living from agriculture.[7] Map 2 (overleaf) shows the location of the Warsaw and the three smaller towns, together with the industrial areas which were to emerge before 1863.

b) British technologies within a follower framework

From the very beginning of the Kingdom's existence, its authorities showed particular concern for general development. The Poles already had their own precedent for state involvement during the last two decades of the doomed Commonwealth. Following the shock of the first partition in 1772, the government attempted to foster national recovery, focusing on mining and the creation of a basic education system, though these measures achieved very few tangible results. The ephemeral Grand Duchy of Warsaw continued mineral extraction and attempted to encourage foreign manufacturers, but also achieved little. The ruinous state of the new Kingdom's economy gave added urgency to the need for development. State involvement owed more to the practicalities of the situation than to any theories of mercantilism - in the complete absence of favourable conditions for spontaneous development, extensive state promotion and coordination of economic activity was the only realistic course.

As a typical follower economy, the institutional framework developed by the Kingdom's authorities was based on other European examples, most notably that of Prussia and

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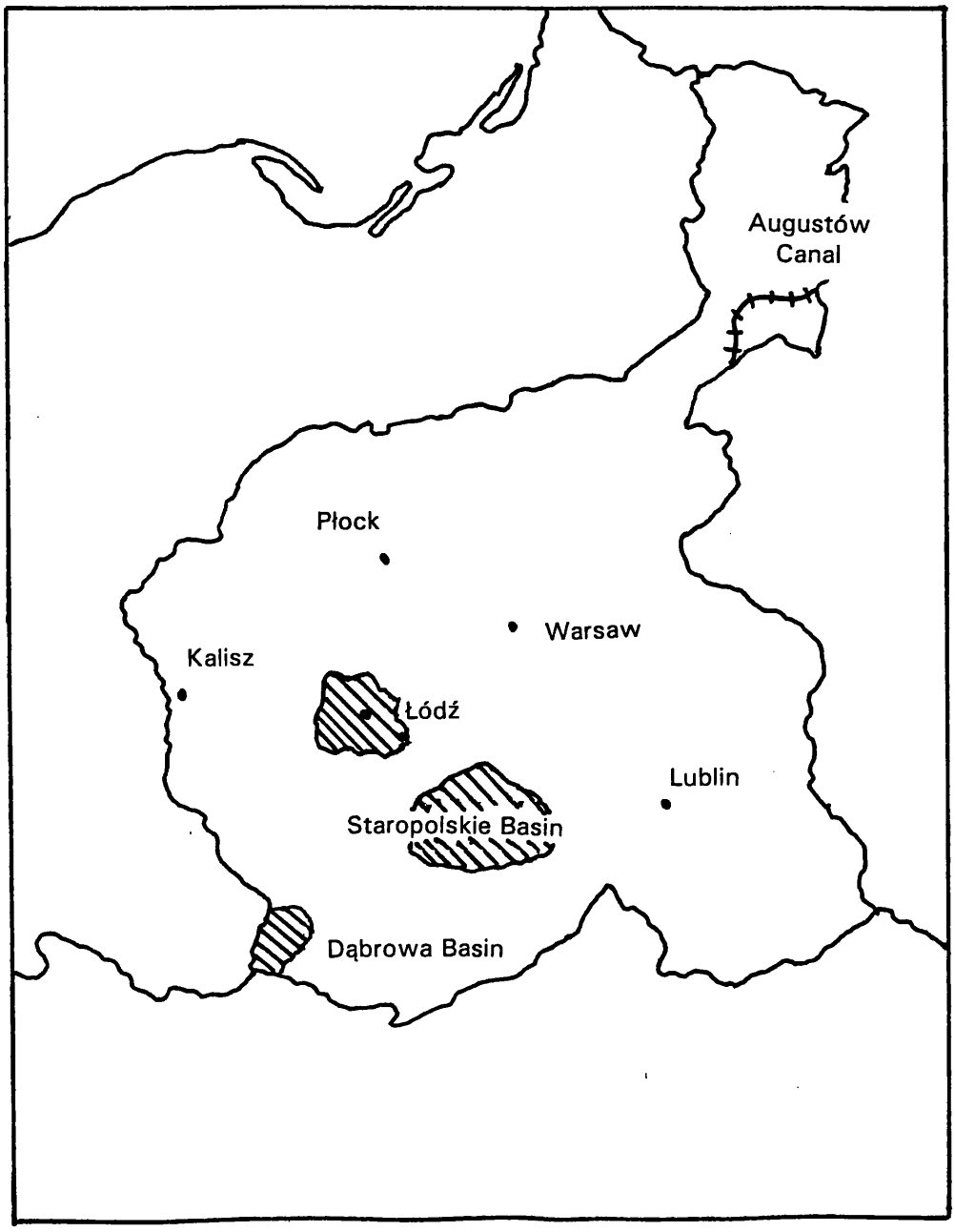
4. H. Radziszewski, *Bank Polski* (Warsaw, 1910), p. XXXI.

5. A.B. Granville, *St. Petersburgh: A Journal of Travels to and from that Capital* (1829), II, pp. 516, 523.

6. Radziszewski, *Bank Polski*, p. XXX.

7. [K. Garbiński] K.G., 'Czyli życie przemysłu naszego', *Roczniki Gospodarstwa Krajowego* (hereafter *RGK*), 1 (Warsaw, 1842), pp. 23-24.



Map 2: Major towns and industrial areas of the Kingdom of Poland

Saxony. The distinctly Prussian character of many Polish initiatives after 1815 has often obscured the British origin of the technologies which the Polish authorities sought to introduce. The vast differences between circumstances in Britain and Poland meant that no general British model held any relevance for the Poles, whereas the undeniable successes of the catching up policies of other followers offered a realistic path to development.

It was entrepreneurial substitution as practised by the Prussian state which proved particularly attractive to the Poles. Von Reden's successes in Silesia provided a significant demonstration of the benefits state efforts could produce, and had a profound influence on Staszic, the geologist and philosopher responsible for the Kingdom's industrial development after 1815. Staszic had been deeply impressed by the newly completed blast furnaces of the Königshütte during a geological tour of the old Polish lands undertaken in 1805.[8] After 1815 he lost no time in creating a Mining Department (Wydział Górniczy) based on the Bergamt. Several specific objectives of the new department were prompted by Bergamt successes. The most notable of these was the successful application of steam power to reopen the old silver and lead mines at Tarnowitz, and their subsequent transformation into the Königliche Friedrichsgrube, which convinced the Kingdom's mining officials of the viability of the similar mines at Olkusz, where flooding had led to the abandonment of what had once been medieval Poland's most important source of metallic ores.[9]

There were other reasons justifying the establishment of a such an institution, of which continuity was one of the more important. Several mines in the Kingdom's territory had been founded by the Bergamt after 1795, when most of the mining areas were in Prussian hands. Several Bergamt officials remained after the formation of the Grand Duchy of Warsaw in 1806, most notably Ludwig Hauke, nominated director of mining operations in 1810.[10] Dynastic links between the Duchy and Saxony led to an influx of Saxon experts, many of which were to remain at their posts within the Wydział Górniczy. These included Johann Ullmann, who became director of the department in 1816, and head engineer Jakub Graff, one time professor at the Freiberg Bergakademie.[11] Other experts from Saxony continued to arrive after the restoration of peace, such as Ernst Kaden, one time student

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8. S. Staszic, *O ziemiorództwie Karpatów* (Wrocław, 1955), p. 43; for details of the Prussian initiatives see Chapter 1.2.

9. N. Gąsiorowska, *Z dziejów przemysłu w Królestwie Polskim 1815-1918* (Warsaw, 1965), pp. 308-310.

10. Ibid., p. 150.

11. Ibid., pp. 150, 198-199.

of Werner at Freiberg and Saxon civil servant who entered the Polish mining department in 1817.[12]

Given the personnel of the mining department, it is hardly surprising that the state sector copied the institutional approach of the German states, with centralized planning undertaken by technocrats supplied by specialist training institutes. Thus the German influences were almost total in the Kingdom's first technical institution, the Szkoła Górnicza (Mining School) at Kielce, founded in late 1816 for the sole purpose of training future officials for the department. At first, all but two of the thirteen subjects offered were taught in German, and four of the six professors were from the German states, including three from the Bergakademie.[13] The other major initiative of this type was the foundation of a school of agriculture and forestry at Marymont near Warsaw, an establishment which owed much to Albrecht Thaer's Möglin Institute.[14]

The German input in administration and education ensured that the Poles used German terminology in metallurgy and mining. This was also the case with many agricultural terms, despite the fact that many referred to concepts or processes taken directly from British practices. This was the result of another aspect of Prussian development which held particular attraction for the Poles - the widespread dissemination of written information. Whereas Polish reformers talked primarily about British farming as the highest possible expression of agricultural development, it was unusual for British agriculturalists to be mentioned by name. Occasional references would be made to Arthur Young, Sinclair, John Claudius Loudon or Coke of Holkham, but the one name which turns up more than any other was that of the above mentioned Albrecht Thaer, the German doctor who did more than anyone else to make continental readers aware of the great progress achieved by British farming.

As elsewhere on the continent, all Polish agricultural reformers knew Thaer's writings, and many visited Möglin for themselves. Indeed, several leading authors remained disciples of Thaer all their lives, especially Oczapowski and Kurowski. Thaer was by far the author most often translated into Polish, and thus his works were far more accessible than untranslated works by British experts. Long after Thaer's death it was still common for

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12. *Polski Słownik Biograficzny* (hereafter *PSB*), XI, p. 398.

13. Gąsiorowska, *Z dziejów przemysłu*, pp. 199, 444.

14. For a description of the Möglin school see W. Jacob, *A view of the Agriculture, Manufactures, Statistics and State of Society of Germany* (1820), pp. 183-185.

news of British developments to reach the kingdom via German sources, sometimes with curious results.[15] This apparent German technological input should be seen as no more than a partial adaptation of British innovations.

A further factor worth emphasising was the relative geographical isolation of the Kingdom, particularly before the coming of the railways. Möglin and the Königshütte were far more accessible than Holkham and Dowlais, and as such represented a cheaper and more convenient option for a Polish mining official, entrepreneur or landowner. Only government officials or wealthy individuals could afford the trip to Britain, though the journey did become easier and more frequent towards the middle of the nineteenth century. Another factor which should not be ignored was official discouragement by all the partitioning powers towards contacts with Britain, though this was less of a hinderance to purely economic contacts. After 1831 the presence of Polish emigres in Britain led to further Russian restrictions on Polish visits to that country.[16]

None of the points mentioned above negate the crucial role played by British personnel and technology in the progress that was achieved by the Poles in the half century following the Vienna settlement. British influences would obviously be absent in new technologies such as beet sugar production which had originated on the continent. It should also be added that many German officials contributed scientific expertise which owed little to the British Industrial Revolution, particularly in geology. British input was indirect in sectors which had been developed by the Prussians, who represented a more immediate and convenient source of skilled labourers in the case of textiles, or civil servants and academics in the case of mining and metallurgy. In the latter sector it would have been impossible for the Poles to have constructed a state apparatus or specialised educational establishments using British personnel, for obvious reasons. Therefore the decision of the Polish authorities to engage in forms of entrepreneurial substitution had much bearing on the origin of the personnel to be recruited for the sectors benefitting from this process, rather than the technologies employed.

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15. Not only ideas could acquire a German flavour; in 1851 it was possible for an important Polish article on land drainage to pay tribute to the writings of Schmidt of Deastone; J. Lipski, 'Obraz szczegółowy osuszeń.. w dobrach Skąpe', *RGK*, 19 (Warsaw, 1851), p. 305.

16. For a description of the strict censorship limiting discussion of British political life in the Polish press; see W. Lipoński, *Polska i Brytania 1815-30* (Poznań, 1978), pp. 78-82. In 1851 the presence of Polish emigres in London was used to justify the refusal to grant passports to visit the Great Exhibition to all Poles not directly connected with commerce; see: Public Record Office (hereafter PRO) FO65/399, no 13, Apr. 20, 1851, no 15, May 4, 1851.

The adoption of Prussian applications of British technologies meant that Prussia could be both a follower economy absorbing British technologies, and a leader passing on the same technologies to the Poles. Where the new leader economy developed a suitable level of sophistication, there was little need to look to Britain for innovation. However, this did not rule out technology transfer from the original leader, especially if the latter continued to produce innovations. The Bank of Poland made a break with pre-1830 metallurgy policies by recruiting British specialists to construct up to date blast furnaces, thus absorbing latest technology almost simultaneously with the Prussians.

c) Staszic and Lubecki

The period of the constitutional Kingdom saw the emergence of two personalities responsible for the direction of state economic policies, each of whom was to leave a distinctive imprint on the course of subsequent developments. The first of these was Stanisław Staszic, head of the Industrial Department (Wydział Przemysłu i Kunsztów) of the Interior Ministry until 1824. More important as an advocate of general development than a transfer agent, Staszic was instrumental in creating an institutional framework for state activity based on Prussian models.

State policies in these early years were more geared towards the exploitation and processing of the Kingdom's natural resources, rather than any specific development projects. Many observers bemoaned the fact that virtually every manufactured item bought in the Kingdom was the product of foreign labour, even though Poland possessed all the necessary raw materials.[17] To this end state attention focused on mining, metallurgy and the woollen industry, primarily for the domestic market.

Although Staszic rendered great services in setting up an industrial bureaucracy in the Kingdom, and achieved undeniable success in encouraging foreign entrepreneurs to found ventures in Poland, it was the greater ambition of Prince Lubecki which was to change the impetus of Polish economic development. Lubecki had headed the Treasury since 1821, and became the chief architect of the Kingdom's industrialization programme after the state mining sector was transferred to direct Treasury control at the end of 1824.

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17. *Izys Polska*, I (Warsaw, 1820), p. 4.

Unlike most other advocates of state economic initiative, Lubecki was completely ignorant of economic theory, a fact he was proud to announce. His policies, based on a combination of common sense and a shrewd perception of the political limitations of the Kingdom's existence, exhibited many characteristics typical of successful state transfer agents in Europe and elsewhere. Lubecki never outlined a coherent programme, but his priorities are clear from several statements made in his official correspondence. His main commitments were to the industrial development of the Kingdom and to the provision of specialist education. At first he followed existing economic policies, advocating the elimination of unnecessary imports by processing the Kingdom's mineral and agricultural resources.[18]

None of this constituted a strong break with ideas prevalent during the last days of the Commonwealth or the Duchy of Warsaw, but Lubecki had far more room for manoeuvre than previous state decision makers and was able to appreciate the new opportunities presented by the markets of the Russian empire and the Far East. While the previous administrations had looked no further than import substitution, Lubecki realised that the Kingdom's impoverished consumers could hardly offer a base for significant industrial development, and turned his attention to potential export markets. Assessing the relative industrial strength of the Kingdom's neighbours, the Prince doubted whether the Poles could ever hope to penetrate Prussian or Austrian markets, but the highly protected Russian market seemed to offer substantial opportunities to Polish producers because of its size and the primitive state of most of Russian industry.[19] Thus began a major reorientation of Polish trade which was to set the pattern for the next ninety years.

The opportunity of trading with Russia and the Far East had been largely created by Lubecki himself following tough negotiations leading to new tariff arrangements with the Russian Empire and the Prussians. The Vienna Treaty had stipulated the customs union of the pre-1772 territories of the old Commonwealth, but this measure was soon ignored by the partitioning powers, which had all signed bilateral trade agreements with each other by the end of 1818. In these conventions the Congress Kingdom was treated as part of the Russian trading area, and the markets of both the Kingdom and the Empire saw a flood of Prussian goods following the liberal Russo-Prussian convention of 1819. In 1821 The Russian government returned to a policy of protectionism by revoking the convention with the Prussians, and in the following year Lubecki's uncompromising stance during months of negotiations in St Petersburg resulted in the granting of full tariff autonomy to the

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18. *Korespondencya Lubeckiego z Ministrami*, ed. S.Smolka, IV (Kraków, 1909), p. 430.

19. Ibid., II, p. 263.

Kingdom on favourable terms, much against the wishes of Russian finance minister Kankrin.[20]

Thus in 1822 the customs union with Russia was ended, but as a result of Lubecki's efforts most Polish goods entering the Empire were subject to only modest duties, while goods passing through Russia to third countries were exempted from duty. The exclusion of Prussian goods, particularly textiles, from Imperial and Chinese markets effectively offered new possibilities to infant Polish industries. Prussian exclusion from Polish markets had already been signalled by certain measures enacted in 1821, but from 1823 Lubecki introduced further restrictions preventing the majority of Prussian manufactures from entering the country.[21]

These new tariff policies signposted Lubecki's vision of the future of Polish industry as supplier to Imperial markets, two years before he articulated this vision in the correspondence quoted above. This represented a huge break in tradition for the Polish economy, which had for over two centuries maintained a role as exporter of agricultural produce to, and importer of manufactures from western Europe. A general picture of the Kingdom's economy can be gleaned from the first available breakdown of trade data from 1822, the last year before Lubecki's measures were enacted. Exports to the west consisted almost entirely of agricultural raw materials. Grain, livestock, wool, unprocessed timber, hides and oil seed comprised 70% of total exports to Prussia (a heading that included all transit trade with western Europe), while livestock, grain and wool accounted for 55% of exports to Austria in that year. Imports from both countries included large sums on articles of consumption such as wine, sugar and salt, together with manufactured goods. Cotton textiles alone comprised 20% of imports from Prussia, while all textiles and metal products accounted for 46% of the total.[22]

Such figures demonstrate ample opportunities for import substitution, but data for trade with Russia show the greater openings offered by the Russian market. Whereas imports from the Empire were overwhelmingly agricultural, with oxen alone taking over a third of the total value, exports to Russia already indicate the growing significance of the new

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20. A. Jezierski, *Handel Zagraniczny Królestwa Polskiego 1815-1914* (Warsaw, 1967), pp. 16-18; W.M. Pintner, *Russian Economic Policy under Nicholas I* (New York, 1967), pp. 45-46.

21. Jezierski, *Handel zagraniczny*, pp. 18-20.

22. Percentages calculated from data in Jezierski, *Handel zagraniczny*, pp. 34, 44-45.

woollen industry. Even before Lubecki's new measures had been enacted, woollen textiles already accounted for 82% of exports by value to Russia. The total value of these textile exports was still only 32% of that of all textile imports for that year, but the potential of the new industry was obvious.[23]

As the agricultural export figures suggest, Lubecki's measures against the Prussians left Polish agriculture vulnerable to Prussian retaliation. Such retaliation soon followed with the imposition of punitive tariffs on the Polish grain transit to Danzig. A tariff war followed, during which Lubecki's customary refusal to compromise, together with his authorization of the Augustów Canal, a waterway offering the Kingdom access to the Baltic via Russian territory, led to the eventual softening of the Prussian position, who reduced their duties on Polish grain by two thirds without regaining access to eastern markets for their industrial manufactures. Despite this partial success, Lubecki's attempts to reorientate the Polish economy by the promotion of export industries as the leading sector earned him considerable unpopularity from the Kingdom's landowners comprising the most influential section of Polish society. For such people Prussian access to Far Eastern markets seemed a small price to pay for the reestablishment of the grain transit.[24]

By the time the new tariff arrangements had been completed, only the woollen industry had benefitted from opportunities offered by eastern markets. Before 1824, Lubecki's energies had been directed towards general measures to develop the Kingdom's finances rather than any specific sector of the economy. Entering the Treasury at a time when the Kingdom's autonomy was threatened by near bankruptcy, the Prince's first priority had been to balance the budget, which he achieved within a year thanks to several unpopular measures, including the rigorous collection of outstanding taxes and an expansion of existing policies of indirect taxation. As a result, state revenue increased from 48 million zlotys in 1821 to an annual 70 million during the following years, allowing for an increase in expenditure from 57 million zlotys in 1821 to 67 million by 1825.[25] Revenue from the leasing of state monopolies on the sale of salt, tobacco and alcohol came to account for 56% of state income, as against only 23% from direct taxation. This supplied capital for industrial

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23. Percentages calculated from data in Jezierski, *Handel zagraniczny*, pp. 37, 45-47.

24. Jezierski, *Handel zagraniczny*, p. 23; S. Smolka, *Polityka Lubeckiego przed Powstaniem Listopadowym* (Kraków, 1907), I, p. 311.

25. Roughly half of the Kingdom's expenditure (30 million zlotys in 1822) was for the upkeep of the army; this sum was decided by the Grand Duke Constantine and could not be reduced by Lubecki; M. Ajzen, *Polityka gospodarcza Lubeckiego 1821-1830* (Warsaw, 1932), pp. 82-89.

development, and a budget surplus worth 31 million złotys by 1830, but the imposition of additional taxation could only reduce the already meagre levels of internal demand.[26]

The combination of harsher tax policies and Lubecki's role in provoking Prussian reprisals against the grain trade made the minister an extremely unpopular figure for the average Polish landowner. Convinced that only manufacturing industry could act as a leading sector dragging the Polish economy out of backwardness, Lubecki - himself a landowner - did surprisingly little for agriculture, believing that improvement in the primary sector could come only as a result of industrial development.

The Treasury had supervised the laying out of the Kingdom's first modern road in 1822, an initiative which led to the construction of over 1,000 km by the end of the decade, but by 1824 Lubecki was ready to take a more direct role in fostering Polish industrialization.[27] In December of that year he succeeded in imposing direct Treasury control over the state mining and metallurgy sector, after criticizing Staszic for being too liberal with government funds. A tour of the mining areas in the following year made him realize that much more investment would be needed, resulting in the drawing up of the first general development plan for the sector, undertaken by the German technocrat Lempe.

However, Lubecki was not content with the gradual expansion of the state mining sector, nor did he envisage a permanent role for the state. He argued that in such a backward country, the state would have to act as an initiator of economic activity until the emergence of private entrepreneurs, hoping that this role of government would soon prove no longer necessary. Potential entrepreneurs would encouraged to the Kingdom and assisted by a variety of measures. In the meantime the state would found ventures with a view to future sale to the private sector - at a loss if necessary. Furthermore, although Lubecki was eager to encourage individual foreign entrepreneurs and the technological expertise they could bring, he was determined never to lose control of the transfer process. Thus he refused to sanction bids from foreign consortiums which could have posed a threat to such control.[28]

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26. *PSB*, XII, p. 583; A. Bocheński, *Wędrówki po dziejach przemysłu polskiego* (Warsaw, 1966-68), I, pp. 325-326; A. Szczypiorski, *Ćwierć wieku Warszawy 1806-1831* (Warsaw, 1964), p. 101.

27. B. Ziętara, A. Mączak, I. Ihnatowicz, Z. Landau, *Dzieje Gospodarcze Polski do 1939 r.* (Warsaw, 1965), p. 366.

28. *Korespondencya Lubeckiego*, IV, p. 430; Smolka, *Polityka Lubeckiego*, I, pp. 193, 194, 485 fn. 22.

If bureaucrats such as Staszic owed much to the eighteenth century traditions of von Reden, the views quoted above suggest that Lubecki was far ahead of his time. Such attitudes towards economic development as being desirable for its own sake rather than simply a means of increasing state power were more sophisticated than most Prussian thinking for the period, whereas both the determination to retain control over the transfer process and the eagerness to engage the private sector at the earliest opportunity bears much resemblance to policies pursued by the Japanese authorities after 1868. Furthermore, Lubecki's concept of the state providing the 'first impulse' predated similar developments in Russia by over six decades.

If Lubecki saw the future of Polish exports as lying firmly in the east, he knew where to look for the technologies which the Polish economy would have to assimilate. Whereas Staszic had shown little interest in Britain, Lubecki appreciated the need for closer links between the two countries, hoping that such links would give the Kingdom increased economic independence. As with most Poles at this time, Lubecki combined an appreciation of the crucial importance of Britain with contempt for the double standards which allowed the British to espouse free trade in industrial goods while practising agricultural protectionism.[29] The Prince had already received a practical demonstration of the success of British machine technology from the Evans factory in Warsaw. Convinced that such technology could play a vital role in stimulating the Kingdom's metallurgy, he decided to construct a government factory in Warsaw based on the Evans plant.[30]

The Prince had once written about the need for selective imports to help introduce new industries to the Kingdom.[31] To this end several emissaries were sent to Britain in 1825 to inspect factories, purchase machinery and livestock, and gather information. While Count Wolicki toured Britain, a chance meeting with Edward Thomas, one of the most active British engineers in Europe during this period, led the Poles to consider the possibility of creating an indigenous technological capability in the field of machine and steam engine production. This resulted in led to the setting up of a machine factory at Białogon in the Staropolskie Basin, a plant which was to become the most successful example of state sponsored technology transfer.[32]

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29. Ibid, II, pp. 236-237; Smolka, *Polityka Lubeckiego*, I, pp. 191-192.

30. *Korespondencya Lubeckiego*, II, pp. 224-225.

31. Ibid., IV, pp. 430.

32. See Chapter 3.1.

While the technologies from Britain were intended for the state sector, Lubecki furthered his aim of boosting the confidence of the private sector by creating new financial institutions. In 1825 he founded the Towarzystwo Kredytowe Ziemskie, based on Prussian models, which offered long term credit to landowners. The second and more important body was the Bank Polski founded in 1828, which was intended to act as a central regulator of economic activity along the lines of the Bank of England.[33]

In such a conducive climate, the decade did indeed witness the emergence of several native entrepreneurs, as Lubecki had hoped. These included Count Wolicki, an important pioneer of the zinc industry with the help of Staszic and trusted emissary of Lubecki, Piotr Steinkeller, the Kraków merchant who followed Wolicki into zinc smelting and later became the Kingdom's best known businessman, and the Łubieński brothers. Each of the above displayed a high degree of initiative, with involvement in a wide range of ventures in different industries, many of which will be discussed in the next chapter. At the same time a large number of landowners founded estate based industrial ventures, while a smaller number attempted to improve their farms by introducing elements of British best practices.

Table 2.2 Polish exports 1817-50 (000 000s silver roubles)

Years	Total	Russia	Prussia	Austria a)
1817-20	1.94	-	-	-
1821-25	4.05	1.42	1.92	0.71
1826-30	5.45	2.16	2.83	0.46
1832-40 b)	5.59	0.79	4.43	0.40
1841-50	7.48	1.04	5.92	0.52

a) Austrian figures include Free City of Kraków 1824-44; no data available for 1840.
b) Figures for breakdown by country unavailable for 1832

Source: averages calculated from annual data in Jezierski, *Handel zagraniczny*, pp. 37.

As a result of Lubecki's policies, the Polish economy made considerable progress up to 1830. Without reliable data for industrial or agricultural performance this progress cannot be quantified, but trade data suggests a much improved economic position. The Kingdom's total trade deficit, which had averaged 7.06 million roubles in 1817-20 and 3.03 million in

33. Radziszewski, *Bank Polski*, chap. I.

1821-25, had been brought down to 1.45 million by 1826-30.[34] Although the trade balance was still driven mainly by agricultural exports to the west, Lubecki's policies for import substitution and exports to the Empire were obviously producing results.

d) The Bank Polski

Unfortunately for the Kingdom's prospects, the Lubecki experiment was terminated within a decade, long before it was able to bear fruit. Gradual Russian encroachments on Polish political autonomy created tensions which finally erupted in an anti-Russian insurrection in November 1830. Defeat in the ensuing war led to the loss of political autonomy with the replacement of the Polish administration by Russian military bureaucrats. Nevertheless, the Kingdom was not formally incorporated into the Empire, and some measure of economic autonomy survived with the transfer of the state mining and metallurgy sectors to the Bank Polski at the end of 1832.

The insurrection and its aftermath proved particularly costly for the country. Besides the loss of autonomy and the leadership of Lubecki, the Kingdom lost large numbers of its most enterprising individuals, with over ten thousand passing into permanent exile. These included the great statesman Czartoryski, and leading agricultural reformers like Pac and Biernacki, while Wolicki was arrested and exiled to Siberia. Many of the ventures initiated by such men were either deliberately destroyed or ruined through short sighted mismanagement. The consequences for the economy were particularly grim. Apart from huge losses sustained as a result of military operations and the closing of the Russian markets for textile exports, a series of punitive measures both impoverished the Kingdom and retarded its most dynamic industries.

The disappearance of the Polish administration meant the end of the state as an effective transfer agent. In the peculiar circumstances of the Kingdom under Russian military rule, the role of state was taken over by the Bank Polski, which pursued a deliberate policy of fostering industrialization by financing new enterprise and pushing through its own major development projects. The Bank Polski thus became the first investment bank on the continent, predating more famous examples such as the Société Generale or the Credit Mobilier. Nevertheless, this role was pioneered by default rather than by design, a situation which was to contribute much to the bizarre outcome of the Bank's activities.

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34. Calculated from annual data in Jezierski, *Handel zagraniczny*, p. 41.

Under the leadership of vice-president Count Henryk Łubieński, the Bank embarked upon a huge investment programme in metallurgy using British coke-based smelting and processing technologies for the first time, and became involved in plans to utilise one of the newest British technologies by constructing the Kingdom's first railway. Although both projects appeared to be drawn up following a rational planning process, the first was a complete disaster and expensive fiasco while the second turned out to be premature and had to be abandoned incomplete.

Much remains unclear about the activities of the Bank Polski, but it seems that Łubieński and his close circle must bear responsibility for subsequent events. The vice-president, who had been one of the few Polish entrepreneurs active before the uprising, was described by a contemporary British observer as a 'man of no principle or judgement, ready to adopt every wild project or speculation which presented itself.'[35] Many unviable schemes were financed apart from the major projects, in which the Bank invariably sustained large losses. As for its own projects, contemporaries bemoaned 'a system of extravagance, peculation and mismanagement', as a result of which 'immense sums of money were laid out.. with very little result.'[36]

Post-war researchers have suggested that the main rationale for the metallurgy investment was pure fraud, a charge which seems difficult to refute.[37] Another researcher claims the construction of extra metallurgical capacity was not unreasonable given probable demand for pig iron from the Russian empire.[38] Whatever the truth, the construction of coke-based plants in an area almost devoid of coke can only be regarded as a supreme example of an inappropriate technology. The skill transmission conducted by British experts achieved considerable success in its own terms, although it produced puddlers with nothing to puddle and rolling mill operatives with nothing to roll. The railway project was an equally murky affair which failed to materialise beyond the initial stages.

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35. PRO FO392/7, Report on the State of Poland, ff. 25, 25 v.

36. PRO FO392/7, Report on the State of Poland, ff. 16, 16 v., 18.

37. Jezierski has proved that corruption was widespread in one of the largest Bank Polski projects; see: A. Jezierski, 'Niwka', in *Ekonomika górnictwa i hutnictwa w Królestwie Polskim 1831-1864* (Warsaw, 1958), p. 220. Another author suggests corruption as the main impetus for the whole Bank programme; see: J. Jedlicki, *Nieudana próba kapitalistycznej industrializacji* (Warsaw, 1964), pp. 373-374. It should be added that although Łubieński himself was certainly guilty of recklessness and poor judgement, his trial offered no evidence of personal corruption; see: PRO FO65/371, no 235, Dec. 30, 1849.

38. Bocheński, *Wędrówki*, II, pp. 14-15.

e) Impetus and obstacles after 1831

The Kingdom's emerging private sector remained subdued after the insurrection, apart from a small number of entrepreneurs close to Łubieński, most notably Piotr Steinkeller, an ambitious but imprudent banker, industrialist and agriculturalist, who ended his career in bankruptcy after a series of daring schemes failed to pay off.[39] Very few new private ventures founded after 1832 met with success. Despite the unfavourable circumstances this period saw the possibility of major transfer initiatives connected with the plans of John Cockerill, who appears to have considered the establishment of a manufacturing base in the Kingdom. The abandonment of these plans following Cockerill's untimely death in Warsaw in 1840 was regarded as a serious blow.[40]

In 1842 the obvious failure of so many Bank Polski projects, coupled with the resentment felt by the Russian bureaucracy towards a Polish institution which had retained so much autonomy, led to the arrest of Łubieński and the Bank president Lubowidzki on charges of corruption. The imposition of strict bureaucratic control over the state sector and the Bank's credit policies, coupled with the continuing repression exercised by the military authorities, led to a period of near stagnation in the Polish economy, which was to continue until the aftermath of the Crimean War. The state declined rapidly as the new administrators sought to reduce costs. Most of the Bank's metallurgical investments were closed within a decade, and cost cutting in state factories left these saddled with increasingly obsolete equipment. The Russian authorities did at least complete the Warsaw-Vienna railway, but poor standards of construction and maintenance together with frequent closures due to troop movements or imperial visits made this line a dubious asset.[41]

By the end of the 1850s only two sectors of the Polish economy had escaped total stagnation. These were the machine industry based mainly in Warsaw, and the small cotton industry centred around Łódź. Both adapted slowly to the harsher climate after 1831. Within the textile sector the huge setbacks to the woollen industry were partly offset by a slow rise of cotton, resulting in the growth of mechanised spinning in the 1850s. While throughout Europe the machine industry made giant technological leaps as a result of the

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39. For the numerous activities of Steinkeller, see H. Radziszewski and J. Kindelski, *Piotr Steinkeller* (Warsaw, 1905); a more critical account is given by R. Kołodziejczyk, *Piotr Steinkeller* (Warsaw, 1963).

40. See chapter 5.2 for details of the Cockerill initiatives.

41. See chapter 3.3.

railway boom, Polish machine producers were forced to specialise in equipment for food processing industries and agricultural machines and tools. Thus instead of Lubecki's dream of heavy industry as a leading sector pulling the primary sector out of backwardness, the machine industry became tied to the fortunes of Polish agriculture.

The failure of the state industrialization programme forced Polish agriculture to attempt to modernise using its own resources. By the 1830s, the situation of the primary sector was particularly dire, despite brief success with distilling and wool production. This period saw the emergence of a new advocate of British agricultural methods in Poland, Count Andrzej Zamoyski. The Count's eight year experiment at Michałów demonstrated in great detail how mixed farming along British lines could be profitable even during an agricultural depression. After 1842, Zamoyski's accession to a group of reformers centred around the new periodical *Roczniki Gospodarstwa Krajowego* turned the journal into a mouthpiece for British methods. By the early 1850s it was these reform minded landowners who displayed the greatest enthusiasm for innovation, helping to promote agroindustries, steam navigation on the Vistula and the mechanization of agricultural tasks.

The Russian punitive tariff barriers raised after 1831 were removed with the full customs union of 1850, but the industrial potential of the Kingdom could not be realised until the Russian authorities restored the confidence of the private sector and society in general. This finally occurred with a combination of political relaxation and official encouragement of private enterprise following the spectacular demonstration of Russian backwardness during the Crimean War. By 1863, considerable progress had already been made in some industries, particularly those which were saw injections of foreign capital and new technologies with an eye to potential eastern markets - thus seeming to vindicate the original hopes of Lubecki. Industries which had languished for a quarter of a century began to expand in the new climate, a pattern that was to continue until the end of the nineteenth century, by which time the Kingdom was the most industrialized region in the whole empire.

The same post-Crimean thaw finally allowed Zamoyski and his circle of agrarian reformers to set up an agricultural society based on British models in 1858. An explosion of activity saw the formation of local committees to disseminate information on new methods via shows and competitions, and to take initiative on road improvements. The sheer energy of the movement was perceived as a social threat, and led to Zamoyski's banishment within three years, thus bringing to an end the last of the Polish initiatives centred around British models.

f) Impetus and anti-impetus: Russian policies

The course of Polish economic development cannot be fully understood without reference to the wider political situation of the Congress Kingdom. If the Kingdom was to flourish under its own resources - and with such a heavy reliance on Russian industrial demand, two conditions were necessary: the commitment of the Russian government to policies of industrial development, and a willingness to allow the Kingdom of Poland conditions of optimal growth.

Russian policies towards industrialization can be best described as ambiguous. Whereas Russian successes in founding institutions for the dissemination of technical knowledge were impressive, particularly in the 1820s, no material basis was created for the application of technology to the needs of the economy.[42] Although the government did usher in reforms of the state peasantry and embarked on a limited programme of railway construction, Russian policies towards industrialization up until the mid 1850s have been summarised as passive and fragmentary.[43] Apart from the prohibitory measures introduced in 1822, Russian tariff policies were more concerned with the raising of revenue than the fostering of industry. Furthermore, Russia was one of the few states where excessive industrial growth came to be regarded as undesirable by the 1830s.[44] Both aspects formed a sharp contrast with the rest of Europe, not least with the policies of the Congress Kingdom. The unconditional desirability of industrial development was not finally accepted in St. Petersburg until the Crimean fiasco.

Russian attitudes towards the economic development of the Congress Kingdom form a more complex issue completely independent from Imperial policies towards industrialization *per se*. In the cases of several other regions reallocated after the Vienna settlement, political subjugation was no hinderance to economic progress. Belgium and Norway are excellent examples of this. Neither Sweden nor the Netherlands could ever be regarded as autocratic regimes, and neither proved a major obstacle to the economic aspirations of the areas it had acquired from the peace treaties. As the work of Bruland has shown, Norway was allowed to acquire a considerable measure of textile technology via direct contact with Britain without any interference from the Swedish government. As for Belgium, the help given by

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42. W.L. Blackwell, *The Beginnings of Russian Industrialization 1800-1860* (Princeton, 1968), p. 407.

43. Ibid., p. 407; Pintner, *Russian Economic Policy*, p. 250.

44. Pintner, *Russian Economic Policy*, pp. 44-47, 91-104.

the King of the Netherlands to the young John Cockerill is well known, and once again suggests a lack of concern about the economic development of a politically dependent region.[45]

The same could certainly not be said about Russia and the Congress Kingdom. It is difficult to agree with researchers who have claimed that Russia did not hinder economic development within subordinated territories such as Poland and Finland.[46] Nevertheless, the varied relationship between the Russians and the Poles require some clarification. Russian measures affecting the Polish economy cannot be dismissed as universally punitive, and several policy swings can be detected. Furthermore, many apparently contradictory aspects of Russian policies can only be understood after a dual consideration of Russian attitudes towards industrialization and Poland.

Russian policies were generally helpful to the Poles until the death of Tsar Alexander. Hence the tariff concessions made to Lubecki, much against the wishes of Kankrin, who argued that Russian industry could not withstand competition from the Kingdom.[47] During the Wolicki missions to Britain, the Russian ambassador provided much necessary help, on one occasion petitioning the Foreign Office in an effort to obtain machinery for which an export licence had been refused.[48] Even where anti-Polish sentiments existed these could be overridden by fiscal considerations, as in the case of the protests by Moscow textile manufacturers in 1826, when Kankrin refused to accede to demands to prohibit imports of Polish cloth, deciding that Polish competition was a lesser evil than the potential loss of customs revenue.[49]

Russian policies did not begin to harden until the late 1820s. Lubecki's original plan to seek a foreign loan in London, which had once received the tacit approval of Alexander, had to

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45. For the Norwegian initiatives, see K. Bruland, *British Technology and European Industrialisation* (Cambridge, 1989); for Belgium, R. Demoulin, *Guillaume I^er^ et la transformation économique des Provinces Belges* (Liége, 1938); also R. Westebbe, 'State Entrepreneurship: King William I, John Cockerill, and the Seraing Engineering Works, 1815-1840', *Explorations in Entrepreneurial History*, 8 (Cambridge, Ma., 1956), pp. 205-232.

46. I.T. Berend and G. Ranki, *The European periphery and industrialisation 1780-1914* (Cambridge, 1982), pp. 107-108.

47. Pintner, *Russian Economic Policy*, p. 44.

48. PRO BT1/233, Petition of Prince Lieven, March 26, 1827.

49. A.J. Rieber, *Merchants and Entrepreneurs in Imperial Russia* (North Carolina, 1982); pp. 62-64.

be abandoned following opposition from his successor Nicholas. At the same time a series of Russian political moves began to undermine the Kingdom's autonomy and create suspicion among the Poles. However, no distinctly anti-Polish measures were enacted until the crushing of the insurrection. A new tariff system saw the imposition of heavy duties on woollen cloth, hitherto the Kingdom's main export to the Empire. Other provisions hindered other Polish exports while facilitating Russian exports to the Kingdom. A further blow was the offer of inducements for entrepreneurs in the Kingdom wishing to move to the Empire, causing an exodus which led to the creation of a new textile producing area just across the imperial border at Białystok. As shown earlier in table 2.2, Polish exports to the Empire dropped considerably as a result of these measures. During the whole 1833-50 period the average value of exports to Russia was just over 40% of the 1829 figure, while in no single year did the value approach even the 1821-25 average.[50]

The defeat of the insurrection proved expensive in several other ways. The Poles had to share the costs of maintaining both the large Russian garrisons and bureaucracy. In 1834 the Bank Polski was forced to grant a loan of 10 million zlotys to the administration, half of which was used to pay for the Russian occupation force. The city of Warsaw was forced to pay for the construction of the Cytadela, a huge fortress housing the Russian garrison, at a cost of 4 million zlotys, an outlay which burdened the city with debts for many years.[51]

Considerable long term damage was caused by the deliberate closure of the university, the preparatory school for the Polytechnic and the agricultural institute, which destroyed every Polish institution for the dissemination of technological and scientific knowledge. Although the Marymont Agronomical Institute was reopened in 1836, no other institutions were allowed to open until the early 1860s. Other measures to disseminate information met with equal setbacks, as no new industrial exhibitions were held before the Crimean conflict.

Arguably, the greater blow to the Kingdom's economic prospects was the complete loss of confidence caused by the repressive policies of the military authorities. In 1837 the British consul remarked that the loss of confidence was one of the major obstacles to further industrial development, while the obvious lack of security for persons or property

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50. S. Rychliński, 'Handel Zagraniczny Królestwa Polskiego w latach 1815-1850', *Ekonomista*, 29 (Warsaw, 1929), pp. 70-86; E. Boss, *Sprawa robotnicza w Królestwie Polskim w okresie Paskiewiczowskim 1831-55* (Warsaw, 1931), p. 31; averages calculated from data in Jezierski, *Handel Zagraniczny*, p. 37.

51. Radziszewski, *Bank Polski*, pp. 248, 249, 260.

discouraged any investment in agriculture, concluding that Russian policy seemed designed to oppress and impoverish the Kingdom.[52] The confidence of Polish society was further eroded by successive official measures eroding the Kingdom's autonomy. A stream of legislation from the 1830s onwards saw the Kingdom's territorial administration, currency and legal system all reorganised on Russian lines, strengthening Polish fears of eventual absorption into the Empire. Such fears were magnified as a result of the customs union of 1850, which was seen by most Poles not as an economic opportunity, but as yet another attack on the Kingdom's separate status.[53]

The removal of all barriers to Polish trade with the Empire following the customs union had little effect on the Kingdom's economy. Decisive change came only with the shift in Russian attitudes after Crimea. The recognition of the desirability of industrialization, together with the subsequent thaw in relations with the Poles created a unique period when rapid development coincided with social optimism. This new Russian tolerance both spawned and was tested by rising Polish expectations, and a brief experiment with a Polish administration in Warsaw led to another futile uprising and further repression. Curiously, despite continuing repressive measures - many elements of discrimination survived until 1914 - the new Russian commitment to economic development ensured the revival of private initiative in the Kingdom and an influx of foreign capital, expertise and technology which came to pay increasingly large dividends in the decades after 1863.

2.2 Methods and modes of transfer

The previous chapter outlined three basic paths by which state actors within backward economies could encourage technology transfer - by the direct introduction of new methods, the encouragement of private entrepreneurs and the provision of bodies for the creation and dissemination of technical knowledge. All three paths were pursued with initial success by the pre-1831 authorities of the Kingdom, with mixed results by the Bank Polski, and much neglected by the Russian bureaucracy, particularly after the fall of Łubieński.

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52. PRO FO392/7, Report on the State of Poland, ff. 40, 40 v., 46.

53. For measures eroding the Kingdom's separate identity, see PRO, FO65/338, no 6, Jan. 24, 1847; also FO392/7, Report on the State of Poland, ff. 45-46. For fears over the political implications of the customs union, see FO65/383, no 66, Sep. 9, 1850. See also Davies, *God's Playground*, II, p. 333.

a) Public and private enterprise

The majority of state/Bank Polski resources was channelled into the state's own investment programmes, particularly in mining and metallurgy. A total of 4.1 million roubles (27.5 million zlotys) was spent on the state sector up to 1832, after which expenditure spiralled to a possible 19 million roubles (126 million zlotys) between 1832 and 1855. Jedlicki estimated a total expenditure of 30-40 million roubles (200-266 million zlotys) up to 1866.[54] The impossibility of calculating GNP figures for the Kingdom makes such sums difficult to quantify, but these could be compared with average annual military and non-military expenditure of 4.5 and 5.5 - 7.5 million roubles respectively under Lubecki.[55]

However, most of this expenditure did not involve any major technology transfers apart from the Bank Polski metallurgy programme and Lubecki's machine factories. Much more success in this field was achieved by the encouragement of private entrepreneurs, a particular success of the Staszic and Lubecki regimes. Between 1821 and 1830 a total of 1.3 million roubles (9.1 million zlotys) was allocated for the founding and development of the private manufacturing sector.[56] Such expenditure proved particularly significant in encouraging the production of machines and textiles, precisely those industries which saw substantial technological inputs by private entrepreneurs.

The best known policies of both central and regional administrators were general measures to encourage the immigration of skilled artisans, and generous inducements to would-be entrepreneurs. The exclusion of Prussian textiles from the eastern markets caused many domestic textile workers to simply cross the border to set up trade in the Kingdom, with substantial numbers arriving also from Saxony and Bohemia. In 1824 Lubecki was convinced that 150,000 artisans had arrived from the German states, but an estimate of 50,000 workers from all regions for this period seems more accurate.[57]

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54. All calculations taken from Jedlicki, *Nieudana próba*, pp. 52, 370-372. The state mining sector (górnictwo rządowe) embraced all state operations in mining and metallurgy, together with the machine factories at Solec and Białogon and various plants taken over by the Bank Polski before 1855.

55. See footnote 25.

56. Gąsiorowska, *Z dziejów przemysłu*, p. 48.

57. Smolka, *Polityka Lubeckiego*, I, p. 191. The best discussion of the long (and frequently fruitless) debate over numbers and origins of artisan emigrants into the Kingdom after 1815 is offered by K. Woźniak, 'Źródła finansowania przemysłu włókienniczego w okręgu łódzkim do lat pięćdziesiątych XIX wieku', *Roczniki Dziejów Społecznych i Gospodarczych*, 49 (Poznań, 1991), p. 39, fn. 2.

The variety of incentives offered to private entrepreneurs proved even more important. In 1819 the Polish government was one of several to bid for the services of the young John Cockerill, but the latter declined in the face of greater opportunities in the Netherlands.[58] Six years later Cockerill cooperated with the government in founding a demonstration woollen plant in Warsaw, which was later sold to Samuel Fraenkel.[59] However, it was the inducements offered by central and local authorities to entrepreneurs from the German states which led to the dynamic growth of the Łódź textile region. An estimated 5.5 million zlotys was offered to textile entrepreneurs in the form of loans up to 1855, much of which was never repaid. In addition, the leading manufacturers were able to take advantage of other considerable concessions such as free premises, tax and tariff reductions. Leading manufacturer Ludwig Geyer received a total of 964,000 zlotys in government credits and other grants, of which 800,000 was never repaid. Several other entrepreneurs in the sector received state help worth hundreds of thousands of zlotys.[60]

Such state assistance for the private sector was particularly significant when it was tied to technology transfer or at least the adoption of best practices. In the textile industry government aid was usually conditional upon the employment of up to date machinery. Such was the case when Christian Wendisch founded the first cotton spinning mill in Łódź in 1824. His receipt of government credit worth 214,000 zlotys obliged him to employ a specific number of mules and other machines. Conversely, state assistance was invariably refused to applicants who could not prove technological competence.[61]

Such concessions to textile manufacturers did much to hasten the diffusion of mechanisation among end users within the sector, but it was state help to hopeful entrepreneurs in the machine industry which offered the first real potential for the creation of indigenous technological capabilities. The pioneering foundry and factory founded by Thomas Moore Evans also made use of state inducements in the shape of free premises and a loan of 40,000 zlotys. This seems quite meagre in comparison with the sums received by textile entrepreneurs, but it was significant in being the first agreement to enshrine skill

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58. T.B. Hodges, 'The Iron King of Liege: John Cockerill', unpublished Ph.D. Thesis, University of Columbia (1960), p. 374.

59. Hodges, 'Iron King', pp. 364-368, 371; J. Śmiałowski, 'Przepływ kapitału ziemiańskiego', in *Aktywność gospodarcza ziemiaństwa w Polsce w XVIII-XX wieku* (Kielce, 1993), p. 22.

60. Woźniak, 'Źródła finansowania', pp. 39-64.

61. G. Missałowa, *Studia nad powstaniem łódzkiego okręgu przemysłowego 1815-1870* (Łódź, 1964), I, pp. 191, 194.

transmission by including an obligation to train Polish apprentices.[62] This was one of the first of many contacts with British personnel which did more than anything else to diffuse skills within the Kingdom. This crucial aspect of British involvement will be discussed in greater detail below.

b) The creation and dissemination of information

In all the features connected with the collection, creation and dissemination of technological information, the Poles copied the standard paths of the European followers, with fact finding missions to Britain and elsewhere in Europe, the despatching of promising students to study or work abroad, the creation of specialized training institutions, and the organization of industrial exhibitions.

The University of Warsaw, founded in 1816, provided a nucleus of general scientific education, but it was the technical institutes which were more important in this period. All these institutions were based on those from other follower countries, particularly Prussia, Saxony and the Vienna Polytechnic. The Kielce Mining School and the Marymont Agronomical Institution were early successes in this field, but the most important initiative of this type was Lubecki's Polytechnical Institute, for which a preparatory school was opened in 1825. This was intended to offer higher education not only in the sciences but also in commercial subjects, but never progressed beyond the preparatory school stage. All these institutions had a short life: the Mining School had been wound up in 1827 in order to be absorbed into the Polytechnic, but the University and the other schools were all closed by the Russians after 1831. Although the Marymont institution was allowed to reopen in 1836, the termination of these initiatives was a particularly damaging blow for the Kingdom's economy.

Despite the relatively short life of these bodies, they were still able to produce graduates who made significant contributions within their respective industries. The Mining School produced Antoni Klimkiewicz and Jacek Lipski, who both came to play important roles in the expansion of the Kingdom's metallurgy, both under Lubecki and the Bank Polski after 1832. Among the graduates of the Polytechnic's Trade School was Leopold Kronenberg, who later became one of Poland's leading bankers and railway promoters after the Crimean

62. Wojewódzkie Archiwum Państwowe, Warsaw (hereafter WAP Warsaw); Hipoteka Warszawska, possesja nr 1766, tom I, nr 2, paragraf nr 6.

War. The Marymont Institute produced several talented estate managers who contributed excellent material to the Roczniki Gospodarstwa Krajowego.[63]

Polish trips to Britain and other western European countries played an important part in the acquisition of elements of technology. Where cost was not the most important consideration, Poles headed straight for Britain and stayed until they had acquired a suitable amount of experience or machinery. Such was the case with the agricultural reformers Stanisław Zamoyski, Pac and Chłapowski. However, such opportunities were open only to those with suitable resources. The majority of Polish journeys to the west were sponsored trips by promising students of technical and commercial subjects, funded either by the Lubecki or the Bank Polski. Such trips either took the form of shorter fact-finding missions such as those of Niepokójczycki or Wysocki, or were longer periods of work and study forming an integral part of training for academic or administrative posts. The latter tended to be spread over several countries, presumably to gain the widest possible range of experience in varying circumstances.

Some journeys were little more than unfocused reconnaissance trips leading only to a greater awareness of the possibilities of new technologies. Such was the mission of civil servant Wincenty Niepokójczycki in 1825. His specific brief was to make observations on technical education in Britain, but Lubecki asked him to take note of anything which could be of benefit to the Kingdom. He thus produced detailed reports on such diverse topics as the recently opened Stockton - Darlington railway, the Edinburgh municipal water and sewerage system, the state of Scottish agriculture and the organization of joint stock companies.[64]

In such manner all the prospective lecturers for the Polytechnical Institute were sent abroad to study and acquire practical experience. Each spent three or four years in a minimum of three countries.[65] Shorter trips were organised for future engineers of the mining department. On the Wolicki - Girard mission to Britain, the two emissaries were accompanied by three young mining engineers Gut, Kitajewski and Cieszkowski. The first two inspected a wide range of industrial sites all over Britain, while Cieszkowski spent three

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63. *PSB*, XIV, p. 627 (Klimkiewicz); XV, p. 325 (Kronenberg); XVI, pp. 420-421 (Lipski).

64. Lipoński, *Polska i Brytania*, pp.113-115.

65. J. Bieliński, *Królewski Uniwersystet Warszawski 1816-1831* (Warsaw, 1909-11), II, pp. 471-474.

months at a coal mine in Newcastle before leaving for France to continue his observations. All three were to distinguish themselves in the state mining sector, with Cieszkowski becoming the superintendent of the Western Region (Dąbrowa Basin) coal mines in the 1830s.[66]

The Bank Polski continued these successful policies, most notably in the case of Stanisław Wysocki, the constructor of the Warsaw & Vienna railway, who was sent to inspect lines on the continent before consulting George Parker Bidder in Britain, and Stanisław Lilpop, a talented young engineer, was sent to the continent to complete his studies, before returning to become the Kingdom's most successful machine constructor.[67]

The nature of information gathering and purchasing trips to Britain changed along with the shift in attitudes displayed by British capital goods firms as outlined in the previous chapter. Unlike many such journeys in the eighteenth century Polish visitors did not encounter great secrecy, but nevertheless such trips often proved frustrating because of the lack of information available on British firms. In 1825 Wolicki had considerable difficulty in obtaining information as to which firms could construct the steam engines he was seeking.[68] Once Britain adopted the European practice of staging industrial exhibitions, foreign visitors were spared such frustrations. Several manufacturers were thus able to visit Britain with a much clearer idea of what was available. Henceforth, leading machine makers such as Lilpop, who had once bought British machinery at the Paris exhibition in 1844, became more frequent visitors to Britain.[69]

The previous chapter also underlined the atmosphere of self promotion cultivated by leading British agriculturalists from an early date. The journeys of Andrzej Zamoyski and General Chłapowski to leading British farms proved particularly fruitful and influential, and will be discussed in detail in chapter 5, but many less exalted figures also made the trip. Over twenty Poles connected with agriculture made the visit to Tiptree Hall Farm, the showcase

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66. Archiwum Główne Akt Dawnych (hereafter AGAD), Akta Komisji Rządowej Przychodu i Skarbu (hereafter KRPS), 1449; Kitajewski to Lubecki, Oct. 19, 1825; Dec. 16, 1825; Bocheński, *Wędrówki*, II, p. 275.

67. Radziszewski, *Bank Polski*, p. 457; Bocheński, *Wędrówki*, II, p. 244.

68. AGAD, KRPS 1449, Wolicki to Lubecki, Nov. 10, 1825.

69. J. Bartyś, *Początki mechanizacji rolnictwa polskiego* (Warsaw, 1966), pp. 213-216, 349-359, 374.

of High Farming, including a professor at the Marymont Institute and an associate of Zamoyski who described the farm in an article in the Roczniki Gospodarstwa Krajowego.[70]

The value of industrial exhibitions for the dissemination of information (and as a demonstration of achievement) was a measure much appreciated in most of the follower economies. Polish success in this field was not immediate - the first government sponsored exhibition planned for 1819 never progressed beyond the planning stage because of a lack of response from producers.[71] The next initiative was more successful, and an exhibition was held in Warsaw Town Hall in September 1821. This was a somewhat modest affair with twenty manufacturers contributing 320 products. The exhibitions was dominated by articles of an ornamental nature, including carpets, cloths, porcelain, metal ornaments and sculptures, pottery and leatherwork, representing crafts rather than manufacturing industry. More useful items were exhibited by government workshops in the Staropolskie Basin, and included iron and zinc sheets, chaff cutters, sheep shearers, scythes, knives, springs and a large variety of weapons. Despite the absence of any products representing advanced technology the exhibition drew the usual enthusiasm from *Izys Polska*, which heralded the exhibition as an important first step.[72] The first exhibition to show real evidence of industrial progress came in 1823, when the judges awarded a gold medal to the Evans factory for its machines.[73] Unfortunately, the staging of exhibitions was another aspect of state activity which was allowed to lapse after 1831. No further exhibitions were to take place before the Crimean War. After Crimea the practice was resumed, with the annual exhibitions organised by the Agricultural Society playing a key role in raising awareness of new methods and products.

c) The development of a technical press

A final instrument for disseminating information was the technical press, usually sponsored by private or institutional rather than state initiative. Over a dozen technical and economic periodicals were founded in the Kingdom, devoted to economic matters were founded. Most folded after a short period, only two lasting for any length of time. By far the most

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70. British Library, Add. MS 30015, Tiptree Hall Farm Visitors Book; [M. Oborski] M.O., 'Nowsze postępy gospodarstwa w Anglii', *RGK*, 47 (Warsaw, 1862), pp. 399-405.

71. *Izys Polska*, 4 (Warsaw, 1821), pp. 66-68.

72. *Izys Polska*, 5 (Warsaw, 1821), pp. 449-467.

73. *Gazeta Polska* (Warsaw, Nov. 13, 1828).

important was the *Izys Polska*, founded in 1820 by Gracjan Korwin, and continued after his death in 1821 by his brother in law Antoni Lelowski, a civil servant in the Industrial Department and Commissioner of Factories (Komisarz Fabryk) from 1825. *Izys Polska* was modelled on similar journals published in Western Europe, but was specifically Polish in character. Rather than simply reporting on technical and commercial developments, it sought to promote the application of such advances in the Kingdom.

Many articles in *Izys Polska* sought to explain why Britain had achieved such preeminence in world trade and industrial output, and the implications of this for the European economies. Britain was often held up as a model to be imitated, though without the almost idealised descriptions sometimes observable in the writings of pro-British agricultural reformers.[74] Other contributions included penetrating analyses of contemporary Polish problems, making very important comments on the obstacles to development, and advocating possible remedies. Apart from articles translated from foreign journals, *Izys Polska* contained contributions from a wide range of Polish experts in various fields, such as the agricultural reformer Jan Kurowski and Tadeusz Wernik, director of the Agronomical Institute at Marymont. Lelowski displayed great enthusiasm in using the journal as a bulletin of developments in the Polish economy, eager to publicise progress in any field.

Unfortunately for Lelowski and for the economy, *Izys Polska* was far too advanced for the majority of Polish readers at the time. Being regarded as too technical, it had problems attracting sufficient interest and folded in 1828, having survived for so long only because of Lelowski's heroic efforts. Such a fate was shared by other similar ventures. Following the demise of *Izys Polska*, the *Sławianin*, a journal on the lines of the Mechanics Magazine, was launched by Kitajewski, the engineer who had toured Britain with Wolicki. It also folded after only a year.[75]

Publications devoted to agricultural matters were far more common, but they also suffered from a lack of mass interest, few lasting longer than a year. As early as 1804 Stanisław Zamoyski founded the *Dziennik Ekonomiczny Zamoyski*, which folded in the following year. Equally short-lived were the *Dziennik Gospodarczy*, the journal of the first agricultural society, and the *Dostrzegacz ekonomiczny i polityczny lubelski*, the first attempt to found such a journal in the provinces. Of more influence was the *Gazeta Wiejska*, founded in

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74. *Izys Polska*, 1 (Warsaw, 1820), pp. 430-438; 2 (Warsaw, 1820), pp. 160-167; 3 (Warsaw, 1820), pp. 555-565.

75. W. Grabski, *Historia Towarzystwa Rolniczego 1858-1861* (Warsaw, 1904), I, p. 201.

1817 by Alojzy Biernacki. This was the most pro-British of all the journals, reflecting the editor's preoccupations with the need to apply British innovations to Polish agriculture. At the same time the respected Oczapowski, director of the agricultural department of Vilna University in Russia proper, included several valuable articles in the local Polish language paper *Dziennik Wileński*, based on the writings of Albrecht Thaer.[76]

After the uprising far fewer technical journals appeared, and those which did had little success. The *Pamiętnik Rolniczo-Technologiczny*, founded in 1832, folded after only fifteen numbers. In 1835 Kurowski launched a new agricultural weekly, the *Tygodnik Rolniczo-Techniczny*, later renamed *Ziemianin*, consisting mainly of the editor's own original work, based on Thaer's adaptations of British practices. In the same year the first comprehensive agricultural textbooks in Polish appeared, each reflecting very different approaches. The first was Oczapowski's *Gospodarstwo Wiejskie* in ten volumes, a largely theoretical work which owed much to Thaer. The other was the *O rolnictwie* by Dezydery Chłapowski, a small book containing a wealth of instructions based on observations of British agriculture and practical experience from two decades of farming on his estate at Turew. Chłapowski's work, though published in the Prussian partition, was an instant bestseller with Polish landowners everywhere, and remained one of the most influential manuals ever written in Polish.[77]

By far the most important publication devoted to technical matters was the quarterly *Roczniki Gospodarstwa Krajowego*, founded in 1842, the most varied, well written and influential of all such publications. Devoted almost entirely to agriculture and related industries, the journal became the mouthpiece of the reform movement centred around Andrzej Zamoyski, and as such came to have a larger impact than all the other journals put together. The *Roczniki* will be discussed in more detail in chapter 4.2.

2.3 The utilization of British personnel

The technical press gave some Poles an awareness of developments occurring abroad, and several were able to acquire knowledge and skills by attending foreign establishments, but the creation of indigenous capabilities in an economy so devoid of skills as that of the

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76. Ibid., I, pp. 197-198; Lipoński, *Polska i Brytania*, pp. 142, 145.

77. Grabski, *Historia*, I, pp. 203-205; Lipoński, *Polska i Brytania*, p. 159.; D. Chłapowski, *O rolnictwie* (Poznań, 1835).

Kingdom necessitated another standard path for the followers: the utilization of foreign personnel.

a) Recruitment of British personnel

Large numbers of Scots had been present in the Polish Commonwealth since the sixteenth century, but the first arrivals of Britons as carriers of the advanced industrial and agricultural technologies seems to have taken place in 1804, with the recruitment of British mechanics for the Zwierzyniec workshop, a practice that was to continue throughout the nineteenth century.

From the viewpoint of technology transfer, British personnel in the Kingdom fall into two main groups: those recruited by Polish transfer agents to fulfil specific tasks, who comprise the majority of Britons economically active in the Kingdom, and individual agents pursuing their own agendas. Some of the more important Britons such as Thomas Evans and Edward Thomas could combine both roles. Recruitment was mainly undertaken by Polish agents - the government or the Bank Polski, or private entrepreneurs and landowners, while some were brought over by compatriots already established in Poland. Very few seem to have gone to Poland on their own initiative.

At first, the institutional framework described above dictated the use of German rather than British personnel, thus German technocrats loom large in histories of the state sector in the early years. The significance of the British in the Kingdom is further disguised by the fact that the only individual recruited by the Poles with a prior international reputation was the French inventor Philippe Girard, who entered government service in 1825.[78] Unlike the German administrators, British personnel rarely appear as decision makers affecting the course of Polish development.

Nevertheless, individual Britons did have considerable influence on Polish transfer agents, with important consequences for subsequent developments. The demonstration effect of the Evans factory and the subsequent decision by Lubecki to found the Solec plant has already been mentioned. Lubecki's other (and more remarkable) contribution to the machine

78. *Korespondencya Lubeckiego*, II, pp. 213-214.

industry - the factory at Białogon - owed its existence to Edward Thomas, already mentioned in connection with technology transfer to four countries.[79]

The famous Landes quote about the significance of the British lying in what they taught rather than what they did holds true for the British in the Kingdom. The recruitment of Britons was largely limited to highly skilled engineers, artisans, and farmers. When dealing with British personnel, the Polish side invariably sought to exact some form of obligation to undertake training of Polish apprentices. This could be stipulated in the contract, or it could be expected in practice. As early as 1817, the Scots artisans working on the Pac estate were training local apprentices, though it is uncertain whether this was a condition stipulated by Pac himself.[80] The 1823 contract between the government and Thomas Moore Evans included an obligation to give training on iron founding to a minimum of six Polish apprentices each year.[81] Such practices continued for decades - as late as 1847, the factory was training 30 apprentices, accounting for 10% of the total workforce.[82] The Evans contract appears to be the first government agreement to include such a training requirement, and henceforth such a stipulation seems to have been the norm for contracts involving British experts. Evidence regarding such obligations on the part of Britons employed at Lubecki's factories does not appear to have survived, but as these enterprises were commonly viewed as training grounds for the Poles, it can be assumed that some form of skill transmission was expected from the British specialists in charge. Among the activities of the Britons at Białogon, we find Preacher advising on the layout and equipping of a projected textile works at Tomaszów, Thomas Felvers journeying to Wąchock to monitor pig iron production, Preacher installing equipment at the ironworks at Samsonów, John Crowe heading a group to instruct the workforce at the Nietulisko ironworks, and the Britons hosting a group from the ironworks at Maleniec.[83] When the Bank Polski leased the Solec works to John and Whitemore Perks in 1834, their contract stipulated that although the Perks were encouraged to recruit foreign specialists, *only* Polish apprentices

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79. See Chapter 3.1.

80. J. Bartyś, 'Działalność gospodarcza i społeczna Generała Ludwika Paca w dobrach Dowspuda na Suwalszczyźnie', *Rocznik Białystocki*, 9 (Białystok, 1970), p. 57.

81. WAP Warsaw, Hipoteka Warszawska, possesja nr 1766, tom 1.

82. F.M. Sobieszczański, *Rys historyczno-statystyczny stanu i wzrostu miasta Warszawy* (Warsaw, 1848), p. 392.

83. J. Pazdur, *Zakłady metalowe w Białogonie 1614-1914* (Wrocław, 1957), pp. 119, 135-136.

could be employed.[84] As part of its metallurgy programme, the Bank employed British puddling instructors, but there were also other ways of utilising British expertise. When William Harris was engaged as overseer of the puddling works at Huta Bankowa, his contract stipulated that he was obliged to suggest any improvements on the basis of his 'long experience in England and Belgium'.[85]

At present little is known about patterns of recruitment for work in Poland. So far only scant evidence has emerged regarding methods of recruitment, the identity of recruiting agents and terms of employment offered. Little is known about the background of the British personnel leaving for Poland, and in only a few cases (such as James Wilden or William Harris) do we possess details regarding previous employment in Britain or elsewhere. There are some sources giving names and approximate dates of recruitment, the most notable being the mechanics recruited by Edward Thomas during the Wolicki missions of 1825/26.[86] Britons recruited by agricultural reformers were usually engaged on the spot. In 1804 Zamoyski personally agreed contracts with the mechanics engaged to found the Zwierzyniec workshop.[87] General Chłapowski took a Scots mechanic back with him after a visit to Britain, presumably Pac also recruited most of his settlers while in Britain.[88] It many cases Britons already in Poland made approaches to their compatriots, as in the case of William Preacher, brought over by Thomas Evans. In 1835 Preacher himself was sent to Britain for a year to acquire new machinery for Białogon, and returned with three specialists, William Allen, Thomas Felvers and Thomas Butler.[89] In the 1830s, some recruits working in the Dąbrowa Basin had been brought from across the border in Silesia such as Harris or Thomas Hart, previously employed at the Königshütte. At the same time, others such as Alexander Watson arrived directly from Britain.[90]

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84. Radziszewski, *Bank Polski*, p. 350.

85. PRO FO394/1, William Harris papers, Contract for the lease of Huta Bankowa puddling works, paragraph VIII.

86. PRO, BT1/228, J.P. Bell to Treasury, Oct. 13, 1826; AGAD, KRPS 1449, Wolicki to Lubecki, Dec. 5, 1825; *Korespondencya Lubeckiego*, II, pp. 479-480.

87. Bartyś, *Początki mechanizacji*, p. 48.

88. W. Kalinka, *Generał Dezydery Chłapowski* (Poznań, 1885), p. 68.

89. *Opis geograficzno-historyczny i statystyczno-techniczny zakładów rządowogórniczych w oddziale Białogon* (Kielce, 1979), pp. 45-46.

90. PRO FO392/1, nos 93, 100; FO392/2, no 73.

In some cases there is evidence regarding terms of employment offered to British artisans. One of the workmen engaged for the projected cotton mill at Serniki was Adam Furnafur, a cotton spinner from Manchester. In November 1829 he was recruited by Jeremiah Crook, a Liverpool merchant acting as agent for William Jones. Furnafur was offered a two year contract on attractive terms: a salary of £2 per week, with free accommodation and fuel. Crook also guaranteed Furnafur's expenses to return to Britain in the event of the latter not wishing to renew his contract after the initial two years.[91] George Blaikie, a Scottish machine constructor, was employed on two different estates for a wage of 2,000 zlotys (£50) per annum plus accommodation, garden, fuel and a large quantity of farm produce.[92] A similar wage of 80 zlotys per week was paid to Brownbill, a blacksmith employed at Solec.[93]

As for more experienced engineers, the case of William Harris is worth mentioning. Harris had probably been employed at the small ironworks at Varteg Hill in South Wales in 1824. Between 1827 and 1829 he was employed as chef lamineur or head of the rolling mill at Seraing. Prior to his move to Poland he had been working in Prussia.[94] In 1834 he was engaged by the Bank Polski to become overseer of the puddling works and rolling mills under construction at Huta Bankowa. By the terms of the agreement stipulated, upon commencement of production Harris would receive a fixed sum on every hundredweight of pig iron produced at the works, with the guarantee that his income would not be less than that he had received while working at Seraing. In the meantime he was to supervise the instalment of machinery, with the stipulation that he could be called upon to undertake similar tasks at other government works. For this he was to be paid 480 zlotys (£12) per month, and receive free accommodation and fuel. Work was also guaranteed for his three sons.[95] Harris was able to extract more concessions from the Bank. Whereas housing for workers cost around 1,200 zlotys per unit, Harris, his brother Joseph and nephew William Swift were able to insist on English type cottages at a cost of 7,000 zlotys each.[96] At Białogon, Preacher initially received 6,000 zlotys (£150) per annum, rising to 9,000 zlotys

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91. PRO FO392/1, no 5.

92. Bartyś, *Początki mechanizacji*, pp. 92-93.

93. Gąsiorowska, *Z dziejów przemysłu*, p. 365.

94. PRO FO392/2, nos 73, 75.

95. PRO FO 394/1, William Harris papers. Agreement between William Harris and the Bank Polski, Paragraphs 3 and 4.

96. A. Wóycicki, *Dzieje robotników przemysłowych w Polsce* (Warsaw, 1929), p. 170.

from 1837.[97] British specialists were more highly regarded than their Prussian counterparts. When British puddlers were engaged to work as instructors at the Bank puddling works at Koniecpol, they were paid 3,360 zlotys per annum, almost three times as much as Silesian puddlers employed at the same enterprise. For comparison, Polish smiths at Koniecpol earned 360 zlotys per annum.[98] The British puddlers were also offered a bonus of 120 zlotys for each man trained.[99]

Nevertheless the recruitment of both workers and engineers encountered several problems. The modest pace of Polish economic development was an obvious drawback, and presumably explains why Edward Thomas decided to move on to Bohemia rather than remain in the Kingdom. However, many problems stemmed from noneconomic factors. When so many enterprising Britons could find work either at home, or at least much nearer home in France, Belgium or Germany, Poland cannot have been a very attractive proposition, and would always remain far back in the queue in the competition for British personnel. Until the development of a substantial European rail network after the middle of the nineteenth century, the landlocked Kingdom must have seemed even more remote than the Russian ports of the eastern Baltic. Moreover, unlike the countries of Western Europe, the Kingdom could offer little in the way of political stability and personal security for the crucial period of the Paskievich regime.

The level of confidence in Poland plummeted with the uprising and the subsequent war. The advance of the Russian armies brought ruin to several Britons, notably William Dawnie, manager of a flax works Wiasowno and Janice Neville at a farm near Puławy, who both saw their property destroyed by troops and suffered personal violence. George Hall, owner of the largest porter brewery in Warsaw, had his premises deliberately fired by Russian soldiers during the storming of Warsaw.[100] In such circumstances confidence among the British community in Poland was shattered, and a petition was drawn up imploring Lord Palmerston to appoint a consul to protect British personnel in the country.[101] Despite several visits from Andrew Evans, younger brother of Thomas, Palmerston delayed his decision until the

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97. Pazdur, *Zakłady metalowe*, p. 124.

98. Wóycicki, *Dzieje robotników*, p. 161.

99. PRO FO392/1, no 69.

100. PRO FO 65/194, Petitions of William Dawnie, Apr. 12, 1831, and Janice Neville, July 10, 1831; FO394/1, Hall papers. In the case of Hall, claims for compensation dragged on for seven years before any payment was received, see: FO65/237, no 5.

101. PRO FO 65/196, Petition to Lord Palmerston, February 1831.

Russians had crushed the insurrection. After a long charade a consul was finally appointed in December 1831.[102]

Although consular representation was not appointed when it was most desired, nevertheless the appointment undoubtably made life much easier for Britons resident in the country, who at least acquired a mode of redress which, however imperfect, offered them some protection from the brutal repression which followed the Russian occupation. The Paskievich regime was notable for both lawlessness on the part of the Russian soldiery and a vast expansion of the administrative bureaucracy, both of which were to cause many problems to Britons resident in the country. Endless bureaucratic problems were too numerous to mention, but more serious incidents were not uncommon, such as the assault on Phinaeas Sunderland by a Cossack patrol in 1835 and the persistent harassment of Alexander Kedslie by border guards in 1838.[103] Such incidents cannot fail to have had an undermining effect on the morale of British personnel employed in the country. It is reasonable to suggest that the attractiveness of Poland among skilled workmen already active on the continent must surely have dropped in such circumstances. This may go some way towards explaining the high wages offered to British specialists after 1831, and also the influx of several incompetent Britons who turn up in Poland during this period.

One well informed British observer was particularly scathing on the subject of the recruitment of British personnel. The archives of the British consulate in Warsaw are full of accounts of personal problems encountered by Britons in the Kingdom, and Consul Barnett had on numerous occasions been forced to intervene on their behalf. He strongly disapproved of the practice of recruiting Britons to work in Poland, and voiced this disapproval to Palmerston in terms worth quoting at length:

> I may be allowed.. to offer.. a few remarks on the evils resulting from the practice which exists to a considerable extent of engaging workmen in England to go out to that country. They are induced by the offer of high wages to leave their homes, often with their wives and families. On their arrival in Poland they meet with many difficulties and petty vexations from the Local Authorities, in regard to their passports and the admission of their few effects. The undertakings for which they are engaged nine times out of ten fail, and the men being then no longer of any use are turned adrift. I have myself been witness to the ill treatment which at such periods they receive from those who had engaged them to come out. On the cessation of their employment they soon spend the little they have earned and then either return to England beggars, or if they remain in the country become drunkards

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102. PRO FO65/196, Andrew Evans - Palmerston/Backhouse correspondence; FO65/210, no 1.

103. PRO FO 392/1, nos 31, 84, 86, 90; FO 393/2, no. 40.

> and lose all their character as Englishmen. It may be a matter of consideration for Her Majesty's Government, whether some measures may not be taken for putting Workmen in the Manufacturing districts of England on their guard against being induced to go out to Poland by the prospect held out of getting better wages and constant employment.[104]

In some respects the consul's pronouncements were a little harsh on the Poles. Few of the ventures for which Britons were introduced failed completely, and there is little evidence of hordes of drunken Englishmen roaming the countryside. Barnett had undoubtably been influenced by his dealings with Furnafur, and although many Britons died in Poland without assets, the particular circumstances of the Furnafur case were not repeated in consular records.

b) The performance of the British in the Kingdom

In personal terms the performance of the British in Poland was varies widely. On the one hand entrepreneurs such as the Evans brothers achieved a large measure of prosperity and recognition. No figures are available for the total profits of the Evans ventures, but when the last of the brothers died in 1870, he left assets valued at £250,000, most of which must have derived from activities in Poland.[105] No other Briton was successful on such a scale. Alexander MacLoed, who worked as a mechanic during this period, went on to found a successful machine making business in 1858, and was able to purchase an estate after retiring eighteen years later.[106] William Preacher, who died in Poland in the 1850s, also achieved a degree of prosperity, leaving assets valued at 17,000 roubles (£3,000).[107]

Other Britons, even those who had tried their hand at business, were not so fortunate. John Douglas and Andrew Kedslie, who had been involved in joint entrepreneurial activity for over twenty years, both died without assets.[108] Joseph Morris, the one time partner of Thomas Evans, also died a poor man despite thirty years of work as iron founder,

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104. PRO FO392/7, Report on the State of Poland, ff. 20-21. To be fair to the Poles, another copy of the Report (contained in FO65/237) included the comment 'It is the same in Austria' added in the margin by an anonymous reader at the Foreign Office.

105. Principal Registry, Family Division, Will of Alfred Smith Evans.

106. *PSB*, XVIII, pp. 615-616.

107. PRO FO392/2, no 78.

108. Radziszewski, *Bank Polski*, p. 387.

ironmaster and machine constructor.[109] Lesser mechanics recruited by the government also failed to achieve much security. Andrew Brownbill, once of Solec, died at Żarki leaving several minor debts.[110]

In wider terms, the recruitment of foreigners has often been derided or ignored by Polish researchers. On the one hand, the presentation of Polish economic development as a logical series of capitalist processes resulting from the interaction of social groups necessitated the playing down of individual contributions. On the other hand, individual failures have been used to criticise the introduction of foreigners per se. Even before 1830 Paweł Kaczyński, one of the prospective lecturers at the Polytechnic criticized the excessive reliance on foreigners in Polish industry and higher education.[111] In agriculture, complaints about foreign advisors and the methods they became part of popular myth, while Garbiński downplayed the importance of Scottish tenants in the Zamoyski *Ordynacja*.[112]

In 1904, Grabski was eagre to quote Garbiński in a work highly critical of the pro-British sympathies of the Zamoyskis.[113] After the Second World War, researchers hostile to capitalism and to the West sought to play down the significance of imported expertise, particularly Bartyś, who played down the importance of British artisans at Zwierzyniec, and Jezierski, who described Łubieński as a man fascinated by Western Europe, who thus recruited a bunch of charlatans unable to find employment anywhere else in Europe, instead of employing Polish engineers.[114]

In the light of such criticisms by both contemporaries and later researchers, the question of competence should be examined in more detail. It is worth asking to what extent did the British personnel in Poland represent the best available? On the wider European scale this problem was mentioned by Henderson, who pointed out the fact that many less able Britons were also active on the continent. One particularly damning condemnation came from the Swiss engineer Johann Fischer, who was adamant in not employing Britons, claiming they

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109. PRO FO392/2, no 53.

110. PRO FO392/1, no 39.

111. A. Zieliński, *Początek Wieku: Przemiany kultury narodowej w latach 1807-1831* (Łódź, 1973), p. 142.

112. [Garbiński], 'Czyli życie', pp. 55-56.

113. Grabski, *Historia*, I, p. 204.

114. Jezierski, 'Niwka', p. 123.

rarely fulfilled expectations placed in them, while Friedrich Harkort was equally scathing about British workmen in Germany.[115] Bruland's study of Britons active in Norway lists cases of 'technical' and 'social' problems, the former meaning straightforward incompetence and the latter invariably meaning drunkenness.[116]

As far as technical problems are concerned, Britons active in Poland offer several examples of incompetence. These include entrepreneurial failure as well as inadequate technical skills. The most glaring example of entrepreneurial failure involved John and Whitemore Perks, a father and son both previously connected with the Berlin Gas Company prior to their arrival in Poland, who took out a lease on the Solec factory in 1834 solely on the strength of a letter of introduction from John Cockerill. It soon became apparent that the Perks were no entrepreneurs and soon the factory lost orders. The lease was not terminated until 1839, by which time the factory had lost 4.7 million zlotys.[117]

A similar failure on a smaller scale was the agricultural machine factory of John Douglas and Andrew Kedslie, founded in Lublin in 1834. Douglas was a millwright by profession, having worked as such since 1820 for Prince Czartoryski, for whom he also managed a paper mill.[118] In 1834 he approached the Bank, together with Andrew Kedslie, a former partner in the paper mill, with plans for such a factory, requesting credits and a guaranteed supply of raw materials from the Bank's ironworks. Despite initial optimism, the new factory experienced problems similar to those at Solec under the Perks. The partners were simply inadequate as entrepreneurs, and as a result the factory never fulfilled its potential and was closed in 1844.[119]

Most of this entrepreneurial failure can be explained by the fact that many Britons were prepared to move between different sectors of the economy in order to make a living. This does not seem to have been unsuccessful in many cases. Andrew Douglas, having been

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115. W.O. Henderson, *Britain and Industrial Europe* (2nd ed., Leicester, 1965), pp. 8-9, 148 fn 40.

116. Bruland, *British Technology*, pp. 133-135.

117. PRO FO 392/7, Report on the State of Poland, f. 18 v.; Radziszewski, *Bank Polski*, pp. 350-352.

118. PRO FO392/1, no. 19.

119. Radziszewski, *Bank Polski*, pp. 382-387.

involved with his brother's paper mill at Celejów, went on manage a brewery in Lublin.[120] Alexander Kedslie, once manager of the steam mill at Solec, took a lease on one of the Zamoyski farms. His notebooks contain a wealth of technical information on a variety of topics relating to engineering and agriculture, suggesting a versatility that allowed such successful transitions.[121] Problems seem to have arisen when Britons attempted to move up the ladder, taking on responsibilities beyond their abilities. Such people as the Perks, Redgate, Douglas and Kedslie may have been talented mechanics, but were obviously unsuited to the task of running an enterprise.

On the question of Britons being unqualified for the technical jobs for which they were actually recruited, there are indeed some glaring examples of incompetence, although they are rare. This certainly cannot be said about any of the British personnel recruited by the government before 1830. The British engineers at Solec and Białogon earned considerable respect for their work. William Preacher appears to be one of the most competent engineers active in the entire Kingdom, and every undertaking he was involved with proceeded smoothly. The only major problem encountered at Białogon were the intractable delays experienced when carrying out a military order for St. Petersburg in 1833. This episode was more likely to have been caused by antipathy towards the Russian occupiers than by any incompetence on the part of the workforce or management.[122] John Pace was killed in the spring of 1831 while making a last minute check of machinery, hours before a ministerial visit was due to take place. He was later treated as a symbol of the reliable, highly competent English engineer, a plaque being unveiled to his memory by Polish engineers in 1898.[123] No other individual involved in the industrialisation of Poland ever received such a compliment.

Similarly, very few complaints were ever generated by any Britons working as independent machine constructors. In 1838 two such mechanics recorded as Jus, father and son, (obviously John Hughes and his son) proved unable to construct a satisfactory steam engine for the agricultural reformer Karol Brzozowski.[124] This, however, proves very little. On

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120. PRO FO392/1, no. 57.

121. PRO FO392/1, no 84; Private collection of Mona McLoed, Notebooks of Alexander Kedslie.

122. Pazdur, *Zakłady metalowe*, pp. 109.

123. Lipoński, *Polska i Brytania*, pp. 130-131.

124. L. Pietrusiński, 'Krasnybór czyli Sztabin', *Przegląd Europejski*, I (Warsaw, 1862), pp. 483-484.

the other hand it cannot be denied that there were Britons who did not match up to the standards set by Preacher and Pace. The main problem group were the metallurgy specialists brought over by the Bank in the 1830s. Llewellyn, the co-constructor of the blast furnace at Niwka, must be deemed partly responsible for its faulty design. His subsequent conduct, including apparent attempts to persuade workers to commit acts of sabotage following his dismissal, suggests that he was not only incompetent but also thoroughly disreputable. Similarly the appointment of Samuel Redgate at Steinkeller's Żarki factory was a complete disaster. Redgate appears to have been thoroughly incompetent as a factory manager, and must take responsibility for the doubtful quality of much of the plant's output.[125] As the whereabouts of these two prior to employment in Poland have not yet been traced, it is difficult to arrive at any conclusion regarding the Bank's recruitment policies. As for Downe and Watson, other British engineers sacked at Niwka, the sources do not give reasons for their dismissal. On the other hand, even Jezierski was forced to admit that the refining furnace at Niwka, under the supervision of Griffiths, did work perfectly according to plan, the only section of the complex which did so.[126]

As for social problems, a lack of evidence makes it difficult to make any general statements. The Scottish agricultural settlers drew great praise for their sober and thrifty habits, earning considerable respect from all Polish observers.[127] However, this was rather to be expected of such a group. Industrial workers were a different proposition. It is known that problems were encountered with other foreign workers from other countries, notably the Saxon miners recruited to work the coal mines at Niwka. Several attracted complaints for being 'given to idleness' and for 'agitating among their countrymen', while other Saxon recruits distinguished themselves by running away shortly after receiving initial payments.[128] No such large groups were introduced from Britain, so most of the evidence for problems involving Britons relates to individuals. The only known case of trouble involving a group of Britons occurred in 1837, when the Warsaw police demanded the interrogation of five Britons under suspicion of raping a woman in the city.[129] The

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125. R. Kołodziejczyk, 'Zakłady budowy maszyn w Żarkach', *Roczniki Dziejów Społecznych i Gospodarczych*, 21 (Poznań, 1959), pp. 99-129.

126. Jezierski, 'Niwka', p. 182.

127. Bartyś, 'Działalność gospodarcza', pp. 50-51.

128. S. Kowalska, 'Zagadnienie siły roboczej w górnictwie i hutnictwie rządowym Królestwa Polskiego w latach 1831-1861', in *Ekonomika górnictwa i hutnictwa w Królestwie Polskim 1831-1864* (Warsaw, 1958), p. 69; Boss, *Sprawa robotnicza*, p. 134.

129. PRO FO 392/1, no 82.

absence of any further reference to this incident in the consular records suggests that the matter did not go any further. Only one violent incident involving Britons led to trial and conviction during this period. In 1844, Andrew Douglas, a machine constructor working at a 'Scots' farm at Biszcza, was sentenced to four years hard labour for assaulting William Fergusson.[130] The antics of Llewellyn and his brother at Niwka do suggest that they were among the least desirable of all the British recruits. Apart from these incidents, contacts between Britons and the forces of law in the Kingdom say more about the lawlessness of the police and army rather than major criminality on the part of the immigrants. There is also no independent confirmation of Barnett's complaints about redundant Britons becoming drunkards and 'losing their character as Englishmen' in the Kingdom. Apart from several farming families living in relative isolation only Alexander MacLoed seems to have assimilated totally, and he was hardly a failure. It would not be unreasonable to state that the Britons in Poland behaved no worse than Britons anywhere else in industrialising Europe, having certainly left no wild tales of the type quoted by Henderson and Bruland.

Few Britons went out to the Kingdom without prior arrangement with either Polish representatives or at least with Britons already active in Poland. Thus with the exception of Evans, Britons in Poland were primarily implementors rather than independent innovators. The majority were recruited to undertake specific tasks and completed them with varying degrees of success. Thomas Evans, and briefly Edward Thomas stand out as the only figures to initiate major developments. In the majority of cases, the Britons were fulfilled all the expectations placed in them, with a considerable bonus in the case of real experts like Preacher. Even where individuals failed to achieve success, as in the case of some of the Scottish farmers, the innovations they introduced were copied most profitably by Polish successors. The recruitment of many unsuitable Britons in the 1830s may say a lot about the Bank's recruitment policies, but it says very little about the general standards of British expertise. It is worth repeating the point that the Bank had to settle for many less suitable recruits because of the simple unattractiveness of the Kingdom in the 1830s, a point which contemporaries could not mention publicly and later researchers have failed to comprehend. Scores of consular despatches and statements by Britons in the Kingdom make it clear just how alien life under the Paskievich regime seemed to British expatriates. The fact that all the major failures involving Britons date from the worst years of repression would suggest that more competent Britons were staying away. The peculiar stories involving foreign personnel were certainly not repeated after the normalisation of life in the Kingdom after Crimea.

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130. PRO FO 392/1, nos 139, 146; FO 392/2, no 95.

Conclusions

In seeking to enjoy the benefits of British technologies, the Kingdom of Poland chose paths typical for the European followers. The standard tools of followership, based on the examples of neighbouring states, should not obscure the origin of the best practices which the Poles wished to assimilate. In the promotion of state initiatives, the encouragement of private enterprise and the establishment of institutions for the creation and dissemination of skills and knowledge, Polish efforts up to 1830 did not depart radically from either those of other European followers or the limited initiatives attempted during earlier periods of Polish statehood. However, several views advocated by Lubecki seemed more forward looking than those of many European contemporaries, bringing to mind measures enacted by Meiji Japan after 1868. The premature termination of the Lubecki initiatives was a huge blow which delayed Polish industrialization for several decades.

The most distinctive feature of the Polish initiatives was the relationship with Russia, a factor which had decisive influence on the course of Polish development. Russian attitudes towards Polish industrialization were not uniformly hostile, but fluctuated according to Russian political priorities. When St. Petersburg showed concern for development in Russia itself, as during the reign of Alexander I and particularly after Crimea, Polish producers were allowed access to Russian markets and some help in dealings with foreign institutions. Once Russian and Polish aspirations diverged, the consequences for the Polish economy were catastrophic. The desire to hasten industrial development by exporting to the Empire was a risky strategy which required Russian acquiescence, a strategy which left the Polish economy helpless once that acquiescence was withdrawn.

Chapter 3

British technologies and Polish industry

Within the general follower framework outlined in the previous chapter, transfer agents within the Kingdom sought to assimilate British industrial technologies within four major sectors of the economy. This chapter will include a survey of transfer initiatives and their impact within these sectors: machine construction, metallurgy, railway transport and textile production, in order to assess the performance of the technologies in the Polish context, the creation of indigenous capabilities within the Kingdom, and the rationality of the impetus behind the transfer attempts.

3.1 Machine Construction

The early history of mechanical engineering in the Kingdom is largely the story of a handful of firms, with small contributions from a host of lesser firms and individuals. As everywhere else outside Britain, in no other segment of the economy did technologies originating in Britain and direct skill transmission by British personnel play such a crucial role. In no other industry in the Kingdom did transfer initiatives produce such a complex combination of outcomes.

a) Initiatives and impact

The Kingdom's capital goods industry grew out of decidedly modest beginnings. An estate based workshop for the production of agricultural tools and machines had been founded by Stanisław Zamoyski as far back as 1805, but this was designed to serve the needs of the huge Zamoyski entail rather than act as a commercial establishment and was thus of limited importance for the first decades of its existence. Other early attempts to found estate based workshops were both shortlived and of no more than local significance.[1]

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1. For the Zwierzyniec workshop see: J. Bartyś, 'Materiały do dziejów przemysłu metalowego w dobrach Ordynacji Zamojskiej w I. połowie XIX wieku', in *Studia z Dziejów Górnictwa i Hutnictwa*, ed. J. Pazdur, II, (Wrocław, 1958), pp. 185-207; for other early ventures of this type see J. Bartyś, *Początki mechanizacji rolnictwa polskiego* (Warsaw, 1966), pp. 48-95.

The first important engineering enterprise was founded in 1822 by a Birmingham merchant Thomas Moore Evans (1794-1837). Present in Poland since 1815, Evans made a modest start by running a shop in Warsaw selling a wide range of British goods, from luxury items to agricultural implements and articles of everyday use. The success of this venture led him to consider producing such goods on the spot with the help of Joseph Morris, a British foundry worker resident in the city. In 1822 Evans took this idea to Staszic, who granted him free use of redundant church buildings in Warsaw's New Town.[2]

The initial success of this venture led Evans to seek larger premises within months. These were secured in 1823 with the granting of redundant monastery buildings by the government coupled with long term credits worth 40,000 zlotys to expand the business. This aid was conditional on the training of Polish apprentices, the first provision for workplace instruction in the Kingdom.[3]

Further success was immediate. Evans products won a gold medal at the second Warsaw industrial exhibition, and captured the imagination of all Poles committed to the industrialization of the Kingdom.[4] In 1824 Lelowski, government Commissioner for Factories and editor of technological quarterly *Izys Polska*, wrote an enthusiastic account of the new works, expressing particular satisfaction at the sight of the Polish apprentices, and listing the machines and tools which the factory could offer. Possessing its own furnaces for smelting iron and casting brass, a pattern shop and several dozen forges and lathes, the factory could supply several types of thresher and many other agricultural machines and implements, together with pumps, hydraulic presses and other equipment for breweries and distilleries, and a huge range of smaller iron goods.[5]

The venture proved immensely profitable. When founding the factory Thomas Evans had assumed an annual return of not less than 12% on the capital invested.[6] Evans' exploitation of his monopoly position, involving profit margins of up to 400% on certain items, incurred the wrath of Prince Lubecki, who wrote scathingly of 'English rapacity'. The

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2. Wojewódzkie Archiwum Państwowe, Warsaw (hereafter WAP Warsaw), Zbiór Przyborowskiego, VII, p. 236; *Wieniec*, ed. L. Pietrusiński (Warsaw, 1857), III, p. 414.

3. WAP Warsaw, Hipoteka Warszawska, possesja nr 1766, nr 2.

4. *Gazeta Polska* (Warsaw, Nov. 13, 1828).

5. *Izys Polska*, 1823/III (Warsaw, 1824), pp. 588-591.

6. 'Akt założenia spółki', ed. A. Wróblewski, *Rocznik Warszawski*, II (Warsaw, 1962), p. 337.

Prince had been deeply impressed by the demonstration effect of the new factory, and had cooperated with Evans at first: with the latter even producing a threshing machine designed by Lubecki. The Prince decided to use government funds to construct a larger version of the Evans factory to produce equipment for the state sector. This led to the second major initiative in machine construction, the factory at Solec in Warsaw, founded in 1826 with the aid of Scottish engineer William Preacher, poached from the Evans plant.[7]

The third significant plant arose from a combination of state and private initiative, where the initially modest plans of the Poles were transformed by the persuasive talents of Edward Thomas, one of the most successful technology transfer specialists active in Europe. One of the purposes behind the 1825 missions to Britain was the purchase of steam engines to reopen the flooded mines at Olkusz. Upon finding British manufacturers had full order books for the next two years, Wolicki was about to acquire engines from the Neath Abbey company originally bought by the Anglo-Mexican Mining Association, when he was approached by Edward Thomas, once of the Cockerill company at Liége and later partner of Harkort in Prussia. After visiting Neath Abbey with Wolicki, Thomas persuaded the Count that he would be able to construct better engines at a lower price than the Anglo-Mexican machines. Furthermore, he offered to construct the machines in Poland, supplying his own workers for the purpose. At first, more complicated parts would be imported from Britain, but Thomas expressed a hope that all the components could eventually be produced in the Kingdom.[8]

During 1826 Thomas and Girard toured Britain in search of equipment and blueprints for various additional machines, and by the end of the year the whole consignment was despatched to Poland, together with a party of a dozen artisans recruited by Thomas.[9] Thomas himself arrived in the Kingdom in 1827 and toured the mining areas in search of a suitable location for the proposed plant. He chose a site at Białogon, originally a copper smelting works founded by Staszic. The plant was reconstructed with the aid of William Preacher, transferred from Solec, and was equipped with large numbers of advanced

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7. *Korespondencya Lubeckiego z ministrami*, ed. S. Smolka, (Kraków, 1909), II, pp. 224-225; *Izys Polska*, 1823/III (Warsaw, 1824), p. 588; *Wieniec*, III, p. 415.

8. Archiwum Główne Akt Dawnych, Warsaw (hereafter AGAD), Komisja Rządowa Przychodu i Skarbu (hereafter KRPS), 1449, Wolicki to Lubecki, Nov. 10, 1825, Dec. 5, 1825; Copy of Agreement with Anglo-Mexican Association, Nov. 10, 1825; H. English, *A General Guide to the Companies formed for working Foreign Mines* (1825), pp. 4-7.

9. Public Record Office (hereafter PRO), BT1/228, J.P. Bell to Treasury, Oct. 13, 1826; *Korespondencya Lubeckiego*, II, pp. 479-480.

machine tools, including lathes from Sharp & Roberts and Fox of Derby, the foremost British producers of such equipment.[10]

The only other large units which produced machinery were built in connection with broader industrial initiatives. The largest of these was the Żarki factory, founded in 1833 by Piotr Steinkeller, which enjoyed a semi-official status, mirroring the functions of Białogon for the Bank Polski's investments in the Dąbrowa basin. This supplied steam engines and other equipment for the metallurgical complexes in the area. In 1844 the newly formed Warsaw & Vienna Railway opened workshops in Warsaw, though these appear to be have been little more than a large repair shop. In 1852 Andrzej Zamoyski's Vistula steamship initiative (Żegluga Parowa) opened a large plant to assemble and service vessels imported from France.[11] Apart from these, the majority of machine construction and engineering plants were either small scale workshops attached to estates or ironworks, and producing mainly agricultural equipment.[12]

Apart from Białogon, Żarki and the plants linked to transport initiatives, all engineering initiatives in the Kingdom had been originally planned as suppliers of agricultural machinery, a rational assumption in an unindustrialized economy. Nevertheless, by 1830 there is evidence that the leading firms were able to produce more sophisticated goods. By 1828 the Evans factory completed the first steam engine to be constructed in the Kingdom (though as yet without the cylinder), a 60 h.p. machine for the steam flour mill at Solec, another initiative connected with Thomas Evans.[13] During the same period the government factory in Solec was able to supply additional machine tools to Białogon in its first full year of operation, and soon afterwards constructed not only steam engines for state projects and some private firms, but also attempted to produce flax spinning machines

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10. PRO, BT1/231, Petition of James Fox, Jan. 30, 1827; *Opis geograficzno-historyczny* (Kielce, 1979), pp. 45-47.

11. R. Kołodziejczyk, 'Zakłady budowy maszyn w Żarkach', *Roczniki Dziejów Społecznych i Gospodarczych* (hereafter *RDSG*), 21 (Poznań, 1959), pp. 99-129; J. Łukasiewicz, *Przewrót techniczny w przemyśle Królestwa Polskiego 1852-1886* (Warsaw, 1963), pp. 77-78.

12. The fullest list of agricultural machine manufacturers in the Kingdom is contained in S. Grzymałowski and K. Chorzewski, *Produkcja maszyn i narzędzi rolniczych w Polsce w latach 1805-1918* (Wrocław, 1970), pp. 204-207; most of the firms included were insignificant.

13. *Wieniec*, III, p. 416; *Gazeta Polska*, Nov. 13, 1828.

according to the designs of Girard.[14] At Białogon initial plans suffered a setback when Edward Thomas failed to return from a trip to Britain to obtain further recruits and equipment for the plant. This delayed the construction of the steam engines for Olkusz, a project which was finally postponed at the outbreak of the 1830 uprising, but the plant was able to start up under the management of Preacher, who turned out to be one of the ablest foreign personnel employed in the Kingdom.[15]

After the evaporation of optimism following the military defeat of 1831, the performance of the Kingdom's machine producers became closely linked to the fortunes of end using industries. With Polish machine firms producing almost solely for the internal market, the depressed state of the Kingdom's industries severely limited the opportunities for further growth. The first of the traditional paths followed by engineering firms elsewhere, the production of textile machinery, was ruled out by the collapse of much of the Kingdom's textile industry. Evans and Solec supplied several producers with steam engines and auxillery equipment, and attempts to construct mules and other spinning machines met with varying degree of success, but there was little demand for specialist production. By the time the Kingdom saw a recovery of textile production led by the new cotton industry in the late 1840s, British specialist firms had already been unleashed onto world markets.[16] The stagnation of the Polish flax industry after 1831 made it impossible to capitalize on Girard's inventions in flax spinning and dressing. A British patent for the latter machine was granted to Thomas Evans in 1833 following some obscure but clearly dishonest transactions. In the event, it was Sharp & Roberts of Manchester who were to derive the main benefit from the production of Girard's innovations.[17]

The other significant stimulus to capital goods firms, the railway, was also absent from the Kingdom until the 1840s. The most significant order the Kingdom's machine makers received from the Warsaw & Vienna railway were nails and base plates supplied by

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14. N. Gąsiorowska, *Z dziejów przemysłu w Królestwie Polskim 1815-1918* (Warsaw, 1965), pp. 328, 365; *Opis geograficzno-historyczny*, p. 46.

15. *Opis geograficzno-historyczny*, pp. 46-47.

16. G. Missałowa, *Studia nad powstaniem łódzkiego okręgu przemysłowego* (Łódź, 1964), I, pp. 246-250.

17. British Library: Science Reference and Information Service: Patent Specification no 6361; W.O. Henderson, *Britain and Industrial Europe 1750-1870* (2nd ed. Leicester, 1965), p. 34; C. Ballot, 'Philippe de Girard et l'invention de la filature mécanique du lin', *Revue D'Histoire Économique et Sociale*, 7 (Paris, 1914-19), p. 187.

Białogon.[18] The only new technological demands which Polish industry placed on its machine makers before 1850 were the large steam engines supplied by Żarki for the ironworks of the Dąbrowa basin, and these were not completed satisfactorily.[19]

In the economic climate after 1831, machine manufacturers had little option but to limit themselves to agricultural machines and tools. Thus instead of becoming a leading sector dragging the Kingdom's economy out of backwardness, the Polish capital goods industry became tied to the fortunes of one of the most primitive agricultures in Europe. In such circumstances, few firms in the Kingdom displayed much technological dynamism. Most smaller concerns stagnated or remained competitive solely because of poor communications in the provinces. The larger firms survived by supplying the small but growing demand for agricultural machines from the Kingdom's more progressive landowners and by specializing in equipment for new agroindustries appearing from the 1840s onwards.

The Evans and Solec factories were particularly successful in supplying machinery for the new sugar refineries appearing in the Kingdom in this period. Of 28 refineries in the Warsaw region in 1852 for which the provenance of equipment is available, eleven possessed machinery from Evans, mainly hydraulic presses and steam engines, while another four had bought equipment from Solec.[20] Białogon equipped at least ten refineries before 1845, one of which was in Western Russia.[21]

By the middle of the 1850s, only a handful of producers retained anything more than local significance. The Białogon factory had withered after the imposition of strict bureaucratic control, and declined rapidly after the departure of Preacher and much of the Polish workforce in 1845. Within a few years it ceased the production of steam engines and concentrated on relatively simple agricultural machinery.[22] In complete contrast to the high reputation of Białogon under Preacher, the plant at Żarki was notorious for the uneven

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18. *Opis geograficzno-historyczny*, pp. 65-67.

19. J. Jedlicki, *Nieudana próba kapitalistycznej industrializacji* (Warsaw, 1964), pp. 86-87; Kołodziejczyk, 'Zakłady budowy maszyn', pp. 110-113.

20. Łukasiewicz, *Przewrót techniczny*, p. 80; J. Ł., 'Wiadomość o fabrykacji cukru w gubernii warszawskiej', *Roczniki Gospodarstwa Krajowego* (hereafter *RGK*), 21 (Warsaw, 1852), pp. 86-96, 271-281; 22 (Warsaw, 1853), pp. 106-125.

21. *Opis geograficzno-historyczny*, pp. 59-68.

22. *Opis geograficzno-historyczny*, pp. 69, 76; J. Pazdur, *Zakłady metalowe w Białogonie* (Wrocław, 1957), p. 167.

quality of its output under the erratic management of Samuel Redgate, probably the least competent of all the Britons active in the Kingdom. Redgate's dismissal in 1840 failed to save the plant, which lost most of its orders after the completion of the Dąbrowa investments, and languished as a small scale producer of agricultural equipment until final closure in 1851.[23]

The Solec plant had stagnated in the 1830s as a result of the disastrous lease granted to the Perks. Recovering after 1840 under the management of Wilhelm Rau, once of Seraing, Solec gained a high reputation at the end of the decade for its agricultural machines section managed by Stanisław Lilpop. With the outbreak of the Crimean conflict in 1854, the surviving Evans brothers sold a controlling share of their business to Lilpop and Rau. Thereafter Solec reverted to state control and passed into gradual decline, but the Evans & Lilpop partnership strengthened its position as the leading machine producer in the Kingdom. By the 1850s, new plants were being formed in Warsaw, notably those of Zakrzewski, Graff and Rolbiecki, while by this time most provincial producers had become more tool and implement makers rather than engineering firms.[24]

The poor quality of data on output for the Kingdom's engineering firms do not allow any meaningful use of statistics to highlight long term trends in production before the late 1850s. Official aggregates of machine production by value suggest large fluctuations according to the general state of the economy before Crimea, with steady growth after 1855. Estimates of value of output of the larger individual plants are notoriously unreliable, but it seems certain that the Evans and Solec plants generally accounted for over half the Kingdom's total, with a significant decline of production outside Warsaw.[25] Despite the unreliability of the data, the relative insignificance of the capital goods sector in the Kingdom's economy is apparent from comparisons included in table 3.7 (see conclusions at the end of the chapter), which show that the value of engineering output was consistently less than a tenth of that of the textile industry and had even been overtaken by new industries such as sugar refining.

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23. Kołodziejczyk, 'Zakłady budowy maszyn', pp. 116-117.

24. T. Łepkowski, *Przemysł warszawski u progu epoki kapitalistycznej* (Warsaw, 1960), pp. 89-90; Jedlicki, *Nieudana próba*, pp. 240-241; H. Radziszewski, *Bank Polski* (Warsaw, 1910), pp. 349-352.

25. Łukasiewicz, *Przewrót techniczny*, pp. 77-78, 148-151.

The general profile of the Kingdom's machine construction industries, with the resulting lack of expertise in such fields as railway or textile engineering, meant that when development in other sectors did finally gather pace from the mid-1850s onwards, Polish firms were unable at first to play a significant role in the reequipping of the Kingdom's industry. Thus for a considerable period after Crimea capital goods imports, particularly from Britain but increasingly from Belgium and Germany, far outweighed home production, as demonstrated by table 3.1.

Table 3.1 Polish machine production and imports by value (000 roubles)

Year	Home Production	Imports
1855	415	-
1860	624	-
1862	785	-
1864	-	527
1865	-	758
1866	-	1,313
1867	922	2,918
1875	3,520	4,619
1876	3,400	3,171

Source: Łukasiewicz, *Przewrót techniczny*, pp. 152, 255, 267.

Unlike other producers, Polish machine constructors enjoyed little tariff protection in this period. Only simple machines and tools were subject to import duties, while more complex machinery entered free of duty, a development which encouraged Polish firms to maintain their role as producers of relatively unsophisticated equipment.[26]

Even with new skills which had been mastered at an early stage, Polish producers were no longer able to keep up with subsequent developments elsewhere. It would appear that the first steam engine produced in the Kingdom, the 60 h.p. machine for the flour mill at Solec, was larger than any others made by the Evans factory before Crimea, and was surpassed in size by only a handful of machines constructed at Żarki in the 1830s. Thus while the

26. *Historia Kultury Materialnej Polski* (hereafter *HKMP*), V (Wrocław, 1978), p. 211.

Evans firm was successfully supplying smaller engines to various agroindustrial plants in the Kingdom, it had little chance of competing with British firms when more advanced models were required for the new Warsaw waterworks in 1853. The machines were eventually acquired from Ransom & Sims of Ipswich. The purchase of engines from the same firm by Evans & Lilpop later in the decade confirms how much the Kingdom's manufacturers had fallen behind in this particular field of production.[27]

b) British personnel and indigenous capabilities

As elsewhere in Europe and beyond, British personnel played a crucial role as channels of skill transmission in the Polish machine industry. There were no major and few provincial plants where British mechanics were not involved in a position of responsibility. The three major plants: Evans, Solec and Białogon, were all directed by British teams, while other ventures employed individuals as managers or instructors. From the Zwierzyniec workshop of 1805 until the late 1840s, almost no factory or workshop in the Kingdom was founded without British input.[28] The role of British engineers and mechanics is shown in table 3.2.

The crucial rule of British personnel should not obscure the small numbers of British mechanics involved. No more than about 50 Britons were active in the Kingdom's machine industry in any capacity up to 1863, of which less than half were involved in the three main plants. Given that the sector employed nearly 1200 workers in 1862,[29] it is clear that many skills had been transmitted successfully, even if allowances are made for an unknown number of mechanics from the German states.

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27. Reading University, Rural History Centre, Ransomes Collection; TR RAN MP1/1, Steam Engine Register.

28. The Zwierzyniec workshop in the Zamoyski entail was founded the aid of a dozen British artisans including a millwright and brass and iron founders; PRO, FO392/2, nos 15bis, 124; J. Bartyś, *Początki mechanizacji*, pp. 48, 50. Two small plants were founded by Scots mechanics in Lublin; the first by John Douglas and Andrew Kedslie in 1835, which folded in 1844 because of the poor entrepreneurial skills of the founders, and the second by the Baird brothers in 1840. After their deaths this was taken over by Alexander MacLoed, under whose direction it later became one of the most important provincial producers of agricultural machinery; Radziszewski, *Bank Polski*, pp. 382-387; *Polski Słownik Biograficzny* (hereafter *PSB*), XVIII, pp. 615-616; B. Mikulec, 'Przemysł metalowy na Lubelczyźnie w latach 1864-1914', *RDSG*, 49 (Poznań, 1991), p. 97 fn. MacLoed had learnt his craft at the small machine works at Bliźyn, while his father had been the manager of a similar plant founded by Jacek Lipski at Skąpe; PRO, FO392/1, no 131; FO392/2, no 178a.

29. Łukasiewicz, *Przewrót techniczny*, p. 151.

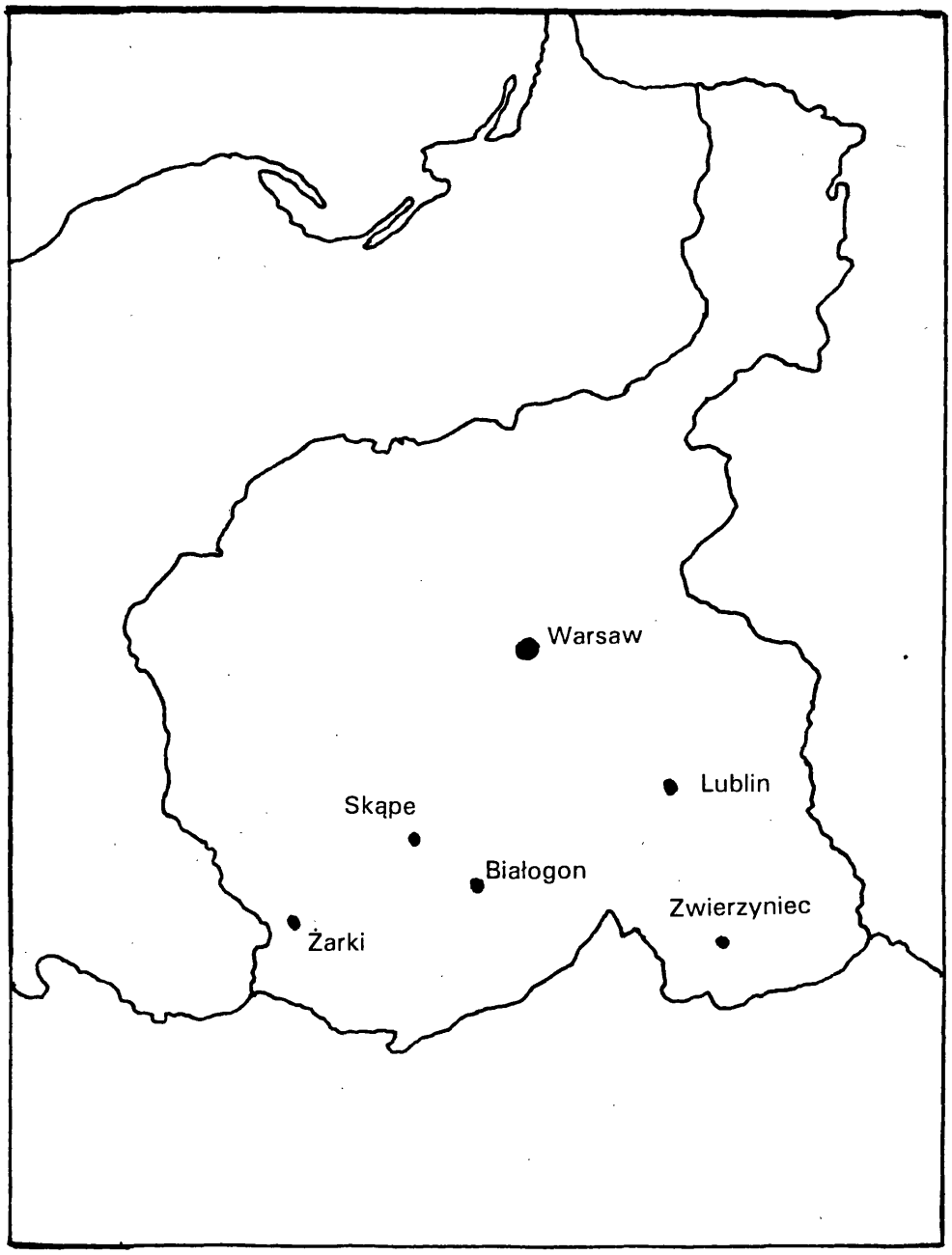
Table 3.2 British input into Polish engineering plants

Plant	Founded	British input
Zwierzyniec	1805	Manager, entire staff
Evans	1822	Owner, manager, some staff
Solec	1826	Manager, key staff
Białogon	1827	Manager, key staff
Żarki	1833	Manager, some staff
Lublin	1835	Owner/managers
Skąpe	1840	Manager
Lublin	1840	Owner/managers

Without reliable data on the composition of the labour force in the Kingdom's machine factories it is extremely difficult to make any precise statements regarding the timing of skill transmissions and the creation of indigenous capabilities in the field of machine construction. The production of steam engines by the Evans factory can hardly be cited as evidence of indigenous capabilities given the predominance of the foreign element at the time. For the earlier period, there is more evidence of the opposite case where skills had not yet been transferred successfully. The Evans plant was unable to undertake precision boring of cannon after the loss of key Prussian personnel in 1831, while Solec was temporarily unable to construct hydraulic presses after the loss of British specialist Buckle in 1832.[30] The smaller plant at Skąpe was unable to develop threshing machine production after initial attempts, which may have been connected with the death of its Scottish manager McLoed.[31] Nevertheless, the small numbers of Britons employed in the following decades suggest that most skills had by then been transmitted successfully. There is no evidence of British personnel being employed at the newer factories opened in Warsaw in the late 1850s, suggesting that basic British skills had become internalized by that time.

30. PRO, FO 65/196, A. Evans to Palmerston, May 20, 1831; Pazdur, *Zakłady metalowe*, p. 117.

31. PRO, FO392/1, no 131, Dec. 13, 1843; W. Caban, *Społeczeństwo Kielecczyzny* (Kielce, 1993), p. 115.



Map 3: Engineering factories and workshops

The use of the new machine tools had indeed changed the position of the British expert as the locus of technology but not as Jeremy had described. The difference is aptly illustrated by the contrast between the Zwierzyniec workshop in 1805 and the Białogon factory in the late 1830s. Whereas the former had been founded with an entirely foreign workforce, the superior equipment of the latter required a mere handful of Britons. Between 1840 and 1844 a total of 236 workers were employed at Białogon, but by the latter year William Preacher was the only British specialist remaining at the plant.[32] From the available sources it would seem that only 10 Britons were ever involved with Białogon in any capacity; of these few stayed for longer than three years.

The contribution of the British mechanics in the Kingdom was not limited solely to the creation of a workforce in the engineering sector. Even mechanics employed in economically insignificant provincial workshops contributed to the diffusion of operational and maintenance skills where none had existed before, a process which facilitated the gradual mechanization of Polish agriculture. Estate based workshops and even individual mechanics were occasionally able to gain a significance far in excess of their actual output if their work was well publicised. Machines and tools from the Zwierzyniec workshop and threshers built by lone mechanic George Blaikie received considerable publicity as a result of Andrzej Zamoyski's Michałów experiment and subsequent Klemensów displays, at which the demonstration effects of the equipment in action had considerable influence on the participants.[33]

Despite the lack of technological dynamism within the sector, it was obvious that a substantial reservoir of skills was being created within the Kingdom. By the 1850s, Polish factories routinely copied machines imported from the west. By the end of the decade it was commomplace for exhibitions of machinery held in the Kingdom to display 'Howard' rakes or 'Ransome' threshers constructed by Polish manufacturers including smaller provincial firms.[34]

A more important consequence of this ability was a growing sophistication of adaptations of British machinery. Early adaptations arose out of the backwardness of the Kingdom's

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32. Pazdur, *Zakłady metalowe*, pp. 210-214.

33. [A. Zamoyski] A.Z., 'Zdanie sprawy o gospodarstwie na folwarku Michałowie ', *RGK*, 2 (Warsaw, 1843), pp. 218-219; [Garbiński K.] K.G., 'Obchód.. na folwarku Michałowskim', *RGK*, 3 (Warsaw, 1843), p. 240.

34. *RGK*, 42 (Warsaw, 1861), pp. 60-63.

agriculture, amounting to nothing more than simplifications of foreign designs to facilitate handling by unskilled estate mechanics, while others experimented with the substitution of wooden for iron parts to reduce construction costs.[35] Many later adaptations still involved low technology solutions to continuing problems of the Polish countryside, such as the Lilpop heavyweight reaping machines from the 1850s, designed to work on badly prepared fields.[36] Nevertheless, other modifications undertaken at the same time displayed a more sophisticated understanding of the principles involved. By the late 1850s, not only was Lilpop able to improve upon foreign threshers with his introduction of the automatic rake, but the Warsaw mechanics were competent enough to turn his ideas into a workable reality. When in 1863 Lilpop was able to sell the patent rights to his improved reaper to Ransome and Sims it was obvious that some innovative capability had been achieved.[37]

Nevertheless, this undoubtable achievement overlooks the most neglected aspect of technology transfer, that of marketability. It was the British firm, not Evans & Lilpop, which was able to realise the potential of reaper innovation. By the end of the 1870s, no Polish firms were producing reapers in the face of British and American competition.[38] Marketability was always a problem for the Kingdom's firms for a variety of reasons. Higher raw material costs, particularly for iron, reduced competitiveness. In 1858 British pig and cast iron could be bought in Warsaw for the same price as the local product, despite import and transit duties, ensuring that Polish machine makers paid almost three times as much for iron as their British counterparts.[39] Without tariff protection Polish producers remained disadvantaged even in their own market, which had never offered any opportunities for economies of scale.

Competetiveness in potential export markets was reduced by the unfavourable geographical location of the country. Prussian (later German) and Austrian policies discouraged imports from the Kingdom, and imposed large duties on goods in transit to third destinations; whereas the Russian market, even when no longer closed by tariff barriers or informal discrimination, was still largely inaccessible until the establishment of significant railway

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35. T. Łubieński, 'Opisanie młockarni w Reyowcu', *Izys Polska*, 1822/I (Warsaw, 1822), pp. 129-145; O. Flatt, 'O młockarniach', *Piast*, 5 (Warsaw, 1829), pp. 1-20.

36. Bartyś, *Początki mechanizacji*, p. 218

37. British Library: Science Reference and Information Service: Patent Specification no 21 (1863); Bartyś, *Początki mechanizacji*, pp. 215-216.

38. Bartyś, *Początki mechanizacji*, p. 218.

39. PRO, FO394/4, no 172.

connections, which were not forthcoming until the 1860s. Finally, technology itself played a large part: the acquisition of skills in Poland was insufficient to create capabilities of producing distinctive lines of high quality machinery which had brought so much success to small economies such as Belgium and Switzerland. Reaper improvements were hardly likely to produce the technological linkages which milling innovations contributed to the Hungarian engineering sector in later decades.[40]

c) General conclusions

Of all the segments of the Polish economy utilising technologies originating from Britain, engineering produced the most interesting combination of results. Despite initial enthusiasm and rapid skill transmission, the Kingdom's machine producers lost most of their dynamism during the 25 year depression following the defeat of the November uprising, being forced to specialize in relatively simple machinery for agriculture while all over Europe similar firms were making great strides thanks to the advent of the railways. Nevertheless, even in such adverse circumstances Polish constructors were able to improve upon certain British machines, demonstrating considerable ingenuity and indigenous capabilities, but were unable to take advantage of such breakthroughs. Specialization in producing equipment for agriculture and agroindustries was a rational entrepreneurial decision in the period before Crimea, but offered few possibilities of creating a significant capital goods industry.

The Kingdom's mechanical engineering sector could not advance without massive new investment and related transfers on the supply side and easier access to sizeable markets on the demand side, neither of which could be obtained within Poland itself. The only realistic combination of circumstances conducive to such developments was the securing of western investment and technology in order to supply a closed Russian market. The former would hardly be forthcoming without the latter, and the latter was not forthcoming until the end of the 1870s. In the meantime, Polish firms were powerless in the face of competition from British and increasingly German and Belgian capital goods producers.

Nevertheless, Polish producers were eventually able to take advantage of wider opportunities once these became available, by capturing valuable niches in Russian markets by securing further technology transfers to become and subsequently remain among the most technologically advanced plants in the empire. By the end of the 1860s Lilpop and

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40. J. Komlos, *The Hapsburg Monarchy as a Customs Union* (Princeton, 1983), pp. 132-143.

Rau abandoned agricultural machinery to enter the field of heavy engineering, specialising in the construction of bridges, rolling stock and other railway related equipment, eventually becoming one of the empire's leading specialist producers, while a host of smaller firms sprang up throughout the Kingdom. Polish producers were finally able to achieve substantial success, fulfilling much of the pre-1830 optimism. This took place in entirely different circumstances to those envisaged by Evans and Lubecki, after the original impetus and much of the initial success were rendered irrelevant by several decades of virtual stagnation. Nevertheless, the superiority of the Polish labour force compared to the Russian, in which Kahan saw a residual body of skills resulting from the longer industrial traditions within the Kingdom, must be regarded as a long term legacy of the utilization of British skills earlier in the century, even if the early initiatives failed to fulfil initial hopes.[41]

3.2 Metallurgy

a) Initiatives and impact

Although mining and metallurgy claimed a major share of government attention before 1830, their initial development owed little to the newest technologies. Despite the employment of so many technocrats from the German states highlighted in the previous chapter, Polish state activities in these sectors displayed little of the technological dynamism so characteristic of the Bergamt in Silesia. It may even be possible to suggest that the presence of so many geologists in the government bureaucracy was counter productive. In mining, more energy was expended on speculative searches for new minerals than on large scale application of new extractive technologies, particularly during the administration of the Staszic, himself a geologist. The high priority given to the location and exploitation of ores of non-ferrous metals (lead, copper, silver) resulted in many expensive projects with distinctly meagre results.[42] To a large extent Lubecki inherited these attitudes: his major initiative in this field, the draining of the Olkusz mines with steam engines manufactured at Białogon, was an updating of earlier plans to exploit non-ferrous ores at the site.[43] In contrast, despite growing demand from zinc smelting and users in Warsaw, coal extraction in the Kingdom remained primitive, involving open-cast mining at a small number of sites.

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41. A. Kahan, *Russian Economic History: The Nineteenth Century* (Chicago, 1992), p. 90.

42. Gąsiorowska, *Z dziejów przemysłu*, part II, chap. II, passim.

43. Ibid., pp. 307-313.

Apart from a handful of older machines inherited from Bergamt investments before 1806, no steam engines were installed in Polish coal mines until 1825, a year after the same technology had been introduced to a small copper mine near Kielce.[44]

Government promotion of metallurgy before 1830 was also notable for a reliance on traditional methods, though this was largely justified by the Kingdom's resource endowment. Whereas coal deposits were limited to the Dąbrowa region in the extreme south west of the country, the bulk of the Kingdom's iron ores were located in the Staropolskie Basin over 200 km to the east. The proximity of substantial timber reserves and easy access to water power made the choice of charcoal-based smelting by far the more rational before the advent of the railways. The first plan drawn up by the technocrat Lempe recognised that state investments would have to adapt to the realities of the market and the available resources. Thus investment before 1830 concentated on the Staropolskie region, and was primarily concerned with the location and exploitation of iron ore deposits, the production of pig iron and the improvement of power sources via the regulation of the Kamienna river. One branch of metallurgy which did develop in the Dąbrowa region was zinc smelting, which used ordinary coal rather than quality coke. This industry was created almost out of nothing by a combination of state and private initiative, and flourished until 1828, when overproduction in neighbouring Silesia caused a glut on world markets.[45]

Despite only modest applications of new technologies in mining and metallurgy, the pre-1830 administration fulfilled its aim of creating a basic capacity in these industries. Coal output increased from 4,100 metric tons in 1815 to 69,000 t at the height of the brief zinc boom in 1824, to settle at 42,000 t in 1830. Although hardly impressive by international standards, this was a considerable advance on the 1815 situation. Pig iron output increased to 16,200 t by 1830, a trebling of the 1810 figure of 5,300 t.[46]

The input of technologies originating in Britain had been minimal in the state mining and metallurgy sectors before 1831. Unlike engineering, where British personnel were central to state initiatives in this period, the Kingdom's early development in metallurgy owed nothing to British expertise. All this was to change after 1833 with the passing of the state sector to Bank Polski control. The Bank instigated a huge investment programme involving

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44. *HKMP*, V, p. 98; Gąsiorowska, *Z dziejów przemysłu*, p. 227.

45. Jedlicki, *Nieudana próba*, pp. 57-58; Gąsiorowska, *Z dziejów przemysłu*, part II, chaps 2-4.

46. *HKMP*, V, pp. 203, 206.

the application of British technologies at all three stages of the iron production cycle: smelting, refining and processing. The introduction of each of these involved the utilisation of British personnel with widely varying results, both in terms of economic rationality and the creation of indigenous capabilities.

The Bank Polski programme was based on a new plan drawn up by Lempe, which was considerably more ambitious than its predecessor. This plan assumed not only the reconstruction of plants already built and the modification of those still under construction, but also the creation of new capacity not envisaged in the original plan. Whereas most of the first two categories involved projects in the Staropolskie basin, the second Lempe plan earmarked the Dąbrowa region as the main centre of the Polish iron industry. In contrast to the small and scattered ironworks of the pre-1830 administration, the Bank plans involved the construction of ten new plants, of which the largest were two large integrated complexes comprising blast furnaces, puddling works and rolling mills, the Huta Bankowa at Dąbrowa and Henryków at Niwka (see map 4 overleaf). These two alone comprised a total of eight blast furnaces with a combined annual capacity of almost 12,000 tons, while the whole investment prgoramme envisaged an eventual total annual capacity of about 50,000 tons (including the private sector), an increase of over 200% on 1830 pig iron output.[47]

The construction of coke-based ironworks assumed the availablity of sufficient supplies of good quality coking coal and iron ores in the Dąbrowa basin. The idea had already been discussed in the 1820s. By 1824 it was known that coal from one nearby mine at Strzyżowice produced good quality coke, though in insufficient amounts to support a blast furnace. The discovery of coking coal at another nearby pit at Niemcy led to the serious consideration of plans for an ironworks in the area.[48] Wolicki, who had managed a zinc works at Niemcy, claimed that local coke equalled that used at the Königshutte, and attempted to persuade Lubecki to introduce coke-based smelting, quoting Girard and Kitajewski, who were both confident that the Dąbrowa basin would yield coke in sufficient quantities.[49]

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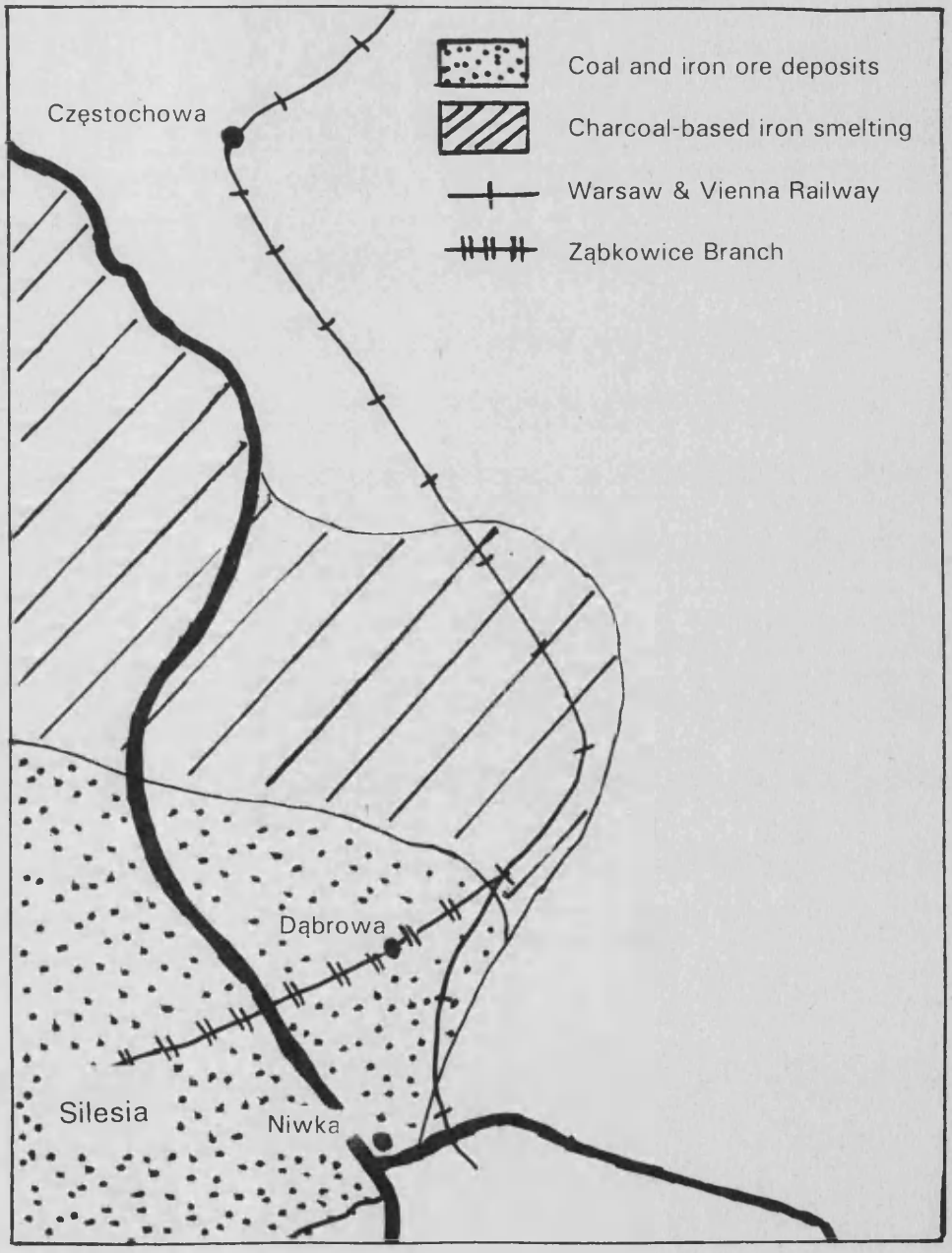
47. Jedlicki, *Nieudana próba*, pp. 59-60; Łukasiewicz, *Przewrót techniczny*, pp. 48-49, 53.

48. Gąsiorowska, *Z dziejów przemysłu*, p. 289.

49. AGAD, KRPS 1449, Wolicki to Lubecki, Sept. 2, 1825.



Map 4: The Dąbrowa Basin

Such confidence was obviously shared by the Polish decision makers who sanctioned the new investments in the Dąbrowa region. Sadly, their optimism was not born out in practice. As late as October 1838, when the British consul visited the Huta Bankowa site with Piotr Steinkeller, it was clear that the local coal was 'very inferior' and 'unfit for coking'.[50] The open knowledge of this fact at such an advanced stage of construction must call into question the entire competence of the planners. At the other large complex in Niwka, chemical tests undertaken in March 1839 by French expert Garnier concluded that the local coal was perfectly suitable for smelting, an opinion which was soon to be contradicted.[51]

Once the new plants were finally launched, several problems quickly became apparent. The Niwka blast furnaces turned out to have design faults which prevented their continuous use, while unreliable steam engines from Żarki installed at Huta Bankowa and a second plant at Blachownia also interrupted production.[52] Worse was to come. To the apparent surprise of the Bank Polski, pig iron at both Huta Bankowa and Niwka turned out to be unsuitable for further processing because of the poor quality of the local coke. The low quality of the pig iron could not be remedied at the refining stage, and as a result the puddling works and rolling mills at both complexes became practically redundant. At both plants the refining and processing mills were kept working for a period using charcoal-smelted pig iron brought in from distant plants, a ludicrous solution which highlighted the folly of the whole project.[53]

The situation came to a head in 1842 with the purging of the Bank Polski leadership. With the exception of one minor plant completed in 1846, all further investment was suspended until further notice. The imposition of strict bureaucratic control and a return to market realities led to the closure of much of the recently created capacity. Not only had coke-smelting proved unviable given the local resource endowment, but the investment programme had created a capacity far in excess of likely demand, a fact that was obvious

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50. PRO, FO65/246, no 18, Oct. 12, 1838.

51. A. Jezierski, 'Niwka. Monografia historyczno-ekonomiczna zakładów hutniczych w latach 1833-1864', in *Ekonomika górnictwa i hutnictwa w Królestwie Polskim 1831-1864* (Warsaw, 1958), p. 123.

52. Ibid., p. 123; Jedlicki, *Nieudana próba*, pp. 86-87.

53. PRO, FO392/2, no 75, Harris to HM Consul, Feb. 13, 1845; Jedlicki, *Nieudana próba*, p. 88; Jezierski, 'Niwka', pp. 124-125.

to British commercial circles in Warsaw as far back as 1837.[54] While the various strands of the Bank Polski programme were underway, the investments themselves absorbed a large part of the new capacity. The completion of the Bank investments left the market saturated. Total pig iron production peaked at 28,000 tons in 1840, of which less than a third came from government plant. The realisation that the expensive new plants could not compete with the smaller charcoal-based ironworks of the Staropolskie basin sealed the fate of the state sector.[55]

The demise of the new plants was rapid. The Niwka complex, which had never functioned properly, was shut down at the of 1842, never to be reopened. Huta Bankowa, which had finally commenced partial production in 1841-42, was shut down in 1843, not reopening until 1846. Other government ironworks closed at the same time. Pig iron output soon dropped: it was not until 1870 that output matched that of 1840. For two decades after 1842, the Kingdom's entire iron industry operated at no more than 40% of capacity, for the state coke-based plants the situation was even worse: while Niwka had been written off, Huta Bankowa never activated more than 2 of its 6 blast furnaces, and even by the mid 1850s its total output had not yet equalled its annual productive capacity.[56] Metallurgy in the Dąbrowa region remained moribund until 1876, when an influx of French capital in a transformed economic climate led to the complete rebuilding of the Huta Bankowa, of which only the name bore anything in common with previous investments.[57]

If the transfer of coke smelting had been a total disaster, at least the introduction of rolling mills showed more positive results. There is little data on the percentage of pig iron undergoing the puddling process, nor on the numbers of puddlers employed in the Kingdom's metallurgical industries, but the majority of pig iron from state plants was processed into bar and sheet iron by 1842, and by 1849 the combined total of rolled iron from both the state and private sectors overtook that of wrought iron. Much of the latter was still produced at obsolete bloomeries.[58]

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54. PRO, FO392/7, Report on the State of Poland, f. 18.

55. Jedlicki, *Nieudana próba*, pp. 95-96, 103; Łukasiewicz, *Przewrót techniczny*, p. 54.

56. Łukasiewicz, *Przewrót techniczny*, pp. 48-49, 53; *HKMP*, V, p. 206.

57. Jedlicki, *Nieudana próba*, 306-308; J.P.McKay, *Pioneers for Profit* (Chicago, 1970), chap. 11.

58. Łukasiewicz, *Przewrót techniczny*, p. 63.

The Poles paid a huge price for the Lempe/Bank Polski metallurgy project, for which Jedlicki has estimated costs at 30-40 million zlotys, close to £1 million.[59] In return the Polish economy received useless plant and surplus capacity which was never utilised. There were few benefits for end users. In 1842 Garbiński complained that the much trumpeted advances made by metallurgy had made little difference for purchasers of agricultural machinery: not only were the products more expensive, but the iron tended to be more brittle than ever before.[60] The low quality of the local product ruled out linkages with the Warsaw & Vienna railway, which would have constituted for only large market for the new capacity. At Huta Bankowa Harris complained about the impossibility of making rails with the available pig iron. Consequently, the Kingdom's metallurgy contributed almost nothing to the railway, which acquired 12,000 tons of rails from Guest of Dowlais, the leading British exporter of this product.[61]

b) Indigenous capabilities

Prior to 1831, the creation of basic indigenous capabilities followed two paths already outlined in the previous chapter: practical experience gained at the workplace together with a strong scientific education provided by the Kielce mining school. The Bank Polski investment programme was the first to follow the more general pattern of recruiting key personnel from abroad, primarily from Britain. Because of the peculiar outcome of the Bank initiatives, this personnel has attracted fierce criticism from researchers. Jezierski described the foreign element as charlatans unemployable anywhere else in Europe. In the case of the constructors of the Niwka blast furnace, Llewellyn and Garnier, this would seem to be justified, given the bizarre behaviour of the former and the additional responsibility of the latter for the dubious chemical analysis of Niwka coal.[62] In the case of other personnel, such an accusation has less foundation. Several had been employed at major sites in Britain and Europe, most notably William Harris, once of Varteg Hill ironworks, and later head of the rolling mills at Seraing, and Thomas Hart, recruited for various zinc smelting projects,

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59. Jedlicki, *Nieudana próba*, p. 64.

60. K.G. [K.Garbiński], 'Reklamacje pana Wolickiego', *RGK*, II (Warsaw, 1843), pp. 178-179.

61. PRO, FO392/2, no 75, Harris to HM Consul, Feb. 13, 1845; FO65/294, no 27, Dec. 24, 1843; L. Ince, *The South Wales Iron Industry 1750-1885* (Birmingham, 1993), p. 50.

62. Following his dismissal over the fiasco with the Niwka blast furnaces it appears that Llewellyn attempted to gain revenge by persuading workers to commit acts of sabotage at the plant; Jezierski, 'Niwka', pp. 123-124.

who had previously worked at the Königshutte.[63] Most of the Britons in the Dąbrowa basin were involved with refining and processing rather than smelting, and performed reasonably well in near impossible conditions. Griffiths, manager of the refining furnaces at Niwka, was responsible for the only part of the complex which functioned perfectly according to plan, while Harris, responsible for puddling and rolling at both complexes, was powerless given the nature of the pig iron he was forced to work with.[64]

From the point of view of skill transmission, the employment of so many specialists on long term contracts without any implicit obligations to train local managers must be regarded as a mistake on the part of the Bank Polski. The agreements between the Bank Polski and William Harris obliged the latter to suggest improvements but stipulated no training, and seemed to constitute life contracts. This contrasts sharply with the standard two year period Harris spent at Seraing.[65] The lack of provision for the gradual replacement of foreign experts by locally trained personnel was contrary to the best practices of technological acquisition. It is impossible to disagree with Jezierski's claim that some foreign appointments were unneccessary given the fact that the Kingdom already possessed qualified personnel, a claim particularly justified in the case of blast furnace construction, where Poles such as Lipski and Klimkiewicz had already gained widespread experience.[66]

Only at the puddling stage were the correct decisions made to employ foreign personnel solely as instructors. Welsh puddlers were employed at a special training establishment set up at Koniecpol in December 1833.[67] Even here, training was delayed as a result of the unwise decision to employ corvee peasants from nearby state owned villages as the main labour force in metallurgy, a mistake that had never been rectified since 1815. Because of the unpopular nature of puddling, several apprentices simply ran away, including a group of five trainees who escaped together. Despite such difficulties, a native cadre of puddlers was eventually trained at Koniecpol, with the Bank expressing particular satisfaction at the

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63. PRO, FO392/1, nos. 66a, 93.

64. PRO, FO392/2, no 75, Harris to HM Consul, Feb. 13, 1845; Jezierski, 'Niwka', p. 182.

65. PRO, FO394/1, Contracts between William Harris and the Bank Polski, Sept. 5, 1834, Feb. 19, 1836.

66. Jezierski, 'Niwka', pp. 123-124.

67. These included Thomas Thomas, employed from the beginning, and David Evans from 1835; PRO, FO392/1, no 69.

work of Thomas Thomas.[68] However, the new mills under construction required more trained puddlers than the Koniecpol establishment could supply, and in 1837 another party of British instructors was sent directly to Niwka.[69]

Criticisms of foreign personnel obscure the ineptitude of the Bank Polski's recruitment policies, given so many unneccessary and often disastrous appointments, together with an absence of any mechanism to create indigenous capabilities apart from puddling. Even in the last case there seemed to be little incentive for those undergoing the training. Any possible long term benefit to the Kingdom's metallurgy was further diminished by the exodus of most of the workforce from the Huta Bankowa to Silesia as soon as the Polish plants were run down.[70] It thus seems an ironic probability that many skills acquired at the Bank Polski's expense benefitted the Silesian rather than the Polish iron industry.

Nevertheless, all debate on foreign personnel or skill transmission is largely irrelevant in the light of the blatantly obvious fact that most of the Bank Polski investments in metallurgy should not have been undertaken. The whole episode suggests either monumental ineptitude or widespread corruption. Although some evidence for the latter among certain minor officials and contractors is available for Niwka, it is impossible to ascertain to what extent the entire investment programme was driven by corruption. If the investments were planned as a development project designed to give impetus to the Kingdom's economy after the dislocations of the military defeat, they can be regarded as nothing other than an ill-considered misallocation of resources, one of the most spectacularly disastrous transfer initiatives of the nineteenth century. If corruption was the main impetus for the project, then the final judgement from an economic perspective can be no less harsh.

Developments in metallurgy should not be obscured by rigid perceptions of technological progress. Despite the undeniable long term superiority of coke smelting over charcoal, the survival of charcoal-based plants is not an adequate indicator of backwardness, a mistake repeated by even the best Polish analysis, where the Kingdom's iron industry is placed in a crude league table based solely on the use of coke.[71] Broad technological choices in

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68. A. Wóycicki, *Dzieje robotników przemysłowych w Polsce* (Warsaw, 1929), p. 165.

69. S. Kowalska, 'Zagadnienie siły roboczej w górnictwie i hutnictwie rządowym Królestwa Polskiego w latach 1831-1861', in *Ekonomika górnictwa i hutnictwa w Królestwie Polskim 1831-1864* (Warsaw, 1958), pp. 67-68.

70. PRO, FO392/2, no 57, Harris to HM Consul, Aug. 23, 1844.

71. Łukasiewicz, *Przewrót techniczny*, pp. 54-56.

Polish metallurgy before 1831 were completely rational in the light of international experience. Because of the nature of the separate technologies in metallurgy, their diffusion outside of Britain was largely determined by resource endowment at the smelting stage, and the availability of British personnel in the case of refining. The spread of coke smelting was understandably hesitant where the right type of coking coal was expensive or unavailable, particularly in areas where charcoal was still plentiful. It is thus hardly surprising that Belgium, with a resource endowment similar to that of the British pioneer, was the first to derive substantial benefits from this technology, while charcoal-based smelting was able to survive until beyond the middle of the nineteenth century in France, the United States and Prussia, up to 1914 in the case of Sweden, and beyond in several other cases.[72]

The decisions made by the Bank Polski planners - in most cases the same technocrats who had served Lubecki, suggests that the impetus may well have been nothing more than a fascination with the newest technology, equating newest with best without seriously considering the appropriateness of the new process. Such supply driven transfers were hardly unique to the Poles in the nineteenth century, and have remained one of the most frequent contributors to the failure of contemporary transfer initiatives.

Nevertheless, it is difficult to suggest easy options for Polish metallurgy at any stage. The relative isolation of iron ore deposits, not to mention the separation of ore and coal reserves, ensured that local iron could never be competitive with British imports without prohibitive tariffs. In 1842 and 1858 British pig and cast iron could still be obtained in Warsaw at prices competitive with the Staropolskie output, despite transport costs and substantial additional duties.[73] The lack of any distinctive qualities ruled out the securing of niche markets as in the Swedish case. By the time Staropolskie iron could reach its markets via the railway network in the 1880s, production was already more profitable in the revitalised Huta Bankowa, leading to the gradual disappearance of all but a handful of large scale producers.

3.3 Railway transport

The history of railways in the Kingdom of Poland can be conveniently divided into three chronological periods, each of which saw different transfer agents with very different

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72. D.S. Landes, *The Unbound Prometheus* (Cambridge, 1991), pp. 175-179; A.G. Kenwood and A.L. Lougheed, *Technological Diffusion and Industrialisation Before 1914* (1982), p. 113.

73. PRO, FO65/294, no 27, Dec. 24, 1843; FO394/4, no 172.

motives. During the first period up to 1842, Polish individuals failed in their attempts to construct not only an internal line from Warsaw to the southern borders, but also other lines designed to ease the Kingdom's disadvantaged trading position with both the west and with Russia itself. In the second period from 1843 to 1857, the Warsaw & Vienna line was completed by the Russian military authorities, but was of little more than marginal significance to the Kingdom's economy. In the final period, after privatization in 1858, the Warsaw & Vienna and other lines built shortly afterwards finally became an economic asset to the Kingdom, offering stimulus and linkages to other sectors of the economy.

a) Early Polish projects

The invention of railway transport offered particular opportunities to a landlocked economy with few roads and navigable waterways. Costs of conventional land transport could be prohibitive, especially as the Kingdom's bulkiest raw materials were far from the capital. According to calculations made by the Mining Department in 1824, the cost of transporting Dąbrowa coal to Warsaw added 300% to the pithead price, but even this figure seemed optimistic.[74] Lubecki's emissaries reached Britain just in time to encounter the new technology in action. Wolicki wrote from London proposing a railway to carry coal for the steam engines to be installed at Olkusz, while Niepokójczycki sent back detailed reports after observing the Stockton to Darlington line and studying proposals for the Glasgow to Edinburgh link.[75] Nevertheless, there is no evidence that Lubecki himself considered constructing railways in Poland, preoccupied as he was with the construction of a road network and the Augustów Canal, neither of which seemed to have utilized British inputs despite claims to the contrary.[76]

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74. Jedlicki, *Nieudana próba*, pp. 29-30. In 1838 the British Consul observed that prices rose by 400% within 20 miles of Dąbrowa, while in 1842 superior Newcastle coal could be bought in Warsaw for the same price as the Dąbrowa product; PRO, FO65/246, no 18, Oct. 12, 1838; FO65/285, no 15, Apr. 17, 1842.

75. AGAD, KRPS 1449, Wolicki to Lubecki, Dec. 5, 1825; W. Lipoński, *Polska a Brytania 1801-1830* (Poznań, 1978), p. 114.

76. Samuel Smiles claimed that the Kingdom's most important road, the 120 mile tract from Warsaw to Brest, had been designed by Thomas Telford in 1829, but this is not confirmed by any Polish source; S. Smiles, *Lives of the Engineers* (1863), II, p. 476. Similarly, Lipoński has exaggerated the 'Britishness' of the Augustów Canal; Lipoński, *Polska i Brytania*, p. 124.

Plans for a Polish railroad did not materialise until the following decade, and were the result of an opaque mixture of initiatives typical for that period involving Bank Polski vice-president Henryk Łubieński and his brother and business partner Tomasz, later joined by the energetic Steinkeller. The first concrete proposals for a line linking Warsaw with the Dąbrowa Basin were conceived by the Łubieńskis in late 1834, after which events moved rapidly. The idea was presented to Viceroy Paskievich in January 1835, and two feasibility studies were drawn up by Bank Polski engineers by March of that year. These first plans were temporarily shelved in 1837 after early attempts to involve Berlin bankers came to nothing despite initial success, but were resurrected in the following year after Steinkeller undertook to float the project on the London stock market. Henceforth the line was promoted by a private company comprising Steinkeller and the Łubieński brothers.[77]

During 1836-37 Bank engineer Wysocki was sent abroad to inspect foreign railways, returning with models of rails. Although it is not possible to ascertain which lines Wysocki inspected, it is known that he unsuccessfully sought to consult Robert Stephenson when in London, but was able to discuss the project with Stephenson's associate George Parker Bidder.[78]

By 1838 detailed estimates of costs and benefits had been furnished. Calculations from June of that year assumed an annual freight of 162,000 tons, of which transports of Dąbrowa coal would consist of almost 40%, with significant quantities of grain, salt and iron. It was further assumed that the line would offer annual savings of at least 1.22 million zlotys over the current costs of land transport. In the same year Steinkeller, by now head of the company officially responsible for the project, estimated construction costs at 20 million zlotys, based on the experience of lines built in Austria.[79]

The Warsaw & Vienna project was floated in London in February 1839, after Steinkeller reached agreement with the bankers Harman & Co. The prospectus painted a rosy picture of the projected line. The estimate of annual freight had been increased to 200,000 tons, though capital requirements had also been readjusted upwards to 21 million zlotys, precisely half a million pounds. The prospectus assured that this sum would prove ample, stressing low construction costs because of the Kingdom's favourable geography, as a result of

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77. H. Hilchen, 'Historya budowy drogi żelaznej Warszawsko-Wiedeńskiej', *Ekonomista*, 11 (Warsaw, 1911), pp. 2-3, 9-12.

78. Radziszewski, *Bank Polski*, p. 457.

79. Hilchen, 'Historya budowy' pp. 6-7, 13.

which the 200 mile line would not require a single tunnel nor a single bridge more than ten yards long. Even the Kingdom's backwardness was cited as an asset: in the absence of competition from good roads or canals, the project could hardly fail to be profitable.[80]

Nevertheless, the most notable feature of the floatation was the government guarantee of an annual dividend of 4% on capital invested in the scheme, a measure endorsed by the Russians on Steinkeller's suggestion. Although the idea had been devised in France, this was the first occasion of such government backing for what was regarded as a private line.[81] This novel aspect of the project monopolized the attention of both contemporary observers and modern researchers. The editor of the Railway Times was full of praise for the Tsar's enlightened support for the project, contrasting the stance of the Russian government with the attitudes of British authorities responsible for so many 'impediments' to railway construction at home.[82] Recent historians continue to highlight the government guarantee as the key feature of the Warsaw & Vienna line, emphasising the 'farsightedness of the Polish merchants'.[83]

The consistency of approval voiced for the financial and institutional arrangements has diverted attention away from the technologicial aspects of the Polish project. As a transfer initiative, the Warsaw & Vienna railway appeared to be a fully rational introduction of new technology, with clear estimates of both costs and benefits. However, the prospectus masked a considerable degree of confusion among the Polish promotors of the railway, calling into question the entire Warsaw & Vienna project.

The prospectus was not so much over-optimistic as deliberately misleading. The Polish planners had not yet decided on the mode of traction by the time the prospectus had been issued. A horse-drawn line had been preferred by the Polish engineers on grounds of cost, and the final decision to adopt steam traction was not made until the end of 1840. The projected cost announced at floatation still assumed horse traction, but the decision to opt for steam raised the required sum from 21 to 38 million zlotys.[84] At no point did the

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80. PRO, FO392/2, no 65, Warsaw & Vienna Railway Prospectus.

81. Hilchen, 'Historya Budowy', p. 12; A.J. Rieber, *Merchants and Entrepreneurs in Imperial Russia* (Chapel Hill, 1982), p. 64.

82. *Railway Times*, Feb. 16, 1839, p.15.

83. Rieber, *Merchants*, p. 64.

84. Hilchen, 'Historya budowy', pp. 13-15, 27-28.

prospectus suggest the line was to rely on horse traction. On the contrary, references to duty free imports of engines and machines could hardly imply anything other than steam. In late 1838 it was strongly suspected in British commercial circles in Warsaw that the announced sum was clearly insufficient.[85]

In the event, the raising of even the initial sum encountered severe difficulties. Out of 5,000 £100 shares, a mere 71 were bought by individuals in the Kingdom, with even smaller individual purchases in European capitals. Although the Railway Times had declared the project 'worthy of the notice of English capitalists', few English capitalists showed much interest in the Polish line. With bank rates well above 4%, the venture was not regarded as attractive, although a large number of shares were bought by British ironmasters in exchange for rails. If the raising of the original sum had proved so difficult, the prospect of securing double that amount was clearly impossible. After the failure of desperate attempts to involve banks in Vienna and Berlin, the Warsaw & Vienna company was dissolved in 1842, at which point all was suspended until further notice.[86]

While the Warsaw & Vienna project still appeared to be viable, the indefatigable Steinkeller furnished two further proposals to improve the Kingdom's trading prospects with both western Europe and Russian and the Far East. The first of these was designed to stimulate Polish trade with Russia and the Far East. In April 1839 Steinkeller proposed a line from Warsaw to Nizhny Novgorod, for which he planned to raise the huge sum of 150 million zlotys (£3.75 million) in London.[87] Nizhny Novgorod, a town east of Moscow, was the site of the Empire's largest annual trade fair, being of particular significance to commercial links with the Far East. The proposal failed to gain Imperial favour, being dismissed as premature.[88]

In early 1840 Steinkeller came up with a second, more modest scheme for a line from Kovno (Kaunas) to the port of Libau, an updating of Lubecki's concept of avoiding the Prussian stranglehold on Polish trade by linking with the Baltic via Lithuania. Polish goods would still have had to reach Kovno via the Augustów Canal, but would been transported

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85. PRO, FO65/246, no 19, Oct. 15, 1838.

86. Hilchen, 'Historya budowy', pp. 32-38; *Railway Times*, Feb. 16, 1839, pp. 150-151; PRO, FO265/64, no 3, Feb. 24, 1840.

87. PRO, FO65/255, no 6, Apr. 22, 1839.

88. J. Kindelski, 'Monografia Piotra Steinkeller', in H. Radziszewski and J. Kindelski, *Piotr Steinkeller* (Warsaw, 1905), pp. 283-284.

to the Baltic more speedily. Despite the enthusiasm of Libau merchants, the project was killed off by the local provincial governor.[89]

b) The Warsaw & Vienna railway 1843-57

In late 1843 the Russian military establishment in Warsaw assumed responsibility for completing the construction of the Warsaw & Vienna line on orders from St. Petersburg. Work commenced in the following spring, but progress was extremely slow. The first short stage to Grodzisk Mazowiecki was not completed until June 1845, with another three years elapsing before the whole line became operational.[90]

Given the circumstances of the collapse of the original Polish initiatives, the completion of the line by the military authorities might have been an unexpected bonus. Nevertheless, during the decade between its completion and the post-Crimean privatization, the line made few significant contributions to the Polish economy. It provided few linkages with either metallurgy or engineering in the Kingdom. The rails were provided by Guest of Dowlais, while locomotives were obtained from Seraing, Sharp & Stewart of Manchester and Borsig of Berlin.[91] The course of the completed line avoided the Łódź textile region and the Staropolskie basin, and missed the Dąbrowa coal mining area by over 10 km. As table 3.3 shows, at no time before privatization did the amount of freight carried by the line even approach the estimates of 1838, let alone those of the prospectus.[92]

The difficulties of transporting coal were further compounded by the operation of a bizarre tariff policy which imposed a 57.5 kopeck per korzec freight charge on coal, which compared to the pithead price of 30 kopecks per korzec ensured that Dąbrowa coal sold in Warsaw for over three times the pithead price, thus offering little improvement on the government calculations back in 1824. This policy was not rescinded until November 1854

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89. PRO, FO65/264, no 3, Feb. 24, 1840; J. Kindelski, 'Monografia Piotra Steinkeller', pp. 279-282.

90. Łukasiewicz, *Przewrót techniczny*, p. 97.

91. PRO, FO65/294, no 27, Dec. 24, 1843; A.D. de Pater and F.M. Page, *Railway Locomotives of Russia* (Birmingham, 1987), I, pp. 28, 30.

92. Łukasiewicz, *Przewrót techniczny*, pp. 98, 167.

when coal freight charges were halved. It was only in the same year that the line's locomotives finally switched to Dąbrowa coal in place of the timber used since 1846.[93]

Table 3.3 Warsaw & Vienna Railway: Freight carried and coal linkages (000 tons)

Years	Total Freight	Coal Carried	Dąbrowa coal production
1846-48	28	-	-
1849-54	60	-	-
1855-57	98	-	78
1858	139	15	119
1859	150	33	157
1860	231	57	167
1861	278	66	164
1862	391	94	189
1863	361	103	188
1864	408	108	225

Source: Averages calculated from annual data in Łukasiewicz, *Przewrót techniczny*, pp. 98, 163, 165, 167.

A further problem was the parsimonious approach taken by the Russian authorities towards the line. To cut costs, only a single track was built at first, and various corners were cut during construction. Even worse was the gradual deterioration resulting from poor maintenance. By 1857, it was clear that a sum of 4 million roubles (£635,000) - more than the initial estimates for constructing the entire line - would have to be invested in order to bring the line up to standard.[94] Only the locomotives were kept up to reasonable standard under the supervision of a British engineer.[95]

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93. Ibid., p. 95.

94. J. Salomon, 'Die Warschau-Wiener Eisenbahn und ihre Verstaatlichung', *Archiv für Eisenbahnwesen*, 17 (Berlin, 1914), p. 1268.

95. Henry Ward, once manager of Steinkeller's Żarki factory, was superintendent of the Locomotive department from at least 1846 until the Crimean war. The line's engine drivers were also British; PRO, FO65/325, no 35, May 26, 1846; FO65/448, Du Plat to Hammond, July 7, 1854.

A final, and particularly damaging problem was the general attitude of the adminstration before 1857. Not only were the Russian military officers demonstrably unfit for the task of running such a venture, but the line was perceived as being a private facility of the Emperor and the military rather than a national economic asset. When required for the personal transportation of the Tsar or other dignitaries, the line would often be closed to normal traffic for days at a time. On such occasions, even the delivery of mail and newspapers would be disrupted.[96] Such inconveniences were particularly frequent during times of crisis. The increased diplomatic activities following the upheavals of 1848-49 resulted in a steady traffic between Warsaw and the Austrian border, or between the capital and the Tsar's palace near Łowicz. The Russian intervention in the suppression of the Hungarian uprising in 1849 was the most notable use of the Warsaw & Vienna line. In the summer of that year the railway was sending from 80 to 100 tons of supplies to the Russian forces in Austria each day, and unknown numbers of Russian troops were despatched from Warsaw by the same route.[97] With the railway being put to such purposes, it is hardly surprising that most observers in the capital were agreed that the transport of bulky goods by the Warsaw & Vienna line was invariably no quicker than by horse drawn wagons.[98]

In 1854 the British Consul described the line as 'one of the most imperfect...in Europe', and 'unfit for any enterprize'.[99] It was clear that something had to change. In the next year, the death of Tsar Nicholas during the Crimean conflict created the opportunity for change. In June 1855 the new Tsar declared the desirability of privatizing the line, one of the first statements demonstrating new Russian attitudes towards industrial activity.[100]

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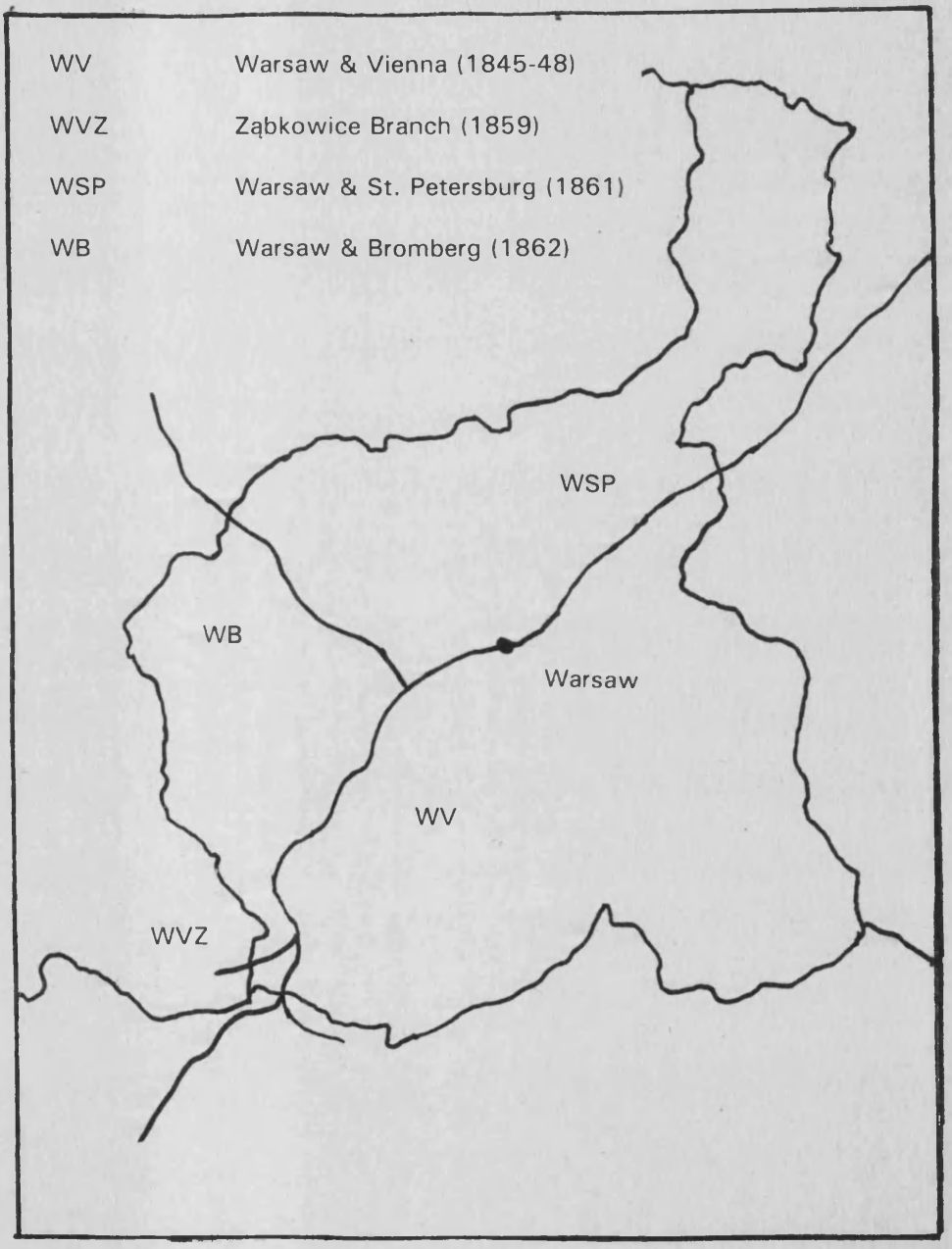
96. PRO, FO65/449, no 6, March 28, 1854.

97. PRO, FO65/369, no 25, May 8, 1849; no 26, May 10, 1849; no 27, May 13, 1849; no 56, June 4, 1849. As with most new technologies it was potential military applications which particularly interested the Russians. Blackwell has highlighted Russian experiments in troop transportation in the late 1840s, but ignores the fact that it was the use of the Warsaw-Vienna in 1849 which demonstrated the military significance of railways half a decade before the Crimean conflict; W.L. Blackwell, *The Beginnings of Russian Industrialization* (Princeton, 1968), pp. 314, 317-318. The lessons of 1849 were studied not only by the Russians; both the French and British governments were eager to acquire information on the use of the line; PRO, FO65/419, Foreign Office to Du Platt, March 16, 1852; no 25, June 13, 1852.

98. FO65/449, no 6, March 28, 1854.

99. PRO, FO65/449, no 6, March 28, 1854.

100. Jedlicki, *Nieudana próba*, p. 141.



Map 5: Railway construction up to 1863

c) The Warsaw & Vienna as a private company after 1857

Following the decision to privatize the line, protracted negotiations with rival groups of bidders finally led to an agreement with a group led by Warsaw banker Epstein, representing mainly Prussian capital, who took over in November 1857. The company undertook not only the management of the existing line but also the construction of two new links between the Warsaw & Vienna and Prussia.[101]

One of these was an independent undertaking dictated mainly by Prussian interests, a 131 km line to Thorn, known as the Warsaw & Bromberg (Bydgoszcz), which opened in December 1862. However, it was the 17 km branch to Ząbkowice in August 1859 which was to prove of far greater significance to the Kingdom's economy. This connected the Warsaw & Vienna to Silesia, passing through the Dąbrowa coal basin, finally allowing the cheap transportation of both Polish and Silesian coal to customers in Warsaw and elsewhere along the line. With this branch the Warsaw & Vienna finally became a significant freight carrier within half a decade, as demonstrated by table 3.3. Reciprocal linkages between the railway and the coal industry were immediately apparent. By 1863 coal alone accounted for a greater tonnage than the carriage of all freight in any single year before 1857, while the simultaneous trebling of the Kingdom's coal production between 1855 and 1864 is equally striking, the latter achieved despite growing imports of Silesian coal.[102] Nevertheless, the railway was stimulating a much broader section of the economy, as coal accounted for only a third of the quadrupling of freight carried between 1857 and 1864.

d) General conclusions

Given the course of railway development in the Kingdom before the privatization of the Warsaw & Vienna line, it is impossible to disagree with Pollard's assessment of the impact of railways on backward economies. The Polish line conformed perfectly to his description of several projects in the geographical periphery, offering few linkages to local engineering or metallurgy, connecting to royal palaces but few manufacturing centres or large towns, amounting to nothing more than 'poor relations of the European network', ..more like

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101. PRO, FO65/502, no 85, Oct. 14, 1857.

102. Imports of Silesian coal rose from 74 tons in 1856 to 27,000 tons in 1860 and 31,130 tons in the first nine months of 1862; Łukasiewicz, *Przewrót techniczny*, pp. 162-163.

foreign bodies than integral parts of the economies'.[103] The Warsaw & Vienna could do little by itself to stimulate the Kingdom's economy in the face of so many inhibiting factors, and must be regarded as a premature inititiative and a misallocation of resources in the context of Polish economic reality under the Paskievich regime. In terms of economic rationality, the original Polish project was no more justified than the simultaneous investments in metallurgy. Had the Warsaw & Vienna not been constructed, it is not unreasonable to suggest that foreign investment would have been forthcoming to construct an entire line along a similar route soon after 1856, given the ease with which capital became available in the new climate after Crimea.

In the case of both the Warsaw & Vienna line and the two other proposals originating in Warsaw, it has been customary for Polish researchers to blame the Russian authorities for the failure. However, given the ineptitude of the Poles over the choice of technologies and their inability to finance any of the projects, it is clear that Steinkeller and the Łubieńskis must share the blame for the fiasco surrounding the original Warsaw & Vienna project. It is curious that despite the almost universal condemnation of the same individuals for their roles in the metallurgy debacle, Steinkeller and Henryk Łubieński have received relatively benign treatment from post-war researchers for their involvement in railway enterprise.

Nevertheless, the Russians must be held responsible for the general climate in the Kingdom before Crimea which did more than anything to reduce the rationale of the Warsaw & Vienna railway and to discourage further construction. Given the Kingdom's central position between the Russian empire and the rest of Europe, it is clear that lines traversing Poland would prove profitable in normal economic circumstances. Furthermore, given the prospects of the Polish economy following the customs union of 1850, neither the railways nor the industries of the Kingdom could achieve their full potential until they were connected to a significant Russian network. The military advantages demonstrated by the Warsaw & Vienna in 1849 made the Russians determined to link up with the Polish line as a window into a wider European network, but the connection did not materialise until the completion of the Warsaw-St.Petersburg line in late 1861. Built from strategic rather than economic motives, it was plain to contemporary observers that this line had little commercial significance.[104] The first line of economic importance, that linking the Kingdom with Moscow, had to wait another decade, but even then the primary Russian

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103. S. Pollard, *Peaceful Conquest* (Oxford, 1992), pp. 207-209.

104. PRO, FO394/4, no 172.

motive was to connect with the frontier fortress of Brest, leaving the Poles to construct the connection from Warsaw.

Nevertheless, the change of policies after Crimea finally made the construction of Polish lines a much more attractive prospect. By the 1860s, Polish entrepreneurs led the financing of railways of considerable significance to the Kingdom's economy, including short sections linking Łódź with the Warsaw & Vienna, and the line eastwards to Brest. Compared to the huge problems encountered by Steinkeller and Łubieński only twenty years before, it is remarkable how rapidly capital was made available for such undertakings in the new climate.

3.4 Textiles

As a recipient of technologies originating in Britain, the Kingdom's textile industry was unique in many respects, owing little to direct state involvement and even less to British personnel. Apart from a handful of Polish landowner industrialists and a small number of relatively insignificant Britons, all the leading entrepreneurs were immigrants from several European countries, primarily Saxony (Ludwig Geyer, May, the Krusche family), the Netherlands (Schlösser, Schiebler) and Prussia.[105] As indicated in chapter 2, the Polish state offered generous assistance to producers, constructed demonstration plants and maintained helpful tariff policies, but the long term adoption and diffusion of new processes in the sector was more dependent on market prospects than on any state industrialization drives. After 1831, progress in the textile industries was undertaken entirely by the private sector, and therefore the course of events does not require the lengthy narratives so necessary for the understanding of developments in other sectors.

a) Wool

One of the first successes of Polish government policies after 1815 was the encouragement of a large, albeit traditional woollen cloth industry. Early growth was mainly based on the influx of large numbers of individual manufacturers and artisans from Prussia, Saxony and Bohemia, mainly in response to Polish recruitment policies, coupled with the loss of markets thanks to a combination of Russian protectionism and British competition. Initially, the

105. Missałowa, *Studia nad powstaniem*, I, pp. 76, 83.

majority of output was destined for local market, including the Kingdom's 30,000 strong army, but by the 1820s a large proportion went to Russia and the Far East, a trade which became increasingly important following Lubecki's successful tariff negotiations in St. Petersburg.[106]

Nevertheless, although this early period has attracted much attention from both Polish and German historians, this did not represent large scale technology transfer. It was not until John Cockerill sent his first machines to the Kingdom at the end of 1817 that a modern industry was founded. With British capital goods producers hampered by restrictions on machinery exports, the field was largely clear for Cockerill, from whose Liége factory machinery worth a total of 449,0000 francs was sold to Poland between 1821 and 1830, together with an unknown quantity from Cockerill's other plant at Berlin. At least seven leading cloth producers possessed equipment from these sources.[107]

Cockerill was also initially important for his entrepreneurial presence. In 1821 he had cooperated with the Polish government in the founding of the demonstration plant in Warsaw, and in 1824 became the co-founder of a cloth factory at Przedbórz in the south western part of the Kingdom. It has been suggested that the Przedbórz works were to serve as a demonstration plant similar to those which had been founded in Lusatia and Saxony. This would have been a logical move, but the Przedbórz venture does not appear to have achieved anything like the success of the Cottbus and Guben mills in this respect, although the Polish factory was one of the few assets which Cockerill retained until the end of his life.[108] A second demonstration plant built by the government acquired the only other example of British entrepreneurial involvement in Polish textiles, the carpet factory in Warsaw, sold to Geyzmer and Perks in 1826 and transferred to Tatar in 1851. This employed some British personnel, including a master weaver from Kidderminster. Although

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106. Wóycicki, *Dzieje robotników*, pp. 78-95; Missałowa, *Studia nad powstaniem*, I, pp. 352-357.

107. T.B. Hodges, 'The Iron King of Liege: John Cockerill', unpublished Ph.D. Thesis, University of Columbia (1960), pp. 369-371, 479-480; Missałowa, *Studia nad powstaniem*, I, p. 245.

108. Hodges, 'Iron King', pp. 364-368, 371; J. Śmiałowski, 'Przepływ kapitału ziemiańskiego', in *Aktywność gospodarcza ziemiaństwa w Polsce w XVIII-XX wieku* (Kielce, 1993), pp. 22, 41-43.

the plant was the leading venture of its type in the Kingdom, it was of marginal importance, despite extravagant claims from contemporary observers.[109]

Cloth production continued to expand throughout the 1820s. Most Polish cloth was of the coarse variety, and was dismissed as being of poor quality by a British contemporary observer, but was perfect for the unsophisticated demands of the eastern markets.[110] By the peak year of 1829, the woollen sector employed a total of 35,000 workers, with output valued at 5.75 million roubles. The heavy reliance on the Russian and Far Eastern cloth trade proved disastrous following the military defeat of 1831 and the subsequent imposition of punitive tariffs on Polish cloth. As a result, most woollen production ceased, with several manufacturers crossing the Russian border to found a new textile district at Białystok. Although wool production gradually increased from the 1850s onwards, thanks to increased demand at home, output by value never recovered to 1829 levels before 1863 (see table 3.4), while employment in the sector remained below 10,000 throughout the period.[111]

Technologically, the woollen sector remained backward, with domestic production still predominating. The first statistics on wool spinning date from 1842, when 82 firms utilized a total of 69,000 spindles. Spindlage dropped to 48,000 during the depression of 1849 before recovering to 62,000 in 1852. It is not clear what share of yarn output was provided by mechanized plants. Mechanized weaving took even longer to develop. In 1851 there were no more than 65 power looms in the Kingdom, accounting for 10% of overall output. Even in 1862 there were still no more than 100 power looms in use.[112]

b) Cotton

While the woollen industry remained almost stagnant, the period after the uprising saw the gradual growth of a cotton industry, which overtook wool in terms of value of output during the 1840s. At first, the preoccupation with industries processing domestic raw materials

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109. PRO, FO 394/5, no 1, Aug. 12, 1865; FO 394/6, no. 43, Aug. 8, 1857; J. Kołaczkowski, *Wiadomości tyczące się przemysłu i sztuki w dawnej Polsce* (Kraków, 1888), pp. 247-248; Łukasiewicz, *Przewrót techniczny*, p. 29.

110. W. Jacob, *Report on the Trade in Foreign Corn* (1826), pp. 88-89.

111. Łukasiewicz, *Przewrót techniczny*, p. 118, 389-390.

112. Ibid., pp. 27-34, 107.

diverted attention away from the possibilities of cotton production. Even Lubecki doubted the wisdom of founding a cotton industry in his early pronouncements, but local adminstrators in what was to become the Łódż region gave enthusiastic support to the new branch.[113]

The first spinning mill had been set up in 1826/27 with a total of 3,104 spindles in 1828, and three small mills were operational by 1830, but a combination of shortsightedness and bad luck had prevented the first significant initiative of this type, a proposal by none other than Edward Thomas, and William Jones, a cotton merchant from Manchester. These plans crystalised into oa project to construct a mill of 36,000 spindles, a number six times larger than that of all the other cotton mills in the Kingdom. However, the first proposal was turned down by the government on grounds of cost against the advice of Lubecki. A revitalised project involving a similar sized plant in a different location collapsed after Jones died of cholera in 1831.[114]

In the event, the first sizeable mill was that of Ludwig Geyer, constructed from 1839 onwards. In 1848 Ludwig Geyer acquired 30 self acting mules from Sharp & Roberts, the first self actors to be installed in the country, by which time his plant possessed a total of 25,000 spindles.[115] However, it was not until the early 1850s that cotton spinning grew to significant proportions. This took the form of import substitution, by which Prussian finished textiles and British yarn were increasingly pushed out of the Kingdom's markets. Whereas Polish spinning mills contributed only 17% of the country's yarn requirements in 1845, this share had grown to around 50% by 1853. Cotton spindlage increased from 15,000 in 1844 to 116,000 by 1862.[116] By the latter date the leading cotton producer was Wilhelm Scheibler, once of Seraing, whose new plant founded in 1855 immediately

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113. S. Smolka, *Polityka Lubeckiego* (Kraków, 1907), I, p. 191; for the activities of state and local authorities in Łódż see A. Rynkowska, *Działalność gospodarcza władz Królestwa Polskiego na terenie Łodzi przemysłowej w latach 1821-1831* (Łódź, 1951).

114. R. Kotewicz, 'Próby utworzenia w Tomaszowie', *Rocznik Łódzki*, 37 (Łódź, 1987), pp. 142-151; Wóycicki, *Dzieje robotników*, p. 95.

115. E.M. Sigsworth, 'Fosters of Queensbury and Geyer of Lodz, 1848-1861', *Yorkshire Bulletin of Economic and Social Research*, III (Leeds, 1951), p. 73; Missałowa, *Studia nad powstaniem*, I, p. 200.

116. Łukasiewicz, *Przewrót techniczny*, pp. 35, 36, 104.

outpaced the competion via investment in the latest equipment from the Platt Brothers of Oldham, the world's leading producer of textile machinery.[117]

As elsewhere in Europe, the diffusion of mechanised weaving of all fabrics was protracted. As late as 1862 no more than 100 power looms were employed in the Kingdom's cotton mills.[118] Despite the lack of a handicraft tradition in cotton weaving, mechanization of this process encountered labour opposition, most notably in 1861, when rioting workers at the Scheibler factory destroyed several power looms while leaving spinning machinery intact.[119]

c) Flax

Flax spinning was little known in Poland apart from the northern Augustów region, where it was conducted by the local peasantry. Curiously, flax attracted the attention of several landowner-entrepreneurs employing Britons in managerial roles, though few of these plants could claim anything more than local significance.[120] The only major initiative in this field was the Żyrardów linen factory, founded in 1829. Despite the presence of Girard himself as technical manager, this plant was never a success as a private enterprise, and became another casualty of government neglect after its takeover by the Bank Polski in 1848. By the 1850s the spinning works in particular were suffering from a lack of investment, as testified by the continued employment of obsolete machinery and a steam engine dating from the 1820s.[121]

As with so many Polish industries, the turning point for linen production came with reprivatization in 1857, when the works were sold to Austrian entrepreneurs Hille and

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117. W. Puś and S. Pytlas, *Dzieje Łódzkich zakładów Przemysłu Bawełnianego im. Obrońców Pokoju "Uniontex"* (Warsaw, 1979), pp. 37-38.

118. Łukasiewicz, *Przewrót techniczny*, pp. 107, 117.

119. Puś and Pytlas, *Dzieje Łódzkich zakładów*, p. 38.

120. These included the linen weaver James Garvie, employed by Prince Ogiński before 1830, David Robertson, head of the bleaching works at the flax mill owned by Karol Dąbrowicz at Wilkia in the far north, and William Downie, manager of a mechanised flax spinning plant at Wiąsowno on the Count Mostowski estate near Warsaw; PRO, FO 392/2, no 11, June 26, 1834; no 69, Feb. 8, 1847; FO65/196, Petition of William Downie, Apr. 12, 1831.

121. Łukasiewicz, *Przewrót techniczny*, pp. 18-19.

Dietrich. Frequent reequipping beginning in 1859-60 put the plant back in the technological forefront, soon turning Żyrardów into the foremost plant of its type in the Empire. The value of output increased from 90,000 roubles in 1852 to 450,000 in 1863, leaping to 3 million roubles by 1882 once Russian markets had been successfully invaded.[122]

d) Conclusions

As with most of Europe in this period, the transfer of technology into the Polish textile industry must be regarded as nothing more than a successful case of diffusion of operating capability among end users, where progress can be measured solely in terms of increased numbers of spindles, power looms or horse power, rather than the creation of independent technological capabilities. Nevertheless, of the four sectors attempting to assimilate British technologies analyzed in this chapter, it was the textile industry which seemed to represent the most promising utilization of advanced technology.

Although early progress had been stifled by the loss of the eastern markets, textile production, had achieved some success based on local demand, with the promise of future forays into Russian markets. Out of the four sectors analyzed, it was the only one where technology transfer was demand driven, and thus able to avoid costly premature initiatives such as railway construction or totally inappropriate choices as the Bank Polski's metallurgy programme. Unlike the engineering sector, where rapid progress in Britain and elsewhere made the attainment and maintenance of higher technological capabilities more difficult with each passing decade, the relative ease of achieving operating capability in an end user industry such as textiles meant that investment in such technologies made good economic sense for the Kingdom's producers.

As table 3.4 demonstrates, textile production achieved considerable progress in terms of value of output even before the post-Crimean watershed, as yet without the benefit of the eastern markets. The brief crisis of the cotton industry at the end of the period under review was caused by exogenous factors in the shape of the international cotton famine, but the trend was clearly upwards. Already by this time textile production was regularly accounting for a third of the total output by value of Polish industry. This was achieved by a relatively small number of mainly foreign though home-based producers, and involved insignificant capital investment compared with the Dąbrowa Basin programme or the

122. Ibid., pp. 122, 199.

Warsaw & Vienna railway, and required much less investment in human capital than transfer initiatives in engineering.

Table 3.4 Value of output of cotton and wool industries 1829-1864 (current prices, 000 000 silver roubles)

Year	Cotton	Wool
1829	-	5.75
1841	2.55	3.02
1845-52	2.33	2.12
1854-58	3.81	2.63
1860	8.09	4.35
1862-64	4.02	4.91

Source: Averages calculated from annual data in Łukasiewicz, *Przewrót techniczny*, pp. 152, 255, 267.

Nevertheless, although the outlook was favourable for the Kingdom's textile industry, it is important to remenber its limitations, both in terms of size (see table 3.6) and in quality and diversity of output. Despite its rapid growth, the Polish cotton industry was still puny by international standards, and was hardly likely to become a major force in international markets. At best, Polish producers could hope to reenter Russian markets, but this was conditional on both further investment in latest technology in the shape of modern equipment, and the completion of suitable railway links with the Empire. Polish producers had little to offer markets other than the Russian in the absence of high quality output as in the French case or distinctive products so characteristic of Swiss producers. Furthermore, the rise of cotton and flax and the recovery of wool production came far too late to offer stimulus to the Kingdom's engineering firms, which never made any significant contributions to the textile industry.

3.5 Conclusions

By the end of the period under review, Polish industry had made significant progress since the depression of the 1840s (table 3.5). The incomplete and unreliable data on output by value rules out precise statements about rates of growth, but the trend was clearly

encouraging. However, the new system of assessing industrial output, embracing not only mining and the state sector but also small and frequently primitive craft industries puts the performance of the industries seeking to utilize new technologies in proper perspective. Where craft industries could account for over a third of gross industrial output, it was clear that the newer industries such as textiles and engineering were still insignificant by international standards. The low level of industrial development is demonstrated by employment data for the end of the period. Total industrial employment in 1860 was estimated at 78,200, including 31,300 in food processing industries and 24,300 in textiles. In 1862 only 1,174 workers were employed in engineering. This pales into insignificance compared with the huge mass of landless peasants, who numbered at least a million in 1820 and 1.34 million in 1861.[123]

Table 3.5 Gross value of output of Polish industry 1847-1863 (000 000 roubles)

Year	Value of output
1847-1852 a)	11.00
1857-1861	27.84
1862	29.80
1862 b)	50.60
1863	43.95

a) data for 1847-49 and 1851 not including the state mining sector or distiliing.

b) from 1862 statistics of industrial output included craft industries such as distilling, tobacco, water and windmills, tallow and soap, together with coal mining and all state factories. Data for 1862 based on the old system is included for comparison.

Source: Averages calculated from annual data in Łukasiewicz, *Przewrót techniczny*, pp. 13, 171, 172.

The low level of industrial development can be further demonstrated by international comparisons (table 3.6). Far from catching up, it is clear that the Kingdom's economic backwardness had increased substantially by the end of the period under review, with per capita indices even poorer than that of Russia itself.

123. *HKMP*, V, pp. 94, 242; Łukasiewicz, *Przewrót techniczny*, p. 151.

Table 3.6 Some international indices 1860-61

Country	A	B	C	D	E
UK	15.1	31,000	2,450	130	2480
Germany	1.5	2,235	850	13	400
Belgium	2.9	612	160	69	1310
Austria	1.2	1,800	330	9	190
Russia	0.5	-	200	4	c50
Poland	0.28 a)	116	4.2	4	40

A: per capita raw cotton consumption 1860 (kg)
B: cotton spindlage 1861 (000s)
C: capacity of all steam engines 1860 (000 HP)
D: per capita pig iron production 1860 (kg)
E: per capita coal consumption 1860 (kg)

a) figures for Łódź region for 1858

Sources: For countries other than Poland, Pollard, *Peaceful Conquest*, table 3.2, p. 108; D. S. Landes, *Unbound Prometheus* (Cambridge, 1991), pp. 215, 221. For Poland, Missałowa, *Studia nad powstaniem*, I, p. 267; Łukasiewicz, *Przewrót techniczny*, pp. 129-130, 163, 169.

It is obvious that the utilization of British technologies had failed to make any significant impact on the Polish economy by 1863. Only cotton production showed rapid growth after the mid 1850s, but even there the capacity achieved was meagre in comparison with s smaller state such as Belgium. The only other industry to show rapid growth was sugar refining, based on technologies originating on the continent. As table 3.7 demonstrates, the value of sugar output soon outpaced the sluggish capital goods industry.

The rationality of Polish investments in British technologies between 1815 and 1863 cannot be reduced to a single formula because of the three very different sub-periods encompassed by these dates. During the years up to the 1830 uprising, several positive developments suggested that the Kingdom would be able to reduce its backwardness by assimilating advanced technologies in engineering and textile production. The intelligent promotion of technical training made it likely that such assimilation would prove easier in the future, while the growing confidence of the private sector was evidence that the Kingdom was likely to continue to enjoy steady growth.

Table 3.7 Value of output of selected Polish industries 1847-1862 (000 000 roubles)

Year	Cotton	Machinery	Sugar
1847	2.52	-	0.63
1849	2.65	-	0.89
1854	2.73	-	1.98
1855	3.35	0.41	-
1857	4.68	-	3.25
1860	8.09	0.62	6.15
1862	5.26	0.78	-

Source: Łukasiewicz, *Przewrót techniczny*, pp. 152, 255, 267.

The circumstances in which the Polish economy found itself between 1831 and the Crimean War cancelled all the grounds for optimism of the Lubecki years. A combination of exclusion from Russian markets and a destruction of confidence condemned the Kingdom to a period of economic stagnation, during which technologies originating in Britain proved to be of limited significance. Those industries which had taken a foothold before 1830 - textile production and engineering, endured 25 years of sluggish growth while making great strides elsewhere. Attempts to introduce new British technologies in such circumstances resulted in expensive supply driven projects with had little economic justification and had little hope of stimulating the economy. Transfers involving British technologies were hardly appropriate in such conditions, which had to wait for a changed climate before they could realize their full potential.

The change of Russian priorities after the Crimean disaster finally allowed the creation of conditions more conducive to economic growth. In the new climate both foreign and domestic capital were finally mobilized to sponsor new transfers of technology with increased railway construction and investment in textiles and engineering. By 1863 the Polish economy was already showing the benefits of the new circumstances. Nevertheless, the Kingdom's backwardness had increased considerably during a quarter of a century of depression. Where craft industries could account for over a third of gross industrial output, the Polish economy had clearly fallen far behind most of Europe. This ensured that the costs of catching up would be vastly higher than they had been before 1830. Unlike earlier periods, by 1863 it was increasingly difficult to speak of "British" technologies, as expertise and capital goods entered the Kingdom from a variety of sources.

Chapter 4

British technologies and Polish agriculture

The input of British agricultural technologies in the form of products and processes - i.e. new crops, breeds of livestock and methods - to the development of farming in the Kingdom of Poland has received more attention from Polish historians than the equivalent contribution of industrial technologies. There are some parallels between British influences on the two sectors. In both cases Poland was equally backward in comparison with Britain, and the recruitment of British farmers was as difficult as the recruitment of British engineers. In both sectors the course of development was heavily influenced by political and social factors, which severely restricted the progress which could be made. Furthermore, because the most significant British contribution in agriculture was in the field of mechanisation, the British machine makers in Poland played important roles in both agricultural and industrial development. There were also some significant differences. Unlike fields such as machine building, where British superiority over the rest of Europe was overwhelming, several European regions enjoyed high standards of agriculture, especially the Netherlands and parts of Germany. Some reformers in the Polish lands were indeed content to follow German models, including the highly respected Kurowski and Oczapowski, who both remained disciples of Albrecht Thaer all their lives. However, as has been pointed out, improvements introduced from Germany were invariably little more than earlier adaptations of British ideas; even Thaer, the foreign agriculturist most widely translated into Polish, usually wrote about British rather than German farming, and was ready to admit that he had gained all his knowledge from the British. The evidence suggests that while theoretically minded reformers such as Kurowski and Oczapowski (who both gave up farming themselves, the former to write, the latter to write and teach about the subject) wrote about Thaer and Germany, the more practical reformers such as Pac, Chłapowski and the Zamoyskis were far more likely to look directly to Britain for ideas.

This chapter will consider the course of transfer initiatives by Britophile agricultural reformers, beginning with two sections outlining the nature and content of individual initiatives culminating in the formation of the Agricultural Society. The final section will analyse the performance of Polish agriculture up to 1863, with an assessment of the transfer agents and their initiatives.

4.1 Early reform initiatives

a) Polish agriculture after 1815

Polish agriculture in 1815 was extremely primitive, with few crops cultivated, insignificant livestock husbandry, impoverished landowners and an inefficient and hostile labour force. If each of the obstacles hindering progress was formidable by itself, in combination they seemed insurmountable to most observers.

The feudal nature of Polish society caused many intractable problems, which would continue to hinder improvement well beyond 1863. In previous centuries Poland had followed a path of development typical for lands east of the Elbe, with peasants bound to the soil as serfs providing labour for their gentry masters. Serfdom had been abolished with the creation of the Duchy of Warsaw in 1807, though this move did not cause any significant improvement in the state of the peasantry. The latter still held their plots in exchange for labour undertaken on the landowner's estate. In many cases this compulsory labour took up the majority of the peasant's week. Furthermore, although the abolition of serfdom gave the peasant personal freedom, it also gave the landowners the right to evict the peasant from his plot. Considering the lack of alternative opportunities, this amounted to what one contemporary described as removing the chains from the peasants legs, but also removing their boots.[1] Without legal rights or security of tenure, peasants had little control of their lives, and thus remained apathetic towards the landowner's farms, being interested primarily with the acquisition of property rights to the plots they held. Such attitudes were to have serious consequences for the course of agricultural reforms later in the century.

The peasants comprised the labour force of Polish agriculture, with the corvee exacted in two forms, either as *piesza* (manual) or *sprzężajna* (draught) labour. Given the corvee system, much of the work undertaken was of little quality. According to the observations of Jacob, the corvee made for gross inefficiency, with the compulsory labour being undertaken 'in the most negligent and slovenly manner possible', and all the 'operations of husbandry' were 'very ill performed'. Ploughing was 'very shallow and irregular' with primitive wooden tools failing to prepare the soil properly, leaving the land 'filled with weeds of all descriptions'. More grain was wasted after harvesting owing to inefficient threshing

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1. S. Kieniewicz, *The Emancipation of the Polish Peasantry* (Chicago, 1969), p. 50.

methods.[2] Another British observer emphasised the crudity of the farm work, and stated that crops owed more 'to the excellence of the soil than to the farmer'.[3] The low quality and efficiency of peasant labour had other important consequences. The efficiency of such labour was so low, that a country with over a million landless peasants saw itself as suffering from severe seasonal labour shortages, which were to become more acute from the 1840s onwards. This had a considerable influence on the course of many developments in Polish agriculture, not least the diffusion of agricultural machinery.

Not only were the operations crude, but the implements were also extremely primitive. Modern implements and machines remained unknown in Poland until 1805, and made little headway for decades after that. Thus the new convertible husbandry, based on improved crop rotation embracing the alternating cultivation of grain and root crops remained an unknown concept in Poland, where the ancient three field system was still universal. This was an archaic system where a third of the land remained fallow, to be followed by wheat or rye, with barley or oats completing the cycle. The new crop rotations, of which the Norfolk system was the best known, offered a self-sustainable system of farming, with the fodder crops allowing for a large increase in livestock numbers, creating a larger amount of manure, removing the need for fallows. The regular manuring of the soil, combined with the cleansing role of the root crops, increased the range, quality and the quantity of produce. By contrast the three field method was a passive system, where one third of the land lay idle out of necessity, in order to recover from continuous grain production in the absence of sufficient amounts of manure. To a large extent the three field system was a vicious circle, and in many cases the fertility of land was dropping to such an extent that on poorer soils a four year cycle with two years of fallow was not unknown.

Foreign observers were dismayed by the backwardness of what they saw. The Prussian statistician Holsche, who spent the first seven years of the century writing a detailed description of Prussia's new Polish territories, was appalled to find no fodder or oil crops in areas he considered eminently suitable for their cultivation. He bemoaned the lack of manure, observing that many fallows received manure only every ten to fifteen years.[4] Jacob was certain that continuous grain production under the three field system would

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2. W. Jacob, *Report on the Trade in Foreign Corn, and on the Agriculture of the North of Europe* (1826), p. 66.

3. J.C. Loudon, *Encyclopaedia of Agriculture* (1825-1835), p. 102.

4. W. Grabski, *Historia Towarzystwa Rolniczego 1858-1861* (Warsaw, 1904), I, pp. 214-215.

prove ruinous to even the best soil, and observed that in every part of his journey through Poland the land appeared to be nearing 'a state of exhaustion from excessive cropping'.[5] Thus not only was the soil declining, with at least a third of all land empty at any one time, but the almost total lack of animal fodder crops such as turnips or clover placed severe restrictions on both quality and quantity of livestock, which not only hindered the development of meat and dairy production but also perpetuated the lack of manure, therefore ruling out the most obvious means of improving soil fertility.

There were other factors hindering the adoption of progressive measures. The landowning class contained few individuals who had any real understanding of the economics of the grain market, or indeed any form of cost accounting, given their reliance on unpaid labour. Consequently, most of the trade in agricultural commodities was in the hands of Jewish middlemen, further reducing the profitability of farming. The political upheavals of the previous two decades had compounded problems even further. A great number of estates had suffered severe damage during the numerous wars since 1792, and very few landholdings were not encumbered by serious debts, which often exceeded the value of the mortgaged properties. In a valuation drawn up by the government in 1824, it was estimated that the Kingdom's landed estates worth a total 818 million zlotys were mortgaged to the sum of 504 million, or 61% of their total value.[6] Table 4.1 shows the level of mortgages to the estate values, as a proportion of all estates in the Kingdom.

Table 4.1 Levels of debt of Polish estates in 1824

Debts relative to estate value	Percentage of estates
0%	7
25%	28
50%	20
75%	18
100%	11
>100%	16

Source: Radziszewski, *Bank Polski*, p. XX.

5. Jacob, *Report*, p. 99.

6. H. Radziszewski, *Bank Polski* (Warsaw, 1910), pp. XIX-XX.

Debt was thus a way of life for the vast majority of Polish landowners. Jacob was surprised to find the Poles ready to talk about their debts, discussing their interest payments 'with as much coolness as an English farmer would speak of his rent'. Most of the mortgages on such estates were held by Jewish traders. However, as Jews, the only group in society with large quantities of floating capital, were still prohibited from becoming landowners themselves, in the event of foreclosure land prices were extremely low.[7]

Despite its importance for the Polish system of farming, wheat occupied only a tiny part of the kingdom's arable land. Jacob estimated it to take up no more than one thirtieth of the total area, while more modern estimates suggest 2.3% for 1822, rising to 2.7% by 1827.[8] Despite the small area under wheat, the grain still played a crucial role in Polish agriculture - it was the only crop to receive manure, and the only crop for which any care would be taken over soil preparation. Any economy so dependent on the grain trade with Western Europe, was bound to suffer from any disruption to normal trade patterns. The Poles were therefore particularly hurt by the by the Continental System, but were even more outraged by the loss of normal access to British markets following the adoption of the Corn Laws. During the old Commonwealth, wheat had been Poland's main export commodity, with Britain being the main customer. Following a short post war boom which masked the real effect of the Corn Laws, the new reality was brought home in the early 1820s when wheat prices plummeted to absurd levels, throwing Polish agriculture into a deep crisis. Exports from Danzig, of which Polish wheat comprised the largest part, had peaked at 550,000 English quarters in 1802, while Danzig wheat prices had reached 115 shillings per quarter in 1817. Table 4.2 shows the extent of the collapse, with its subsequent effect on wheat prices within the Kingdom.

With such a litany of obstacles militating against progress, only exceptional individuals were willing to take up the cause of reform. Within a few years of the loss of independence many of the more responsible landowners came to realise that something had to change. In such circumstances, the struggle for agricultural reform came to be regarded more as a patriotic duty than just a campaign for better farming. Public spirited landowners saw the improvement of their estates as a real contribution to the resources of the nation rather than a purely commercial venture. When Prince Czartoryski decided to introduce Scots mechanics to found a paper mill on one of his estates, he declared that his aim was 'not to

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7. Jacob, *Report*, pp. 62, 81.

8. Jacob, *Report*, p. 67; I. Kostrowicka, *Produkcja roślinna w Polsce* (Warsaw, 1961), p. 63, table IX.

improve his income, but the bettering of the manufactures of his country'.[9] For army generals such as Chłapowski and Pac, exhausted by a decade of fighting ending in fresh defeat, the improvement of the devastated Polish countryside seemed the most responsible way of continuing the struggle. Chłapowski, perhaps the most effective of the reformers, began his textbook on farming with the declaration that he felt it was his duty to share his knowledge with fellow Poles, a subtle suggestion that more than economics was at stake.[10] Such early attitudes anticipated by decades the famous notion of 'organic work', serving Polish interests by strengthening the economy, which became a national slogan after the final military disaster of 1863. Nevertheless, noble aspirations did not always go hand in hand with the profit motive or even economic sense in many cases. Later initiatives, particularly those of Andrzej Zamoyski which culminated in the Agricultural Society of 1858, retained a nationalistic subtext but paid much closer attention to the economic side of technology transfer, particularly the need for profitability.

Table 4.2 The crisis of Polish wheat exports 1819-1825

Year	Wheat exports from Danzig (000s English quarters)	Warsaw wheat prices (zlotys per Polish korzec)
1814	61.1	
1815	15.5	
1816	134.5	28.3
1817	222.2	41.4
1818	282.9	34.3
1819	123.2	25.8
1820	315.0	19.6
1821	137.3	21.6
1822	27.0	21.7
1823	56.2	17.5
1824	55.6	12.0
1825	54.4	13.3

Sources: Jacob, *Report*, p. 210; S. Siegel, *Ceny w Warszawie w latach 1816-1914* (Poznań, 1949), p. 174.

9. Public Record Office (hereafter PRO), FO392/1, no 19.

10. D. Chłapowski, *O rolnictwie* (Poznań, 1835), pp. III-IV.

b) Early attempts at agricultural reforms

The first attempts to introduce genuine agricultural reforms took place in the final half century of Polish independence. Although highly influenced by the spirit of the Enlightenment, they owed more to fears for the long term security of the Commonwealth. Agrarian reforms were thus invariably part of grander schemes to revitalise the Commonwealth and enable it to fight off the threats to its independence posed by its aggressive neighbours. Early reformers invariably concentrated on institutional arrangements rather than technological advances. Most notable were calls for the abolition of serfdom, particularly the personal and state initiatives of Andrzej Zamoyski, who abolished the corvee on his own estates and also attempted to abolish serfdom in the Commonwealth via the drafting of a new legal code. Nevertheless, few of these initiatives achieved any tangible success.[11] As for actual technology itself, few initiatives were concerned with best practices from either Britain or elsewhere. The only links between the old Commonwealth and the British new farming were some high level contacts with the writer Arthur Young, which included unsuccessful hopes to recruit Young to help with the foundation of an agricultural society in Warsaw.[12]

The first direct introduction of British innovations to Polish agriculture came as part of the reforms introduced by successive generations of the Zamoyski family, owners of the massive Zamoyski entail (*Ordynacja*). The *Ordynacja*, founded in the XVI century by Chancellor Jan Zamoyski, was the largest in Poland, and the family was one of the most important aristocratic clans in the country. The entail included within its boundaries nine towns and 291 villages, and comprised over a hundred large farms with a total area of 373,000 ha, of which just under half was arable land.[13] Successive generations of the Zamoyskis were to promote the cause of agricultural reform - via the adoption of British practices and institutions - for over a century.

While Chancellor Andrzej Zamoyski (d. 1792) had been only partially successful in his attempts to reform his estates, and a complete failure in his struggle to change the legal status of the peasantry, his son Stanislaw took a more practical approach to agricultural

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11. Kieniewicz, *Emancipation*, pp. 13-15, 18-20; J. Broda, *Andrzej Zamojski a sprawa chłopska w drugiej połowie XVIII wieku* (Warsaw, 1951), pp. 37-41.

12. *Autobiography of Arthur Young*, ed. B. Edwards (1898), pp. 143-144, 159, 180-181.

13. J. Bartyś, *Nizinna hodowla owiec w II połowie XVIII i I połowie XIX wieku na przykładzie dóbr Ordynacji Zamoyskiej* (Wrocław, 1963), p.15.

progress, and became the first serious reformer to visit Britain. Taking advantage of the peace of 1803, he toured England and Scotland, visiting several of the aristocratic promoters of the new farming, Zamoyski was able to gain first hand knowledge of the progress the new technology was bringing. Impressed with the standard of agriculture in Scotland, particularly the use of new tools and machines there, he recruited a group of mechanics from Britain to found a workshop to produce such equipment for the *Ordynacja*. The pioneering venture at Zwierzyniec catered not only for Zamoyski's own needs and that of neighbouring landowners, but also served as a showcase for the new technologies thanks to the holding of regular meetings where the local farmers were treated to displays of the new equipment in action.[14]

c) The first agricultural societies

During the first decade of the nineteenth century, a series of hesitant initiatives finally culminated in the foundation of an agricultural society. This was formed in 1810 and brought together Zamoyski, Staszic and several other magnates and landowners interested in saving Polish agriculture.[15] This generated some useful ideas, such as the creation of a model farm and tool workshop at Łomna near Warsaw, and the funding of a trip to the famous Fellenberg farm at Hofwyl in Switzerland, after which a report was read at one of the society's meetings. However, little of lasting value was achieved by the society, partly because most of the founders were too occupied by official duties within the Duchy. Interest declined rapidly, and the course of the 1812 war with Russia soon led to the society's complete collapse.[16]

After the creation of the Congress Kingdom the society was resurrected in 1815, this time with Zamoyski and General Pac as chairman and vice-chairman respectively. Despite being headed by the Kingdom's most zealous advocates of British agriculture, this also achieved little of any significance. Once more a lack of interest from the wider circles of Polish landowners limited its activities. Zamoyski, although a talented reformer, lacked the ability to mobilise wider enthusiasm for the cause. Furthermore, differences of opinion emerged between those who advocated pure agricultural progress, and the more popular view which

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14. W. Lipoński, *Polska a Brytania 1801-1830* (Poznań, 1978), p. 134; J. Bartyś, *Początki mechanizacji rolnictwa polskiego* (Warsaw, 1966), p. 31.

15. Grabski, *Historia*, I, pp. 38-48.

16. Bartyś, *Poczatki mechanizacji*, p. 31; Grabski, *Historia*, I, pp. 47-58.

held that the industrialisation of the country should be given greater priority. By 1817 membership had dropped to forty, and the society was moribund was once more, and for the next two decades the cause was carried on by individuals.[17]

d) Government measures

Like the major landowners, the attention of the government before 1830 was concentrated on the stimulation of industrial growth. Few measures were taken to foster agricultural development. However, two notable moves were enacted, both owing much to Prussian developments. The first initiative was the creation of the Instytut Agronomiczny at Marymont near Warsaw, another initiative of the indefatigable Staszic. This was modelled on Thaer's Möglin establishment, and specialised in the training of stewards and administrators rather than sons of landowners. It was headed by Jerzy Flatt, who had earlier been sent to study farming in Switzerland and Germany, especially Hofwyl and Möglin. This was an extremely useful initiative, and 72 students graduated from Marymont before its closure in 1831. Flatt himself wrote several articles on agriculture, some based on experiments undertaken at the institute. However, despite Flatt's enthusiasm, organisational difficulties and a lack of teaching personnel depressed the quality of tuition.[18] The institute was to realise its full potential only after its reopening in 1835 under the directorship of Michał Oczapowski, and particularly in the late 1850s under the leadership of Zdzitowiecki, a close collaborator of Andrzej Zamoyski.

Lubecki's major contribution to agriculture was the creation of the Land Credit Society (Towarzystwo Kredytowe Ziemskie) in 1825. This provided long term credit to landowners in debt, allowing them to switch from high interest, short term credit from private lenders - usually Jewish traders - to 6% mortgages with the state.[19] This measure had the effect of saving large numbers of landowners from collapse.

e) Major individual initiatives before 1830

Given the general enthusiasm for industrial development prevalent throughout the Kingdom before 1830, it is not surprising that scores of minor ventures were founded by landowners while only a handful concentrated their efforts on agricultural progress *per se*.

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17. Grabski, *Historia*, I, pp. 58-67.

18. *Polski Słownik Biograficzny* (hereafter *PSB*), VII, pp. 36-37.

19. H. Radzisewski, *Bank Polski* (Warsaw, 1910), pp. 1-50; Jacob, *Report*, pp. 82-83.

Much of the theoretical knowledge regarding new methods and crops reached Poland via German translations. The German rational farming as promoted by Thaer had its own advocates, many of whom no longer looked to Britain for inspiration. Among such agriculturists were Michał Oczapowski and Nepomucen Kurowski, who both played an important role in publicising latest developments. After studying at Halle, Kurowski visited Belgium, France and the German states to study the current progress of agriculture in those countries. He was particularly fascinated by Möglin, where he stayed for a considerable period. In 1825 he abandoned farming to move to Warsaw, devoting himself to writing. He left 38 works, including translations, and was one of the most important representatives in the creation of a technical press. For eighteen years he published various weekly papers, usually writing the entire contents single handed. Often nicknamed the 'Polish Thaer', Kurowksi must rank as one of the most persistent advocates of agricultural progress.[20]

Oczapowski's role as publicist was even more successful than that of Kurowski. Before 1833 he occupied the chair of agriculture at Vilna University, still dominated by the Polish element in Lithuania at that time. Oczapowski travelled extensively throughout Europe to observe farming methods, visiting Britain in 1822, but far more influential was his visit to Möglin in 1819, when he stayed with Thaer for almost a year. He produced the first Polish translations of Thaer while at Vilna, from where they quickly penetrated all Polish speaking territories. Following the closure of Vilna university, Oczapowski moved to Warsaw, where in 1836 he took over the Marymont agricultural institute prior to its reopening. Under his direction Marymont became a much respected establishment. Oczapowski's most immediate legacy was first Polish agricultural encyclopaedia in ten volumes, a work that continued to be consulted widely for the rest of the century.[21]

By contrast, in line with the market driven, practical approach characterising the British new farming, it was the Britophile Poles who led the field in attempting actual improvements rather than simply publicising developments elsewhere. One of the most energetic enthusiasts of British agriculture was Alojzy Biernacki, the owner of the Sulisławice estate near Kalisz, and one of the leading members of both the abortive short lived societies. Biernacki had studied in Germany, and travelled extensively in France and Britain, and remained abreast of developments in the west, via membership of the Leipzig Agricultural Society. Although much of his time was taken up by political duties, he promoted the cause of new farming in a variety of ways. In 1817 he launched the *Gazeta Wiejska*, in

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20. *PSB*, XVI, pp. 259-260.

21. *PSB*, XXIII, pp. 522-525.

which he regularly stressed the desirability of adopting British practices, emphasising in particular the urgent need to introduce crop rotations. The paper folded after only two years, but Biernacki continued to publicise the results of various experiments with new methods, seeds and livestock breeds, wrote leaflets on English threshing machines and farm buildings, and translated several works by John Claudius Loudon. Furthermore, he founded a small school on his estates, offering pupils a mix of practical instruction in crop and vegetable cultivation and formal training in mathematics and science. He was one of the first landowners to import British machinery, and organised agricultural shows which included displays of such machinery in action, thus emulating in western Poland the activities of Zamoyski in the south east of the kingdom.[22]

The most strenuous efforts to introduce British best practices before 1830 were undertaken by retired senior army officers. The most notable initiative in the Kingdom was carried out by General Józef Pac at his estate at Dowspuda near Augustow, in the north eastern corner of the country. A wealthy aristocrat, Pac was a friend of Stanisław Zamoyski, whom he accompanied on the journey to Britain in 1803, to observe British agriculture.[23] Following a decade of distinguished military service, during which Pac reached the rank of general of the French and Polish armies, he returned to Britain in 1814, devoting a year to further study of British farming, particularly in the Scottish lowlands. He visited several Scots farmers, of whom only Muir, a tenant of Kirkcudbright is known by name.[24] He returned to Poland in 1815, and immediately set about modernising Dowspuda along Scottish lines.

The Pac estates at Dowspuda consisted of 4,000 acres of arable land and 3,000 acres of forestry, farmed on traditional lines until 1815. Labour shortages in this sparsely populated area, made it usual for most of the estate to lie fallow.[25] Labour scarcity suggested the introduction of settlers as the most direct means of improving the estate. Between 1815 and 1817 several families from Bavaria and the Rhineland were offered long leases on tiny plots (7.6 ha) with little success at first.[26]

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22. *PSB*, II, pp. 76-77.

23. *PSB*, XXIV, p. 718.

24. K. Lach Szyrma, *Anglia i Szkocya. Przypomnienia z podróży roku 1823-1824 odbytej* (Warsaw, 1828), I, p. 161.

25. J. Bartyś, 'Działalność gospodarcza i społeczna Generała Ludwika Paca', *Rocznik Białystocki*, 9 (Białystok, 1970), p. 54.

26. Ibid., p. 47.

The really successful settlers at Dowspuda were a large group of Scots farmers and artisans arriving from 1815 onwards. Most of these received larger plots varying between 48 and 81 hectares, with small plots going to artisans and estate officials. All plots were leased for 25 years, at rents in line with Polish averages. Roughly 50 families from Scotland settled on the Pac estates, forming a group consisting of an estimated 500 individuals.[27]

The settlers encountered language problems in the beginning, but the main difficulties arose from the general agricultural crisis which the Kingdom suffered after 1820. With falling prices for farm produce Pac was forced to reduce rents by a considerable margin. Despite these problems, the Scots were quick to acclimatise to the new conditions, founding several villages, and rapidly gaining a reputation for hard work, thrift, sobriety and integrity. They introduced many innovations hitherto unknown in the backward north east of the Kingdom. These included crop rotation, involving the widespread use of potatoes and turnips, and the introduction of breeds of livestock far superior to anything previously kept in Poland, particularly dairy cattle. The settlers enclosed their holdings with ditches and hedgerows, and reduced the acidity of the soil via composting, manuring and mulching, practices virtually unheard of in the kingdom. They also constructed proper roads. The Scots farmed without recourse to corvee labour, carrying out the majority of day to day tasks themselves, hiring extra peasant labour during the summer.

Pac did not limit himself to passive supervision of his new tenants. With the aid of the Scots he promoted the development of rural industries at Dowspuda, founding a brewery and distillery, a machine workshop, a cloth dyeing mill, a timber mill, oil and starch mills and a tannery. Among the early products of the workshop were two large static Meikle thresher machines, each of which could an estimated 6,000 man days of work per annum. This aroused particular fascination in the area, and earned second hand praise from a correspondent in one of the Warsaw technical journals.[28]

Pac was also an important figure in the national campaign for agricultural reforms, acting from 1816 as vice chairman of the Agricultural Society, where as deputy to Stanisław Zamoyski he contributed to the Society's programme of promoting British innovations. Generous with his wealth, he made several endowments to Warsaw University, including a collection of models of agricultural machines and implements acquired during one of his

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27. Ibid., pp. 48-51.

28. Ibid, pp. 58-60; *Izys Polska*, III (Warsaw, 1820), pp. 453-454.

trips to Britain.[29] He also gave considerable financial support to Karol Brzostowski, another agricultural reformer in the Augustów region, frequently saving the latter from bankruptcy in the early days of his experiment.[30]

The Pac initiatives were ruined by the 1830 uprising and its aftermath. Like the majority of higher ranking officers the general joined the insurrectionary forces, and was forced into exile following another distinguished but unsuccessful campaign. He later attempted to use his extensive international connections to aid the Polish cause, but died of a fever while on a mission in Smyrna in 1835.[31] The Russian occupiers employed a ruthless policy of confiscation of property of all participants of the war, and the Pac estates were unique in being handed over to a Russian army officer. The new owner, a general Sulima, showed little interest in the estate, handing over management to an unscrupulous administrator who had little sympathy for the new methods. Within a decade all of the general's innovations had been destroyed. The industries collapsed, and the corvee was reintroduced. A handful of the Scots remained, where thanks to their tenacity they still managed to survive the new regime, but the vast majority dispersed around the country, thus ending the most interesting experiment of its type in the Congress Kingdom.[32]

The activities of general Pac in the Kingdom were mirrored in the Prussian partition by General Dezydery Chłapowski (1788-1879). Although strictly beyond the scope of this study, Chłapowski's fame and influence was considerable throughout all three partitions and must receive a brief mention. The similarities with the early career of Pac were striking - an illustrious record during the Napoleonic wars, followed by a spell in Britain (1814-15) before returning to Poland to take up farming as an alternative patriotic duty.

After his return in 1815 he bought the estate of Turew from his father, and set about the task of teaching himself modern farming methods. The estate was typical of many in the Polish lands at that time: nominally worth 1.2 million zlotys, it was encumbered by debt of a million zlotys. Furthermore, the current system of farming at Turew was bringing in an annual profit of a mere 8,000 zlotys, hardly sufficient for living expenses let alone debt

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29. J. Bieliński, *Królewski Uniwersytet Warszawski 1816-1831* (Warsaw, 1909-1911), I, p. 411.

30. J. Bartyś, 'Geneza testamentu Karola Brzozowskiego', *Rocznik Białystocki*, 8 (Białystok, 1968), p. 118.

31. *PSB*, XXII, p. 720.

32. Bartyś, 'Działalność gospodarcza', pp. 62-64.

interest repayments.[33] He therefore embarked upon a cost cutting programme, and set about saving the estate. He imported books by John Sinclair, Arthur Young and Brown in English, together with the works of leading German agriculturists, Albrecht Thaer, Block and Koppe. After studying these, he decided the best way of furthering his experience was to seek practical instruction directly from the authors, and so in 1817 he set off to visit Thaer at Mögelin. Thaer readily admitted to Chłapowski that he had gained all his knowledge from the British and suggested he should go directly there. The general took this advice, and went to Britain in the summer of 1818.[34]

Visits to Sir John Sinclair and Coke at Holkham were followed by an extensive tour of the Lothian farms. During eighteen months in Britain, Chłapowski acquired considerable experience of best practices in Scottish Lowland farming, including methods of practical instruction employed there. After his return he reorganised the Turew estates accordingly, introducing crop rotations and methods learnt in the Lowlands, and founding several agroindustrial plants. Results came quickly: according to his biographer, the general had repaid most of his debts by 1830, by which time his estates had almost doubled in value. Some of the profits were used to enlarge the estates, which grew from an original 2,000 to over 8,000 hectares during his lifetime.[35]

Despite this personal success, Chłapowski's real importance lay in his efforts to publicise and teach what he had learnt in Scotland. In 1834 he published O rolnictwie, which became one of the most highly regarded farming textbooks in the Polish language. The work contained observations from over a decade of farming at Turew using British machines, tools and seeds, and offered practical guidance on how to adopt and adapt best practices from Scotland. Careful to avoid blind copying of British methods, he was nevertheless adamant that the Polish climate made the introduction of British style farming eminently suitable.[36] Apart from his textbook, Chłapowski also became a regular

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33. W. Kalinka, *Jenerał Dezydery Chłapowski* (Poznań, 1885), pp. 61-62.

34. Ibid., p. 64.

35. Ibid., pp. 65, 185; J. Tupalski, *Generał Dezydery Chłapowski 1788-1879* (Warsaw, 1983), p. 282. Printed sources say little about the general's profits, but the accounts for his small sugar refining plant for 1842/43 were printed in the agricultural press, and show a clear profit of 2,200 Thalers, equivalent to 12,000 zlotys - thus more profitable than the entire estate had been under the old system; *Roczniki Gospodarstwa Krajowego* (hereafter *RGK*), 5 (Warsaw, 1844), pp. 162-163.

36. Chłapowski, *O rolnictwie*, p. 121.

contributor to agricultural journals in the Prussian partition, writing many articles for the *Przewodnik Rolniczo-Przemysłowy*, drawing on his experiences at Turew and abroad.[37]

Finally, the general initiated a programme of practical instruction based on methods he had seen in Scotland, where apprentices were sent to progressive farmers to gain direct experience. Chłapowski invited students to come to Turew to share his expertise, inviting groups of six, later twelve students to stay with him for two years (at his own expense) to learn the practical side of farming. Several of the Turew students later became famous as talented administrators, including Maksymilian Jackowski who went on to pioneer machine co-operatives in the province. Over 150 students were trained at Turew, making the general's estate the most important private source of practical instruction anywhere in the Polish lands.[38] Turew rapidly became a magnet for Polish reformers from all the partitions. Andrzej Zamoyski visited the general before publicising the Michałów experiment, and continued to correspond with him later in life.[39] Contemporaries spoke of Turew as a place of pilgrimage, while the general was held up a model for every Polish landowner.[40] Such eulogies convey the esteem in which Chłapowski was held by his peers, demonstrating at least the psychological importance of his initiatives.

Several other practical initiatives should be mentioned, particularly a handful of landowners experimenting with improved crop rotations and drill culture. Nevertheless, the fact that such initiatives could be listed in one sentence testifies to their small number.[41]

4.2 Andrzej Zamoyski and the Agricultural Society

a) Polish agriculture after 1831

The consequences of the 1831 defeat were particularly grim for the Polish countryside. The serious restraints placed on Polish industries outlined in the previous chapter meant that

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37. *PSB*, III, p.302.

38. Tupalski, *Chłapowski*, p. 282.

39. [A. Zamoyski] A.Z., 'Zdanie sprawy', *RGK*, II (Warsaw, 1843), p. 217.

40. Lipoński, *Polska a Wielka Brytania*, pp. 159-160; *PSB*, III, p. 301.

41. T. Wernik, 'Nauka uprawy rzędowej', *Izys Polska*, 6 (Warsaw, 1821), pp. 257-279, 464-478.

there was little scope for the Kingdom's agriculture to advance in response to significant industrialization. Henceforth progress in the primary sector would have to be achieved largely from within, with Polish agriculture being forced to depend on its own resources.

This was hardly an auspicious time for such an undertaking. Much of the cream of Polish society had emigrated following the defeat, including most of the leading personalities associated with agricultural initiatives. Czartoryski and General Pac found themselves in France, as did Biernacki and Antoni Ostrowski, notable for his vigorous promotion of the textile industry in his dominions. By remaining in exile over 2,000 emigres forfeited their property, with estates valued at 26 million zlotys being confiscated by Imperial decree.[42] The removal of progressive landowners invariably led to the collapse of their initiatives, most notably those on the Pac estates. For those who remained in the Kingdom, the atmosphere in the country was hardly conducive to either individual investment or concerted agitation for reform. Regarded as the most patriotic element of Polish society, the landowners were viewed with particular suspicion by the military authorities, and were allowed little scope for independent action.

Several apparent advances in agriculture brought short term profits but heightened social tensions. The wool industry was hit by the loss of the Russian market for Polish cloth, but continued to be profitable for a while as raw wool was exported to Prussia. Wool production frequently went hand in hand with enclosures and widespread evictions of surplus labour from estates. The rural industry which made the most progress during this period was distilling, which had blossomed since the introduction of the Pistorius apparatus after 1817. One of the least labour intensive areas of farming, the introduction of distilleries also led to evictions of surplus peasants. At the same time the massive rise in vodka production produced an unprecedented wave of alcoholism resulting in heightened social tensions in the countryside.[43]

Other valuable initiatives to export processed agricultural goods also foundered during this decade. The Towarzystwo Wyrobów Zbożowych, founded to export Polish flour in 1825,

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42. PRO, FO392/7, Report on the State of Poland, ff. 54, 54 v.

43. Production of spirits rose sharply from an estimated 10 million litres per annum during the Duchy of Warsaw period to 37 million litres in 1844/45; as a response to widespread alcoholism, official measures to restrict distilleries were introduced in 1844, as a result of which hundreds of smaller distilleries collapsed, though output remained at similar levels until the 1860s; *Historia Kultury Materialnej Polski* (hereafter *HKMP*) (Warsaw, 1978), V, p. 231-233; *Zarys historii gospodarstwa wiejskiego w Polsce*, ed. S. Arnold (Warsaw, 1964), II, pp. 519-520.

encountered great difficulties in securing export markets. Furthermore, the company was plagued by particularly bad luck, with several cargoes being lost or ruined in freak accidents. As a result the company almost went bankrupt and had to be bailed out by the Bank Polski before finally succumbing in 1836.[44] When the Polish industrialist Steinkeller took over the Warsaw steam mill soon afterwards, the Prussian government thwarted any attempt to export flour by the imposition of heavy duties.[45]

It was against the backdrop of such developments that a new range of initiatives emerged from the next generation of the Zamoyski family. These sought to demonstrate that the introduction of elements of British new farming into Polish agriculture could be not only profitable but could also be undertaken without exacerbating the growing distrust between landowners and peasants. In 1820-21 Stanisław Zamoyski, the owner of the *Ordynacja* and founder of the Zwierzyniec workshop, had sent his eldest sons, Konstanty and Andrzej, to study agriculture and economics at Edinburgh. While there they received private lectures on political economy from McCulloch, met Ricardo and visited Owen's New Lanark. All this had a particularly strong influence on the younger Andrzej, who acquired a passionate belief in British institutions and ideas of liberalism. Also instructed to familiarise themselves with latest developments in British agriculture, the Zamoyskis were able to use their family connections, to visit many of the leading aristocratic practitioners of the new farming. Andrzej was able to inspect several Lothian farms, including a stay with Rennie at Phantassie, where he claimed to have learnt much. Most influential of all was his time spent with Coke at Holkham, where he participated at the last of the sheep-shearings, the prime showpiece of aristocratic improvement.[46] To a large extent, it was the Holkham gathering which was to explain not only much of the content of Zamoyski's later initiatives but also the mode of presentation of his ideas.

After returning to the Kingdom the brothers entered public service. Konstanty, as elder son, was being groomed for succession as owner of the *Ordynacja,* but Andrzej worked as a civil servant in the Interior Ministry under Mostowski, supervising various public works projects such as road construction. In 1825 he was promoted to the chief administrative body, the

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44. Radziszewski, *Bank Polski*, pp. 343-349.

45. J. Kindelski, 'Monografia Piotra Steinkeller', in H. Radziszewski and J. Kindelski, *Piotr Steinkeller* (Warsaw, 1905), p. 324.

46. A. Zamoyski, 'O uprawie rzędowej', *RGK*, 3 (Warsaw, 1843), pp. 62, 74; R.N. Bacon, *A Report on the Transactions of the Holkham Sheep Shearing* (Norwich, 1821), pp. 58, 116.

Council of State, as deputy head of the Trade and Industry section.[47] The aftermath of the 1831 defeat changed the brothers' situation completely. With the abolition of many of the Kingdom's institutions, and the introduction of large numbers of Russian officials, employment in an official capacity was no longer an option for most Poles who had been involved with the uprising. Andrzej, who had been sent to Vienna as an emissary for the insurrectionary government, was regarded as particularly suspect. Even worse was the fact that younger brother Władysław, a high ranking officer in the insurrectionary forces, had chosen to emigrate, becoming Czartoryski's right hand man and one of the most politically active emigres. In such circumstances, both brothers kept a low profile in the first years of the Paskievich regime, devoting themselves to the affairs of the *Ordynacja*.

From 1833 both became involved in a series of initiatives to modernise their estates via the introduction of methods observed in Britain. Both took practical lessons in agriculture, and secured useful allies for their ventures by giving employment to several Poles and others displaced by the change of regime and unable to earn a living elsewhere. Individual farms on the *Ordynacja* were leased out to ex-officers of the now defunct Polish army, and several Scots were recruited either as tenants or estate mechanics.[48] However, it was the large complex of estates in the Stanisław district east of Warsaw, forming the private property of Andrzej Zamoyski, which attracted both the most prestigous and the most useful new recruits. The post of complex administrator went to Kajetan Garbiński, one of the many young proteges of Staszic in the first years of the Congress Kingdom, who had studied mathematics at the Sorbonne before becoming a lecturer at the polytechnical preparatory school. A spell as education minister in the last days of the uprising had left him without a livelihood until Zamoyski's offer allowed him to forge a new career which culminated in the cofounding and editorship of the *Roczniki Gospodarstwa Krajowego*.[49] At the same time Zamoyski ensured a more practical introduction of British practices by recruiting his own Scottish tenants. Three Scots farmers came from estates once belonging to General Pac, where deteriorating conditions following the confiscations had made life intolerable for the Scots settlers.[50]

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47. S. Skrzyński, *Andrzej Hrabia Zamoyski* (Kraków, 1884), pp. 142-144.

48. *Jenerał Zamoyski 1803-1868* (Poznań, 1897-1922), III, pp. 250-251; [K. Garbiński] K.G., 'Czyli życie przemysłu', *RGK*, I (Warsaw, 1842), pp. 55-56.

49. *PSB*, VII, pp. 269-270.

50. [Zamoyski], 'Zdanie sprawy', p. 191.

The first major reform in the *Ordynacja* was the abolition of the corvee. Moral objections to compulsory labour had been voiced for over half a century, but the Zamoyskis' inspection of British farms had demonstrated the superior performance of hired labour. From 1833 Konstanty Zamoyski offered the *Ordynacja* peasants the option of switching from labour dues to money rent payments. The commutation process was slow but largely successful, with 12,000 out of 14,000 peasant plots having switched to rent payments by 1844. Furthermore, it was claimed that the switch was achieved in a socially responsible manner, without expulsions or any reduction in the size of peasant holdings.[51] The Zamoyskis naturally hailed their reform as a great success, and it was held up as an example for all Polish landowners to follow. Little independent evidence is available to assess the real achievements of the commutation, though in 1837 British consul Barnett visited one of the *Ordynacja* villages where the switch appeared to have been successful. He observed that living standards had risen, rent arrears were insignificant, and found no desire among the peasants to return to the old system.[52]

At the same time strenuous efforts were taken to replace the old cumbersome central administration of the *Ordynacja* with modern tenancies on British lines. By 1843 all the 120 or so farms of the entail were held by tenants. Furthermore, unlike the short tenancies prevalent in the Kingdom, the *Ordynacja* leases were based on the Holkham model, each lasting for 25 years.[53]

The *Ordynacja* reforms had sought to demonstrate that tenancies could be viable without the corvee. However, the bulk of Polish landowners would not easily be convinced, and the reforms seemed to have few imitators at this stage. Within a decade, the opportunities and problems of British style farming without the corvee became a subject of heated debate thanks to a small but vitally significant propaganda exercise conducted by Andrzej Zamoyski. In 1835 the Count took a lease on two average *Ordynacja* farms in order to prove that market orientated farming, concentrating on increased yields and livestock rearing, could be profitable without the use of corvee labour. With the help of Scottish farmers, ex-settlers on the Pac estates, he devised a long term plan to introduce convertible husbandry. A complicated eight year crop cycle was drawn up for each of the different types of fields comprising the farms.

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51. Grabski, *Historia*, I, p. 98.

52. PRO, FO 392/7, Report on the State of Poland, ff. 39 v., 40.

53. Bartyś, *Nizinna hodowla*, p. 23; [Garbiński], 'Czyli życie', p. 55.

Zamoyski was particularly concerned to avoid the traditional reliance on wheat production by concentrating on the rearing of livestock, which he regarded as being one of the key successes of British agriculture. Alongside this change of direction, Zamoyski introduced a rent reform on the same lines as in the *Ordynacja*, although some peasants chose to remain with the corvee. Throughout the first seven years of the experiment he worked in isolation and did not publicise his efforts, but after the founding of the *Roczniki Gospodarstwa Krajowego* he felt the time was ready to publish the results, which appeared in the journal in 1843. His article included a detailed breakdown of his accounts for the last seven years - the first time Polish estate accounts had ever been published. These showed that after seven years he was beginning to reap the benefits of his earlier efforts. The annual income from the farms had increased from 11,000 to 52,700 zlotys, with a cash profit of over 24,000 zlotys for the whole period. He had started with an initial investment of 25,000 zlotys, and a further 88,000 zlotys had been ploughed back into the farms over the seven years. Apart from the annual income, by the end of the seven years the value of the livestock had increased to 41,000 zlotys, which Zamoyski saw as his main achievement. This was despite a severe setback in 1841, when 1,300 lambs worth 15,000 zlotys were lost to an epidemic.[54]

The experiment was hardly perfect. Zamoyski admitted that it was more a demonstration of what could be achieved rather than a model farm as such, but the intiative established the Count as the leading reformer in the Kingdom. The article proved to be immensely influential and reopened the debate on the future course of the Kingdom's agriculture. In July 1843 Andrzej used the completion of the eight year crop cycle to stage a celebration of his successful experiment. At the Zamoyski palace in Klemensów he invited the leading landowners of the Kingdom to a long conference to discuss the issues highlighted by his success at Michałów, and to give a practical demonstration of the innovations he had applied. This was a major event based on the Holkham sheep-shearings, which Andrzej had attended over twenty years before. It was the first independent gathering of the Polish elite since the crushing of the rebellion, and engineered a heated debate on the merits of the Scottish system as applied by the Zamoyskis. The Klemensów meeting was a huge success for Andrzej Zamoyski's ideas, which hereafter came to dominate the agenda of agrarian reform. On a more practical level, those present were treated to displays of new crops, techniques and equipment, all of which made a deep impression on the participants.[55]

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54. [Zamoyski], 'Zdanie sprawy', pp. 124-125.

55. K. Garbiński, 'Obchód...na folwarku Michałowskim', *RGK*, 3 (Warsaw, 1843), pp. 220-257; Grabski, *Historia*, I, pp. 126-130.

Similar meetings at Klemensów in 1844, 1845 and 1847 continued to both intensify the debate on the future of Polish agriculture and to confirm Zamoyski as the leader of the reform movement.

Zamoyski continued to innovate at Michałów, most notably in the application of artificial fertilisers, still in their infancy in British and European farming. His first report on Michałów showed familiarity with the works of Liebig and Boussingault, and in 1848 he published results of experiments on the farm, in which he demonstrated how turnip yields could be increased by the use of various fertilisers.[56]

c) The *Roczniki Gospodarstwa Krajowego*

The mouthpiece of the reformers was a periodical which quickly came to outshine every other publication of its type in the Kingdom. This was the *Roczniki Gospodarstwa Krajowego* (Annals of National Agriculture), founded in 1842 in Warsaw by a group of reform minded individuals led by Kajetan Garbiński. Although an employee of Andrzej Zamoyski, Garbiński was certainly no mouthpiece for the Count, who does not sem to have played any role in the founding of the journal.

The rationale behind the new periodical found eloquent expression in Garbiński's first editorial, 'Czyli życie przemysłu naszego...' (*Do we have a correct understanding of our agriculture?*). This contained the most penetrating analysis of the problems of Polish agriculture yet written. It started with a demonstration of the superiority of the British economy over that of the rest of the continent, with special emphasis on the development of British agriculture. The author then urged his readers, especially the most fanatical Britophiles, to consider the specific conditions of British farming before embarking upon a blind copying of British methods. Even though Polish reformers, in line with their French and German counterparts, were calling for the adoption of such methods, the author asked his readers whether British results could easily be repeated in other countries, where general economic conditions were hardly as favourable. If even the French and Germans were hardly able to replicate British achievements despite widespread adoption of methods, then what could the Poles hope to achieve given the vastly different circumstances of Polish agriculture, with the poverty of the Kingdom's internal market and the difficulties of securing export markets. Dismissing any possibility of a return to unlimited British demand

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56. W. Brandt, 'Zdanie sprawy z doświadczeń czynionych w Michałowie', *RGK*, 12 (Warsaw, 1848), p. 139-140.

for Polish grain, it was essential to consider which foreign methods were really appropriate to Polish conditions.[57]

Throughout its twenty year existence, the *Roczniki* maintained this essential stance; blind copying of methods could achieve little by iself if not economically justified. In articles too numerous to quote, successive contributors reemphasised the need to achieve a proper understanding not only of available markets but of the general economics of agriculture, particularly labour costs. With the accession of Andrzej Zamoyski to the journal in 1843, the elimination of corvee labour and the need for careful adaptions of elements of best practices abroad, particularly those of British farmers, were given great prominence. The journal contained valuable information on developments within Polish agriculture, keenly emphasising positive initiatives without the uncritical optimism so characteristic of almost all previous publications devoted to economic matters.

Following the premature death of Garbiński in 1847, the editorship of the *Roczniki* passed to Andrzej Zamoyski who moved to Warsaw to intensify his efforts to promote British style farming. As the acknowledged leader of the Polish landowners he gained his first official post as the head of the Agricultural Credit Society shortly afterwards, and also embarked on his own industrial venture to aid Polish agriculture, the Vistula Steam Navigation founded to provide faster and cheaper grain transports to Danzig. Under his editorship the *Roczniki* continued to flourish, maintaining an eclectic approach though still retaining an obvious Britophile flavour, particularly in the articles of Zamoyski himself.

The *Roczniki* played a major role in acting as a focus for advocates of agricultural progress, and acted as an invaluable bulletin board offering information on markets and achievements, but could not circumvent the intrinsic limitations of its format. In the political circumstances of the Kingdom before the Crimean conflict, the legal ban on national and local agricultural societies and restrictions on formal gatherings of landowners, together with the absence of agricultural shows and displays placed severe limitations on the demonstration value of practical reform initiatives.

Such restrictions were accepted with grim resentment during the repression of the Paskievich era, but began to seem particularly irksome in the freer atmosphere of the post-Crimean thaw. In 1856, during his first visit to Warsaw, the new Tsar made a point of

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57. [Garbiński], 'Czyli życie', passim.

warning against any political adventures.[58] Although this speech was directed primarily at Polish landowners, it was nevertheless clear that some form of association coordinating agricultural reform initiatives might be possible in the new climate. In 1857 permission was given for the first formal gathering of Polish landowners since the last Klemensów meeting ten years before, when farmers arriving in Warsaw for the annual wool fair visited the Wilanów estates of Count Potocki situated just outside the city.[59] In the meantime Zamoyski was working behind the scenes to obtain permission for the founding of a national agricultural society. The initial petition presented in January 1857 finally received imperial approval at the end of the year, and the new society officially came into being at the beginning of 1858.[60]

d) The last Agricultural Society

The formation of the Agricultural Society (Towarzystwo Rolnicze) coincided with a huge wave of optimism resulting from the political thaw, together with favourable market prospects for grain exporters following the reestablishment of trade links with Britain where demand for Polish wheat was unusually brisk in this period. Conditions were thus optimal for rapid growth and high participation which soom ensued. The formation of the Society after almost thirty years of political oppression liberated a huge reservoir of energy, particularly in the provinces. Membership grew rapidly, from 2,588 in 1859 to 4,033 by 1861. This number embraced all the major landowners in the Kingdom, a large proportion of the lesser gentry and tenant farmers, together with many publicists, academics and manufacturers of agricultural equipment.[61] Given the scant interest shown in the first society led by Stanisław Zamoyski and General Pac, such numbers reflect huge changes in attitudes.

At the top, the Society's origins guaranteed continuity of the *Roczniki* mix of practical reform initiatives together with the simultaneously eclectic and Britophile influences personified by Zamoyski. The Count was the natural choice for the presidency, while the governing committee was dominated by Zamoyski's collaborators from the editorial board

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58. N. Davies, *God's Playground: A History of Poland* (Oxford, 1981), II, p. 348.

59. *RGK*, 31 (Warsaw, 1857), pp. 140-152.

60. *RGK*, 32 (Warsaw, 1858), pp. 145-148.

61. *RGK*, 38 (Warsaw, 1860), p. 384; 45 (Warsaw, 1861), pp. 85.

of the *Roczniki*.[62] Thus the main agenda remained the same - the need to commute the corvee into rent payments, the necessity of achieving better balance by increasing the emphasis on livestock production, and the need to achieve profitability by reducing production costs and gearing output to identified demand.

The *Roczniki* became the official organ of the Society, including alongside its normal contents transcripts of all the Society's meetings. Whereas the old *Roczniki* had been read by relatively small numbers of reform minded individuals, the journal was now sent to every member of the Society, achieving a distribution of 4,750 by February 1861.[63] However, of more direct importance as vehicles for dissemination and demonstration were the other means now open to the Society. At the national level, the annual general meetings held over a week in February acted as a forum for discussion on a wide range of topics. Dozens of papers on preannounced topics were read at the meetings, with discussions following each paper, with the entire transcripts appearing later in the *Roczniki*. Topics could range from general debates as to the most desirable methods of rent commutation to detailed discussions on diseases of wheat. A relatively large proportion of members attended the annual meetings, rising from 405 in the first year to 1426 in 1861.[64]

For the summer months, the most notable initiatives were the founding of an annual agricultural show held over four days at Łowicz, the first real event of this type in the Kingdom. The shows included exhibitions of crops and livestock, together with demonstrations of machinery and tools, ploughing matches and horse races.[65] The Society's special emphasis on livestock led to the setting up of a two day show devoted solely to livestock held each year in Warsaw.[66] The principle of competition as an incentive to improvement was extended with the awarding of prizes for a huge range of aspects of farming. Apart from prizes allocated at the shows, awards were made to farmers on the basis of reports by provincial delegations, covering such diverse areas as the provision of healthcare for peasants, to cowshed design and best use of fertilisers.[67]

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62. *RGK*, 32 (Warsaw, 1858), p. 182.

63. *RGK*, 43 (Warsaw, 1861), p. 43.

64. *RGK*, 32 pt. 2 (Warsaw, 1858), pp. 5-12; 40 (Warsaw, 1860), pp. 171-175; 43 (Warsaw, 1861), p. 12.

65. *RGK*, 33 (Warsaw, 1858), pp. 662-732.

66. *RGK*, 40 (Warsaw, 1860), pp. 82-102.

67. *RGK*, 40 (Warsaw, 1860), pp. 3-51.

The leadership was hoping to further extend the demonstration value of competitions and exhibitions by holding annual events in each of the Kingdom's 77 subdistricts. These were to include ploughing matches, livestock shows and displays of machinery.[68] However, the most notable developments in the provinces was the explosion of activity on the part of members in various localities. Although permanent district committees could not be founded because of government restrictions, regular local meetings of Society members spawned a plethora of long overdue initiatives. In a large number of districts landowners came together to organise and finance local road maintenance, in some cases involving the construction of new routes. Other initiatives saw groups of landowners forming associations to drain marshland, purchase expensive machinery and recruit veterinary surgeons to serve their districts.[69] At a higher level were initiatives to found district cooperatives to trade agricultural produce, several of which produced profits to the landowners mainly via the elimination of middlemen.[70]

Other initiatives included the setting up of a soil analysis laboratory in Warsaw, the financing of several apprenticeships at farms and workshops, the collection of statistical data relating to agricultural output and prices and the publication of books on various aspects of farming.[71]

By providing many valuable channels of dissemination and mobilising the enthusiasm of Polish landowners, the Towarzystwo Rolnicze was an initiative which could have done much to rescue Polish agriculture from neglect and backwardness if it had been allowed to continue for a sufficient period of time. Unfortunately, as in the case of Lubecki's earlier industrial programmes, the Society was ended long before its intiatives could bear fruit. In the end it was the very aspect which could have made it so effective - the mobilisation of the majority of the Polish gentry - which ensured its rapid demise.

The foundation statute of the Society had restricted its brief to matters directly pertaining to agriculture alone. Such a limitation created severe difficulties, as such topics as the prospects for landlord/peasant relationships obviously involved legitimate discussion on the

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68. *RGK*, 43 (Warsaw, 1861), pp. 93-95.

69. Dozens of such local initiatives were recounted in the monthly provincial correspondence section of the *Roczniki* between 1858 and 1861.

70. Some of the more interesting examples are given in *RGK*, 37 (Warsaw, 1859), pp. 89 ff., 305 ff., 38 (Warsaw, 1860), p. 327 ff., 41 (Warsaw, 1860), pp. 363 ff.

71. *RGK*, 38 (Warsaw, 1860), pp. 384-412.

future of Polish society. Despite the particular caution of Zamoyski and his associates, it proved almost impossible for the Society to restrict itself to the narrow confines laid down by the authorities. Stern reminders were issued whenever the Society was deemed to have overstepped its brief, particularly when it wished to set up standing bodies in the provinces.[72] Davies has described the body and its local branches as political organs in disguise, bearing a remarkable resemblance to the parliaments of the old Commonwealth.[73] Whatever the original intentions of the founders, such a development was inevitable in a political system with no legitimate mechanisms for expressing alternative views.

The Russians had no objections to economic reforms in the countryside, but were in a position to dictate the institutional arrangements in which these reforms were enacted. The fate of the Towarzystwo was inevitable where rising expectations within Polish society came up against an unwillingness on the part of the authorities to accept a body gaining in strength and moral authority and capable of presenting a real challenge to the status quo. The backlash came in April 1861, when the Society was dissolved on the grounds of 'having adopted a stance inappropriate to the circumstances of the day'. In exchange the authorities proposed the setting up of local agricultural assemblies in a handful of districts.[74] The final move came in the following year when Andrzej Zamoyski was sent into exile following an audience with the Tsar. The *Roczniki* continued to appear in increasingly difficult circumstances until its readership collapsed in 1864 during the turmoil of the last uprising. The passing of the *Roczniki* brought to an end the last connection with initiative involving 'British' technologies.

The Zamoyski/*Roczniki* initiatives were probably the most interesting example of a coherent movement for institutional and technological change in agriculture. It was unfortunate that the ideal combination of improving market outlook, rising confidence in the economy and a highly organised coordinating body lasted for only three years out of a possible three decades between the two uprisings. The Society set out to provide guidance during a period of unprecented change in the Kingdom's agriculture. The removal of this guidance, coming in the same month as the legal abolition of corvee labour and three years before the granting of full ownership rights to the peasants, left Polish landowners particularly vulnerable during a painful period of transition, with serious consequences for the shape of Polish agriculture after 1863.

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72. *RGK*, 39 (Warsaw, 1860), poszyt II, pp. I-III.

73. Davies, *God's Playground*, II, p. 349.

74. *RGK*, 45 (Warsaw, 1861), poszyt III, pp. I-III.

4.3 The impact of British technologies

The assessment of fifty years of agitation by Britophiles is a complex task given not only the greater unreliability of agricultural statistical data, but also the near impossibility of defining technological capabilities in agriculture, where considerations such as differences in climate or soils necessitate far more extensive adaptations to best practices from abroad than would be the case with industrial technologies. To assess the performance of British technologies in Polish agriculture, it is necessary to consider several points: what the Poles really understood by British style farming, and which specific aspects of the new farming were regarded as essential by the Britophiles. This will be followed by an analysis of the actual performance of the Kingdom's agriculture up to 1863 and the contribution of new farming technologies to this performance, concluding with an analysis of the suitability of such technologies in Polish conditions and some observations regarding the effectiveness of the Britophiles as transfer agents.

a) Polish perceptions of the new farming

Polish observers of the new farming shared the general European view of developments in British agriculture. Modern reassessments have gone far towards destroying the picture of a British agricultural revolution as rapid and far reaching as its industrial counterpart. Recent analysts of both transformations have played down the magnitude of the progress achieved by British farmers, and have also called into question the significance of many features of the new farming, many of which have not stood the test of scholarly reassessment.[75] Several traditional assumptions can no longer be sustained: agrarian advances can no longer be explained by reference to a handful of great innovations, nor can progress be credited to a narrow aristocratic clique. Equally fundamental has been the retiming of the advances, the beginnings of which can be traced back to the seventeenth century. The great landlords received the credit for the new farming mainly thanks to their publicising efforts, and it is perhaps a testimony to their skilful self-publicity that the old myths managed not only to endure for so long, but were also able to cross over to Europe, where they influenced decisions made by continental reformers.

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75. P.K. O'Brien, 'Agriculture and the industrial revolution', *Economic History Review*, 30 (1977), pp. 166-181; D. Mathias, 'Agriculture and Industrialization', in *The First Industrial Revolutions*, ed. D. Mathias and J.A. Davis (Oxford, 1992), pp. 101-126; both articles offer surveys of the debates on the agricultural revolution.

If the British themselves were unclear as to the significance of the various features constituting the new farming, it is hardly surprising that foreign observers were also likely to be confused as to the real nature of British developments. The notion of revolutionary transformations sponsored by a handful of visionary aristocratic landlords held currency throughout the nineteenth century. The Poles were not the only observers to believe this. While the idea of an aristocratic clique as the guiding force behind an agricultural revolution may have seemed particularly appealing to the Zamoyskis - the most obvious continental equivalents of the great aristocratic improvers - it was nevertheless believed by many well informed observers who did not share the social background of the great landlords. August Weckherlin, director of the agricultural school at Hohenheim, one of the most respected institutions in Germany, made a careful study of the new farming, and fully appreciated the technological significance of the advances made in Britain, but seemed typically unaware of the origins of these advances. His summary of the history of the new farming starts in 1750, with a Britain unable to feed itself but soon being transformed thanks to the great improvers.[76] Garbiński, a realist in all other respects, also overdid the significance of the handful of great names, while a later contributor to a Society debate in 1859 assumed that British agriculture had been backward only eighty years before.[77]

Given the strength of such beliefs in current circulation, it is perhaps hardly surprising that the new farming must have seemed so attractive to foreign observers. The prospect of such swift and fundamental transformation was obviously alluring. Even reformers such as Garbiński, fully aware of the vast contrasts between the agriculture of Britain and his native country, saw the adoption of elements of the new farming as the surest way forward, while Andrzej Zamoyski's visit to the last Holkham sheep-shearing obviously convinced him the British way was the ideal.

If there was confusion over the extent and pace of progress in British agriculture, there was a much clearer understanding of the major features of the new farming, particularly by the middle of the nineteenth century when detailed statistical data on the British economy became readily available to continental readers. Most data on prices, wages, rents, yields and output were well known to Polish observers, and were quoted with great frequency in countless articles in the agricultural press.

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76. Quoted by K. Garbiński, 'Gospodarstwo Angielskie', *RGK*, 5 (2) (Warsaw, 1844), pp. 135-136.

77. K. Garbiński, 'Ważność angielskiego rolnictwa', *RGK*, 10 (Warsaw, 1847), pp. 130,140; *RGK*, 35 (Warsaw, 1859), p. 167.

Polish reformers were thus fully aware of the balanced nature of British farming, with as much emphasis on livestock production as on crops, with a huge acreage devoted to fodder crops. Zamoyski and his *Roczniki* collaborators emphasised with monotonous regularity the need to expand livestock production, not only to increase supplies of meat and dairy products, but to increase the supply of fertilisers to improve the appallingly low fertility of most Polish fields. This was the prime objective of Zamoyski's Michałów experiment, and was a topic which generated endless debates at Agricultural Society meetings. The need to develop increased numbers of livestock necessitated the cultivation of new fodder plants. Root fodder crops such as turnips and mangles were first advocated by Zamoyski, and later taken up by the Society activists, while the cultivation of grasses and the need to improve the Kingdom's neglected meadows and pastures became part of the general debate on livestock.[78]

Another aspect of the new farming which occupied the attention of the reformers was the increasing use of improved tools and new machines. This aspect lay behind Stanisław Zamoyski's workshop at Zwierzyniec as far back as 1805, and became one of the main discussion points within the Agricultural Society. As will be seen later, the advocacy of increased mechanisation in Polish agriculture spread beyond the Britophile reformers alone, but the diffusion of machines and tools owed much to specifically Polish factors. Whereas the Britophiles tended to emphasise the full range of equipment becoming available to farmers, other Polish landowners became fixated by the specific labour saving qualities of each machine.

The greater efficiency of hired labour as opposed to the primitive corvee was the next major theme of all the reform initiatives. The need to abolish the corvee was regarded as essential by all advocates of reform, but opinions differed as to the eventual replacement for labour dues. Zamoyski and the Britophiles were firmly in favour of commuting the corvee in rent payments, while others advocated granting ownership rights to the peasantry. Zamoyski's ceaseless promotion of rent payments, begun with the reforms in the *Ordynacja* in the 1830s, envisaged bringing the peasantry into the cash economy as both producers and consumers, stimulating the productivity of peasant plots and creating an outlet for gentry produce, while guaranteeing rent incomes for the gentry landlords. While not ruling out eventual land purchases by the peasantry, Zamoyski was vigorously opposed to immediate granting of ownership rights, fearing excessive subdivision leading to what he described as 'chessboard farming' as practised by the French peasantry.

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78. [Zamoyski] 'O uprawie rzędowej', pp. 61-96.

Zamoyski's views dominated what was to become the most hotly debated topic at Agricultural Society meetings, though the Count was opposed by several reformers who identified ownership rights with social justice rather than mere economic efficiency. Although articles within the *Roczniki* and competitions organised by the Society reflected the Zamoyski line, a vociferous minority continued to oppose rents.

Andrzej Zamoyski's particular admiration for British agriculture led him to promote aspects of British farming ignored by most non-Britophile reformers. These included long leases on the lines of the Holkham estates, the necessity of understanding the economics of farms and markets, and the need to encourage professional farmers with capital to take up tenancies.[79] Zamoyski also stressed the obvious need to mobilise capital investment in agriculture, though his associates were fully aware that the huge sums associated with High Farming could never be justified in the Kingdom given the capital and markets available to most Polish producers.[80]

b) The performance of Polish agriculture up to 1863

In general terms, although Polish agriculture was far from static in the half century before 1863, its achievements were far from spectacular. Some progress had been achieved. As for the products and processes most frequently advocated by the reformers: livestock rearing and new associated crops; the use of better ploughs and machines for threshing, reaping and sowing; and a general departure from grain orientated agriculture, progress was even more erratic.

Despite the promotion of mixed farming, and dire warnings from the reformers about the need to diversify their output, the Kingdom's farmers remained orientated towards crops, with continued emphasis on wheat and rye. No reliable statistics exist for the period before 1863, but a rough estimate for 1859, valued total arable production at 61 million roubles, as opposed to livestock production worth 19 million.[81] With industrial exports of little significance before 1863, wheat and rye continued to maintain their position as the Kingdom's biggest sources of foreign earnings.

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79. [A. Zamoyski] A.Z., 'Wstęp do artykułów', *RGK*, 6 (Warsaw, 1845), pp. 1-3.

80. [M. Oborski], M.O., 'Nowsze postępy gospodarstwa w Anglii', *RGK*, 47 (Warsaw, 1862), p. 405.

81. *RGK*, 35 (Warsaw, 1859), pp. 433-434.

As table 4.3 demonstrates, output of the four grain crops shows considerable increases over the period up to 1863, with wheat production almost quadrupling, and lesser but still impressive increases in output of the other grains. However, most of the increased output was achieved by expansion of the area devoted to these crops rather than by significant increases in yields.

Table 4.3 Output of major grains 1810-1870 (000 tons)

Year	Rye	Wheat	Oats	Barley
1810	478	89	202	161
1822-29	555	94	251	174
1841-50	533	156	296	180
1851-60	646	215	250	198
1861-70	1067	347	521	301

Source: T. Sobczak, *Przełom w konsumpcji spożywczej w Królestwie Polskim w XIX wieku* (Wrocław, 1968), p. 30.

Table 4.4 Yield ratios 1822-1864

Year	Rye	Wheat	Oats	Barley	Potatoes
1822-27 [a]	3.3	3.6	3.1	3.1	4.5
1840-50 [b]	3.5	3.9	3.7	3.7	5.8
1857-58	4.5	4.8	3.7	4.3	6.5
1863-64	4.7	5.0	4.4	4.7	4.8

a) average for 1822, 1824 and 1827
b) average for all years except 1844, 1847 and 1849

Source: Averages calculated from data in *Zarys historii gospodarstwa*, II, pp. 442-443.

Estimates of yields expressed in terms of grain ratios: the ratio of the amount of grain harvested to the amount sown (table 4.4) show that despite definite improvements yields remained extremely modest by western European standards, a fact of which the Poles were

acutely aware.[82] While the absence of long (and reliable) data runs make it difficult to be precise over the exact timing of change, it is clear that most of the increases in yields occurred with the improvements in market outlook following the repeal of the Corn Laws in 1846 coupled with the new psychological climate after Crimea.

Table 4.5 Estimated area under selected crops 1822-1864 (000s of hectares)

Year	Potatoes	Wheat	Rye	Barley	Oats
1822	122	101	853	194	428
1827	161	119	1020	263	620
1840	262	166	898	216	600
1846	351	239	1251	424	708
1850	406	324	1348	309	778
1858	438	329	1462	342	787
1864	510	362	1641	369	898

Source: Kostrowicka, *Produkcja roślinna*, pp. 54, 63, 64.

Table 4.6 Estimated percentage of total arable area under selected crops 1822-1864

Year	Potatoes	Wheat	Rye	Barley	Oats
1822	2.8	2.3	19.9	4.5	10
1827	3.7	2.7	23.7	6.1	14.4
1840	4.9	3,1	16.9	4.0	11.3
1846	5.7	3.8	20.3	6.8	12.4
1850	7.1	5.6	23.6	5.4	13.6
1858	7.4	5.5	24.7	5.7	13.3
1864	8.6	6.1	27.8	6.2	15.2

Source: Kostrowicka, *Produkcja roślinna*, pp. 54, 63, 64.

82. A key Agricultural Society debate in 1859 contrasted average wheat yield ratios of 5 for the Kingdom, compared with 8 for the German states and 12 for Britain, Belgium and parts of Northern France; *RGK*, 34 (Warsaw, 1859), p. 487. Whether accurate or not, such comparisons show the reformers had no illusions about the backwardness of the Kingdom's agriculture.

The changes in acreage devoted to the main grain crops expressed in absolute terms (table 4.5) and as percentages of total arable area (table 4.6) show that far from seeking to diversify their activities most Polish farmers were actually strengthening their reliance on traditional grains throughout this period. Whereas increased use of grain in the growing number of distilleries offered a lifeline to producers in the 1820s, the gradual replacement of grain by potatoes for spirit production soon reduced the significance of this alternative market. It was only with the abolition of the Corn Laws that the continued emphasis on grain brought large cash returns with the increased demand from abroad and the resulting upsurge in grain exports as demonstrated by table 4.7. In the absence of significant grain exports between 1831 and 1854, the bulk of the Kingdom's output was destined either for human consumption (rye and wheat), brewing (barley) or animal feed (oats). With population growth minimal for fifteen years after 1846, it has been estimated that per capita consumption of wheat and rye saw considerable increases towards the end of the period under review (table 4.8). In any case, even when grain exports did resume on a large scale, they accounted for only a small proportion of total output. Although exact percentages are impossible to calculate because of the difficulties of disaggregating transits of Russian grain passing through Polish rivers, it appears that even during years of substantial grain exports, no more than a quarter of the Kingdom's wheat output and perhaps one tenth of rye output left the country. Given the psychological importance of grain exports to the average Polish landowner, these figures seem surprisingly low. Given the low numbers of actual consumers in the Kingdom, it would be reasonable to suggest that most wheat and rye produced was consumed by the producers themselves, and thus did not constitute an important cash commodity.

Table 4.7 Wheat and rye exports 1811-1863 (000s of tonnes)

Year	Wheat	Rye
1811	12.6	18.6
1815/16	10.4	5.3
1817/20	25.7	17.2
1821/24	10.5	15.8
1826/29	27.5	17.1
1857/63	77.6	74.2

Source: averages calculated from Sobczak, *Przełom w konsumpcji*, pp. 34-35.

While grain production still commanded most of the attention of the Kingdom's farmers, the only new crop of any significance was the potato, which made rapid progress throughout the period before 1863. As a percentage of total arable area, potatoes advanced even more swiftly than the major grains. Output rose equally rapidly, though the figures are slightly obscured by the frequent problems associated with the potato famine of the mid-1840s and several subsequent harvest failures.[83]

Table 4.8 Estimated annual grain consumption 1810-1870 (kg per capita)

Year	Wheat	Rye
1810	16	78
1822-29	14	86
1841-50	15	64
1851-60	23	88
1861-70	34	120

Source: Sobczak, *Przełom w konsumpcji*, p. 53.

Potatoes had played relatively little part in the initiatives of the Britophile reformers, and their rapid diffusion can be ascribed to two main factors which owed little to Zamoyski or his predecessors. For the landowners, the crop was initially more important as a raw material for estate distilleries than it was for human consumption, while for peasant producers potatoes instantly assumed the role of a staple food. Sobczak has estimated that throughout the period between 1827 and 1863 at least a quarter of the total output was processed by the distilleries, with the proportion rising as high as 42% during years of bad harvests, while as late as 1870 around half of the crop from gentry farms was still destined for alcohol production. Very few potatoes were cultivated for use as animal feed.[84]

By contrast with the continued importance of grains and the rapid progress of the potato, the cultivation of other crops failed to reach significant levels before 1863. Despite the frequent efforts of Zamoyski, the diffusion of fodder crops was anything but spectacular. Neither turnips, mangles nor swedes were cultivated widely enough to attract the attention of the statisticians, a reflection of the limited progress of livestock husbandry in the

83. Potato yields were low in 1847, 1851, 1853 and 1854, with the harvest for 1853 being particularly disastrous; Sobczak, *Przełom w konsumpcji*, p. 62.

84. Ibid., pp. 65-68.

Kingdom. The attention paid to industrial crops such as rape, flax, hemp and sugar beet was also relatively insignificant. A mere 62,000 hectares were given over to the first three crops in 1864, amounting to barely more than 1% of the total arable area. Although the area given over to sugar beet cultivation increased from 2,400 to 16,200 hectares between 1845 and 1865, this was still meagre by any standard, amounting to no more than 0.27% of total arable area. In only two out of 39 local districts, where the bulk of the Kingdom's sugar refineries were located, did the amount of land devoted to beet exceed 3%.[85] Furthermore, the growth of sugar beet cultivation in the Kingdom was especially modest in comparison with similar developments in the much smaller province of Bohemia, where the area given over to beet rose from 4,800 ha in 1853/54 to 11,500 ha in 1858/59, reaching 64,400 ha by 1869/70.[86]

Arable farming in the Kingdom before 1863 shows a picture of minor improvements but little significant transformation in either the importance attached to arable production in general or the preference of crops being cultivated. This absence of diversification shows that little attention had been paid to the persistent appeals of reformers from the early writings of Kurowski in the early 1820s right through until the broader campaigns of Zamoyski decades later. It is clear that the advocates of British style mixed farming had little influence on the choice of crops cultivated, and proved unable to persuade the bulk of Polish landowners to consider possible alternatives. In effect, Zamoyski's persistence with the Vistula Steam Navigation in the face of serious and frequent losses demonstrates how he himself had been forced to make the best of this failure.

The neglect of crops other than grains was both part cause and part consequence of the limited impact of the cornerstone of British new farming as advocated by the Polish reformers - the need to develop livestock farming. If stagnant or falling grain prices in the eighteenth century did much to stimulate the interest of British farmers in animal husbandry, the same could not be said of their Polish counterparts in the following century.[87]

The statistical evidence relating to livestock numbers in the Kingdom (table 4.9) shows that some quantitative progress had been achieved. In numerical terms, it was sheep farming which made the most considerable advances, spurred on by demand for wool both within the Kingdom itself and in the German states. Although little progress was achieved by

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85. Kostrowicka, *Produkcja roślinna*, p. 74; *Zarys historii gospodarstwa*, II, p. 431.

86. O. Mrázek, *Vývoj Průmyslu v Českých Zemích* (Prague, 1964), p. 165.

87. J.V. Beckett, *The Agricultural Revolution* (Oxford, 1990), pp. 30-31.

peasant farmers accounting for a consistent 30% of the total stock, the gentry farms were more successful in introducing new breeds, particularly electorals and negretti. Statistics for 1844 claim that 82% of gentry stock consisted of improved breeds. Nevertheless, while contemporaries reported improvements in the preparation of the wool after shearing, there is little evidence to suggest that the quality of the stock itself underwent any significant changes. In particular, attempts at cross breeding to achieve new varieties better adapted to Polish conditions met with spectacular failures, even in the more advanced farms.[88]

Table 4.9 Livestock cultivation 1808-1862 (000s of animals)

Year	Sheep	Cattle	Horse	Pigs
1808	914	1151	328	440
1827	2477	1448	425	617
1844	3879	1304	480	703
1850	3774	1653	568	864
1862	3797	2093	618	1012

Source: *HKMP*, V, p. 200.

If few qualitative advances had been achieved while the market outlook was favourable, then they were less likely once conditions for Polish producers worsened following the introduction of Australian wool into Europe. Whereas the Kingdom could still export 9 million pounds of wool to Prussia alone in 1835, and British and French merchants made regular purchases at Polish wool fairs in the 1840s, by 1847 foreign interest in the Polish product had diminished in the face of cheaper imports from Australia. By 1850 a textile manufacturer in the Kingdom could express a preference for Australian wool, tempered only by the import duties which allowed home producers to remain competitive.[89] As mutton production made little headway in the Kingdom, the rapid progress of foreign competition ensured the gradual decline of Polish sheep farming, with numbers remaining stable for several decades until collapsing towards the end of the century.[90]

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88. *Zarys historii gospodarstwa*, II, pp. 460-465; Garbiński was particularly scathing about the results achieved with new breeds, 'Czyli życie', pp. 49-50.

89. PRO, FO65/339, no 42, July 6, 1847; FO65/382, no 20, June 25, 1850; [Garbiński], 'Czyli życie', p. 20.

90. *Zarys historii gospodarstwa*, II, pp. 458, 459, 465.

In contrast to the favourable market outlook enjoyed by wool producers for several decades, the Kingdom's cattle farmers could not count on high levels of demand either at home or abroad. On the contrary, competition from the huge herds of Podole oxen from the Ukrainian steppes was a major disincentive to Polish producers. Of the four branches of livestock husbandry, cattle farming made the least progress up to 1863 in numerical terms (table 4.9), and little tangible progress in quality. This had importance consequences for the diffusion of fodder crops, crop rotations and ultimately mixed farming itself.

As a result of the imbalance between livestock and crop husbandry, improved crop rotations, the concept central to the new farming, were slow to replace the three field system which continued to dominate beyond 1863 in most parts of the Kingdom. Kostrowicka's estimates for 1863 assume that 18% of all arable land was farmed using rotations not involving fallows. Admittedly, national estimates disguised considerable regional variations, with large differences both between and within the five provinces of the country, ranging from 28% and 24% in Radom and Warsaw provinces to a mere 3% in the backward Augustów region in the far north. Nevertheless, only 4 out of 39 local districts had totals higher than 40%. Assuming such proportions, Kostrowicka estimated that 1.6 million hectares, or 27% of the entire cultivated area lay fallow in 1863.[91]

The absence of significant livestock cultivation undermined the rationality of introducing rotations involving fodder crops and requiring far larger amounts of manure. Thus, unlike in Britain, turnips or swedes played almost no role in the Kingdom's agriculture, where it was potatoes for direct consumption and distilling which formed the main root crop in rotations which amounted to improvements of the triennial system rather than a radical leap towards convertible husbandry.

Given the central role of cattle husbandry in the British style farming advocated by Zamoyski and his associates, this branch requires closer scrutiny. Whereas many contemporaries blamed the conservatism of the landowners for the slow development of livestock farming, later writers have called for a revision of such standard views. Śmiałowski has emphasised that the modest achievements in animal husbandry cannot be ascribed to conservatism alone. On the basis of claims from the 1850s stating that, unlike grain, livestock could not be profitable, he suggested that the neglect of cattle farming in particular was a rational economic decision throughout the pre-1863 period given fierce competition from the huge

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91. Kostrowicka, *Produkcja roślinna*, p. 53.

estates of the Ukraine.[92] If true, this would have made a mockery of the efforts of Zamoyski and other leading members of the *Roczniki* group, and is thus worth examining in detail.

The competition from Podole oxen from the Ukraine was indeed a major factor influencing landowner behaviour during this period, as can be testified by several contemporary statements. Many regarded cattle as a bad investment, keeping small numbers for draught or for manure, seeing them as a necessary evil costing more to feed than they were worth.[93] There is much evidence to offer partial support for such views. On two occasions Agricultural Society discussants - both advocates of livestock farming - proved that steppe oxen were indeed cheaper than the local product. In 1860 it was demonstrated that 5 year old oxen from Russia could be bought for 233.10 zlotys (35 roubles), up to 50 zlotys cheaper than the cost of rearing such an animal on a Polish farm. In the previous year accounts were used to show that the sale of 3 year old oxen reared at home could not recoup the costs of rearing.[94]

With the availability of cheaper cattle from the Ukraine, imports of steppe cattle remained consistently high, rising from 26,000 head in 1828 to an average 41,000 per annum between 1853 and 1861.[95] This was obviously a disincentive to Polish producers, but imports from the steppes cannot entirely justify developments in the Kingdom. It is worth considering to what extent Polish farmers attempted to meet Russian competition by either rearing a better quality product or by reducing their own rearing costs by producing cheaper fodder crops. Any judgement of the rationality of Polish landowners should also consider other aspects of cattle husbandry such as dairy farming, together with the main priority of the Britophiles - the production of manure to raise soil fertility.

The overwhelming majority of cattle imports from Russia consisted of oxen, of which some were acquired as draught animals rather than for slaughter. Sobczak's estimates suggest

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92. J. Śmiałowski, 'Uwagi w sprawie rozwoju kapitalizmu w rolnictwie Królestwa Polskiego 1815-1864', in: *Materiały na sesję naukową z okazji 50-lecia Archiwum Państwowego w Radomiu* (Radom, 1971), pp. 138-139.

93. Such statements were made frequently in Agricultural Society debates; even Marymont graduates could share such views; F. Koperczyński, 'Opis statystyczno-gospodarczy dóbr Karwosieki', *RGK*, 30 (Warsaw, 1857), pp. 10-11.

94. *RGK*, 36 (Warsaw, 1859), pp. 98-101; *RGK*, 40 (Warsaw, 1860), p. 261.

95. *Zarys historii gospodarstwa*, II, pp. 472-473; averages calculated from Sobczak, *Przełom w konsumpcji*, p. 103.

that net imports comprised no more than about 30% of total beef consumption in the Kingdom by 1858, having risen from 22% in 1827. Furthermore, it was primarily Warsaw demand which was met by such imports.[96] The same estimates assume a rise in domestic beef production from 13,000 to 20,000 tons between the same dates, but there is little evidence that this increase was achieved via substantial improvements in livestock quality. Sobczak has suggested an increase in the deadweight of beef in the period before 1863, but these are based on very flimsy evidence. In any case, his estimates for both oxen and cows suggest deadweight increases of less than 10% in half a century. The paucity of relevant statistics make any qualitative assessment of progress in breeding problematic, but even allowing for the increased deadweight there is little evidence to suggest that most Polish livestock breeders achieved any significant results, with deadweight being extremely modest when compared with some western European estimates for previous centuries.[97]

If it is possible to suggest that lower quality beef was hardly worth producing in the face of Russian competition, this cannot offer a convincing explanation for the failure to achieve a better quality product, particularly as it was common knowledge that beef was consumed primarily by the more affluent sections of Polish society, accounting for no more than one sixth of the Kingdom's population according to contemporaries. Advocates of livestock farming complained that most Polish meat was hardly worthy of the name, with good quality beef difficult to find even in Warsaw. Towarzystwo debates also highlighted the lack of skills in livestock rearing, with imports of fully grown oxen and small numbers of exports consisting almost entirely of calves.[98]

Other associates of Zamoyski pointed out that cattle husbandry was not neglected because it was unprofitable, but was unprofitable precisely because it was neglected.[99] Little was being done to reduce feeding costs by intensifying the cultivation of fodder crops or improving the appalling state of the Kingdom's meadows and pastures. According to figures quoted by the Society, root crops and legumes accounted for less than one sixth of

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96. Sobczak, *Przełom w konsumpcji*, pp. 103, 105, 107.

97. Ibid., pp. 95-98; the 1858 estimates of average deadweight for oxen and cows respectively - 142 and 101 kg; this could be compared with estimates for a leading Saxon farm in 1618 of 175 and 100 kg for oxen and cows, and 200 kg for Schleswig Holstein oxen in the eighteenth century; B.H. Slicher Van Bath, *The Agrarian History of Western Europe 500-1850* (1963), p. 334.

98. *RGK*, 32 (Warsaw, 1858), pp. 109,110; 36 (Warsaw, 1859), p. 91.

99. E. Sygietyński, 'Projekt stowarzyszenia nabiałowego', *RGK*, 41 (Warsaw, 1860), p. 56.

the total area available to Polish agriculture (i.e., arable, meadows and pastures) while the proportion was closer to 25% in France and over 70% for Britain.[100] It is hardly unreasonable to assume that more attention to increasing fodder supplies would have at least reduced the cost differentials between Podole cattle and the domestically reared product. Although opponents of livestock farming pointed out the unsuitability of clover given the Polish climate, this argument is undermined by the fact that farmers in the Posen province across the Prussian border were devoting 16% of total arable area to this crop by 1878.[101]

Imports of steppe cattle are less satisfactory in explaining the slow progress of specialized dairy production in the Kingdom. No meaningful statistics are available for either consumption or production of dairy products, but speculative estimates for average annual milk yields suggest 600-700 litres per cow, with virtually no information available on butter or cheese production.[102] Because of the low numbers of agricultural consumers, milk production for the market was viable only on the outskirts of large towns, though processed products such as butter and cheese had a wider market. Efforts of the reformers concentrated on the liquidation of the pacht system whereby trade in dairy products was conducted by mainly Jewish middlemen, and the raising of milk yields. The *Roczniki* publicised several initiatives involving the formation of dairy cooperatives, plus individual successes of cheese producers, but all evidence suggests that progress in this branch was slight. In 1851 a report on the Czersk district south of Warsaw observed that no farmers in the area were producing butter or cheese for the market, while as late as 1858 no landowners near Warsaw had experimented with British high yield breeds.[103] Quality cheeses could find ready markets in Warsaw or even Danzig, but the general lack of interest shown by Polish landowners suggests a general lack of initiative in this field.[104]

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100. *RGK*, 33 (Warsaw, 1858), p. 200.

101. *Zarys historii gospodarstwa*, II, p. 432.

102. Ibid., II, p. 471.

103. [L. Górski] L.G., 'Okręg czerski', *RGK*, 18 (Warsaw, 1851), pp. 211-215; *RGK*, 31 (Warsaw, 1857), p. 148.

104. Zamoyski advocated cheese production after successful sales of Chester cheese to Danzig in the early 1840s; one of his Scots tenants at Jadów became a leading producer of such cheese in the Kingdom, while other initiatives showed how cheese could be profitable if the necessary skills were available; [Zamoyski], 'Wstęp do artykułów', pp. 4-6; *RGK*, 36 (Warsaw, 1859), pp. 32-38; J. Bartyś, 'English and Scottish Farmers in Poland in the First Half of the Nineteenth Century', *Agricultural History Review*, 15 (1967), p. 89.

The chronic shortage of natural fertiliser was an inevitable consequence of the neglect of livestock. Several descriptions of otherwise successful farms contained in the *Roczniki* show that it could be possible for a highly regarded Polish gentry farm to manure no more than 10% of its arable area each year.[105] Although Zamoyski and his associates consistently promoted the use of such alternatives as night soil, guano, marl and industrial by-products, cost and availability limited their significance for most producers at this stage. The scarcity of natural fertiliser ruled out the possibility of achieving any substantial increases in soil fertility. It is curious that none of the contributors to the extensive debates on cattle husbandry ever considered whether the increased yields resulting from improved fertility would have compensated for the cost differences between Polish and steppe cattle.

Livestock farming was still at an early stage by the end of the period under review. The Agricultural Society, ever eager to publicise areas of progress, was blunt in its assessment of the branch, dismissing the livestock exhibits at the Warsaw annual show as unsatisfactory.[106] Whatever the competition from Russian cattle, the inability of Polish producers to meet the competition by lowering rearing costs, achieving a better quality product, considering the benefits of dairy cattle, and, worst of all, their failure to appreciate the significance of relationship between manure shortages and low soil fertility must be regarded as serious shortcomings which cannot be explained by costs alone. Capital and labour shortages could well have discouraged many from the cultivation of fodder crops, while improving the quality of food was obviously a low priority in a low income economy with few urban consumers, but there is enough evidence to suggest that the majority of Polish landowners cannot be rehabilitated as easily as revisionists such as Śmiałowski may wish.

c) The mechanisation of Polish agriculture

The diffusion of new tools and machines for agriculture is another area where apparent economic rationality on the part of Polish landowners went hand in hand with an imperfect understanding of the issues involved. With much of the new equipment, diffusion was sluggish even in Britain before 1815, despite theoretical availability in the eighteenth

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105. L. Loewenstein, 'Rys statystyczny dóbr Sanniki', *RGK*, 29 (Warsaw, 1856), pp. 5, 36; even the fairly progressive Wilanów estates were able to fertilise only between 5% and 17% of the arable from their own livestock; *RGK*, 31 (Warsaw, 1857), pp. 142-144.

106. *RGK*, 33 (Warsaw, 1858), p. 689.

century. Diffusion was even slower on the Continent, and thus Polish advocates of mechanisation were part of a general European phenomenon.

According to a contemporary classification, there were nine basic tasks in which improved tools were playing an important role.[107] For the purposes of this work four of these tool groups will be considered: ploughs - of crucial importance to husbandry and to the diffusion of many types of machine - and harrows for preparing the seed bed; seed drills for sowing or planting crops; various machines for harvesting crops; and machines for processing and preparing grain. Each offered different advantages to the farmer, either in terms of quality of operation or savings of labour or grain. These differing advantages played a major role in shaping the diffusion process within Polish agriculture.

i) Ploughs and tillage tools

Under the corvee system, all ploughing in the Polish lands was undertaken by the peasants, who used what Loudon described contemptuously as their "own wretched tools". On his journey through the country in 1813 he witnessed a peculiarly primitive form of ploughing - a pair of oxen dragging a sharpened pole along the soil.[108] Over a decade later Jacob observed that ploughing was still shallow and irregular, and that the use of ineffective harrows with wooden tines meant that large numbers of weeds infested the fields.[109] Unsurprisingly, one of the first moves of reformers was to introduce better designs from abroad. These included the German Fessendorf and Hohenheim ploughs, the Dombasle design from France, and the Zugmeyer from Austria. A Czech swing plough as modified by local smiths at Września gained considerable popularity on lighter soils, especially in the Prussian partition.[110]

However, the most successful foreign design was the so called Scotch (szkocki) or Small plough, deriving from the old Scotch plough as improved by James Small and several other designers. Variations on this basic design were produced by all the leading tool manufacturers in the kingdom. General Chłapowski was the first staunch advocate of

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107. Loudon, *Encyclopaedia*, pp. 368-406.

108. Ibid., p. 102.

109. Jacob, *Report*, p. 66.

110. S. Grzymałowski and K. Chorzewski, *Produkcja maszyn i narzędzi rolniczych w Polsce w latach 1805-1918* (Wrocław, 1970), pp. 10-12.

Scotch ploughs, devoting considerable space to plough theory and design in his textbook, and including details about individual ploughs in his possession. He emphasised the benefits of increasing the topsoil through deeper ploughing, frequently repeating the maxim that deepening one's topsoil is the equivalent of acquiring a second farm.[111] Andrzej Zamoyski was the other great promoter of good soil preparation. He originally started at Michałów with an ordinary Polish plough, and also experimented with a French Dombasle design, but soon switched to a Small plough with iron parts. He determined to use wholly iron Small ploughs after a visit to Chłapowski, and also used harrows, a roller and extirpators.[112] As noted in the previous chapter, his practical demonstrations at Michałów seem to have acted as a most emphatic showcase for the improved plough as manufactured by the local Zwierzyniec workshop.[113]

However, the lack of debate on ploughs and tillage tools suggests that unlike such innovations as the threshing machine, better ploughs were not regarded as particularly essential by the majority of Polish landowners. Part of the problem lay with the unwillingness of the peasants to use new tools. Even where the corvee labour was replaced by a permanent retinue of farmhands, the problems could still be acute. Chłapowski's farmhands categorically refused to try the new plough, and only consented to use it after the general brought in ploughteams from elsewhere.[114] Zamoyski also encountered similar problems. His farmhands were used to lighter tools, and found the heavier ploughs difficult to use. He found that the roller was also unpopular. However, within two years the new ploughs had gained complete acceptance at Michałów. Zamoyski later admitted that a 2 zloty reward for a farmhand who became competent with the Scots plough ended all complaints about its heaviness or any other difficulties.[115]

Nevertheless, it would seem that despite the heavy publicity Chłapowski and Zamoyski were giving to the new tools, the importance of improvements in soil preparation had not been fully appreciated. Threshing machines were discussed at length in the technical press, with considerable feedback from landowners, whereas ploughing hardly got a mention. Factories

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111. Chłapowski, *O rolnictwie*, pp. 161-170, 171-172; Tupalski, *Chłapowski*, p. 108.

112. [Zamoyski], 'Zdanie sprawy', pp. 216-217.

113. [Garbiński], 'Obchód', p. 240 fn.

114. Kalinka, *Chłapowski*, p. 68.

115. [Zamoyski], 'Zdanie sprawy', pp. 216-217; [K. Garbiński] K.G., 'Odwiedziny w Klemensowie', *RGK*, 7 (Warsaw, 1845), p. 275; [A. Zamoyski] A.Z., 'Kodex rolnictwa', *RGK*, 11 (Warsaw, 1847), p. 154 fn.

advertising individual threshers would go into great detail about their capacity, whereas ploughs were simply sold as English or Scots without any details regarding soil suitability, or ease of use. As late as 1851, a description of farming in the Czersk region directly south of Warsaw - an area with excellent access to the Warsaw markets and good loamy soil revealed that the local landowners continued to use traditional wooden tools. As a result the topsoil in the area was no deeper than three to four inches, whereas the writer added that on a recent visit to Silesia he had seen identical soils with a twelve inch layer of topsoil.[116] Tillage tools thus seem to have remained a marginal issue, which was to have considerable consequences not only for soil quality but also for the cultivation of root crops, particularly sugar beet, and for the diffusion of many agricultural machines, especially seed drills and reapers. One report of a reaper trial stressed the difficulty of operating the machine where fields contain large clods of earth or stones, while another noted that the machine could have cut at least 33% more grain if not for the frequent stops caused by the necessity to remove large stones from the field.[117] Such statements, made without a hint of irony, speak volumes about the general level of soil preparation in the average Polish farm.

ii) Seed drills

The main rationale behind the adoption of seed drills in Britain was not only the efficient use of seed, but primarily the desire to ensure both an even distribution of seed, and an appropriate thickness of soil coverage to ensure optimal growth conditions. Labour savings were of only marginal significance with such tools.

As Bartyś has pointed out, seed drills encountered more resistance in Poland than any other machine, making very little impact in the Polish lands before the 1850s. They were first used by the Britophile reformer Biernacki, who demonstrated his own improved version of the Cooke seed drill in 1802. This drill had first been patented in 1782 and formed the basis for most subsequent developments in Britain.[118] The more sophisticated seed drills for sowing seeds in rows were probably introduced to Poland by the emigrants to Zwierzyniec and Dowspuda. The Scots farmers at Dowspuda made and used such

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116. [Górski], 'Okręg czerski', pp. 201-203.

117. *RGK*, 38 (Warsaw, 1860), p. 828; *RGK*, 41 (Warsaw, 1860), p. 611.

118. Bartyś, *Początki mechanizacji*, pp. 145-146; G.E. Fussell, *The farmer's tools: a history of British farm implements, tools and machinery 1500-1900* (1981), p. 105.

machines, including a two row machine for rape, peas and beans. They also introduced drill husbandry for potatoes.[119] In 1821 it was claimed that drill husbandry was still limited to a handful of estates belonging to the most progressive farmers.[120]

This situation was to last for a considerable period, but seed drills did make slow progress thanks to the spread of clover and fodder crops. Once again, the most fervent advocates of seed drills were Chłapowski and Andrzej Zamoyski. The former publicised the results of his use of a seed drill based on a British design, emphasising the durability of the machine and large savings of grain.[121] Zamoyski was the first to publicise the benefits of the drill husbandry for potatoes and root fodder crops, emphasising the improved results at his Michałów shows, and publishing these in an extensive article on the subject.[122] By the 1840s, all the leading manufacturers in the Kingdom were producing more advanced drills based on several designs, proving that Polish landowners were slowly acquiring these machines, but Bartyś has estimated that by 1863 although simple 2,000 seed broadcasters and 2,500 hand drills were in use in the country, no more than 300 drills for row culture were used. This suggests that less than 2% of Polish farms possessed the more sophisticated version of this machine.[123]

The seed drill was hindered by two important factors - the appalling neglect of soil preparation, and the lack of any significant labour savings deriving from its use. Where ridge farming was still the common practice, and fields remained uneven, uncleared of stones, and full of large clumps of unbroken earth, a seed drill was hardly likely to prove particularly efficient. Furthermore, the lack of significant labour savings made such machines relatively unappealing given the high prices of the better machines.

iii) Reaping machines

Machines for reaping corn took a considerable time to develop, and even longer to gain widespread acceptance. The evolution of such machines was far from straightforward,

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119. Bartyś, *Początki mechanizacji*, pp. 156-157.

120. Wernik, 'Nauka uprawy rzędowej', pp. 258, 267.

121. Tupalski, *Chłapowski*, pp. 276-277.

122. [Zamoyski], 'O uprawie rzędowej', pp. 61-96.

123. Bartyś, *Początki mechanizacji*, p. 376.

involving dozens of different designs of varying quality but little impact for over half a century, until the twin breakthroughs of the London Great Exhibition and the New York Great Fair, both occurring in 1851.[124] Reapers had appeared in Poland at an extremely early date, with the introduction of two machines by Patrick Bell, comprising a quarter of all world exports of this pioneering machine.[125] One of these was purchased in June 1833 by Tomasz Potocki, the Britophile owner of the Wilanów estates near Warsaw.[126] Little is known of the subsequent fate of this machine, but there is no evidence to suggest that it made any contribution to reaper design in the Kingdom.

Several Poles tried their hand at reaper design, most notably Tyminiecki who produced several machines in conjunction with the Białogon factory, but the major breakthrough from the Polish point of view was the Amerykanka, Lilpop's adaptation of a Manning design acquired at the Great Exhibition. 90 of these machines were sold in seven years.[127] Most reaper adaptations undertaken in the Kingdom had little to do with technological advances, being more concerned with producing a reaper capable of performing on standard Polish fields - i.e. uneven and full of ridges. This meant a heavier and more robust machine, which according to Bartyś seemed more suitable for cutting sugar cane than wheat.[128]

Reaping technology diffused rapidly in the Polish lands, even if developments followed a somewhat distorted path because of the woeful state of Polish fields. Bartyś has estimated that around 1,100 reapers were being used in 1864, or roughly in about 5% of gentry farms.[129] The main reason for the great interest shown in such machines was the opportunity of overcoming seasonal labour shortages, and most discussion on their performance contained some indication or even detailed calculations of the extent of the savings which could be achieved.[130]

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124. Fussell, *The Farmer's Tools*, pp. 115-139.

125. *Quarterly Journal of Agriculture*, 4 (Edinburgh, 1834), pp. 87-88.

126. Bartyś, *Początki mechanizacji*, p. 212.

127. Ibid., pp. 213-216.

128. Ibid., p. 218.

129. Ibid., p. 411.

130. *RGK*, 41 (Warsaw, 1860), pp. 159-160, 604-613.

iv) Threshing machines

The development of the threshing machine was one of the first successful applications of mechanisation in agriculture. The Meikle thresher, developed in Scotland in the 1780s, was immediately successful, and most advances over the next eighty years were little more than improvements on the basic Meikle design. The thresher was the one agricultural machine to capture the imagination of the Polish landowner, once again because of the labour factor rather than the technological issues involved.

In the Polish lands, all threshing had been carried out by flail, and Jacob noted the "want of attention" given to this operation, stating that far more grain was left in the straw than would have been the case in England.[131] What he may not have known was that as with sowing, threshing offered an excellent opportunity for the peasants to appropriate the landlord's grain, an opportunity that was regularly taken as a form of unofficial compensation for the peasant.

It is not possible to ascertain when the first modern thresher appeared in Poland. Models of the Meikle design had been brought to Zwierzyniec by the British mechanics, and Bartyś feels that the workshop produced a machine before 1810. Biernacki used a British thresher from about 1807, a machine which worked until 1823.[132] After 1815 British threshers were starting to appear in larger numbers. Loudon knew of at least half a dozen bought by the Poles.[133] The advent of mechanised threshing brought several attempts by Polish constructors to design their own machines. Prince Lubecki, future director of the Kingdom's economy, built a thresher on the flail principle which he used with some success on his farms at Szczuczyn, a design later put into limited production by the Evans factory. Other projects for mechanical flails came to nothing during this period, but many interesting attempts were made to adapt threshers to Polish conditions.[134] After 1822 Thomas Evans was producing threshers at the Warsaw foundry, and by the following decades all the leading firms in the Kingdom together with the Cegielski factory in Posen) were offering

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131. Jacob, *Report*, p. 66.

132. Bartyś, *Początki mechanizacji*, p. 324.

133. Loudon, *Encyclopaedia*, p. 103.

134. Bartyś, *Początki mechanizacji*, pp. 317-319, 326; *Izys Polska,* 1823/III (Warsaw, 1823), p. 588; T. Łubieński, 'Opisanie młockarni w Reyowcu', *Izys Polska,* 1822/I (Warsaw, 1822), pp. 129-145.

a plethora of various machines, mostly based on leading British designs from firms such as Ransome and Garrett.

Discussions of thresher performance inevitably involved calculations of labour savings, indicating the chief motivation behind the purchase of such machines. The first detailed calculations were supplied by Biernacki in 1823, based on the savings obtained from his portable thresher at Marchwacz, while in 1829 Flatt, director of the Marymont school, produced his own figures.[135]

Biernacki estimated that 300 threshing machines were being used in the Kingdom in 1830. Bartyś suggests that by 1864 over 12,000 threshers of various kinds were being used on gentry farms in Poland, of which less than a hundred were steam driven, six hundred were large permanent machines and roughly 7,500 were horse gear machines of different sizes. He estimated that on such farms over half of all threshing was done by machine by this time, which would represent a successful level of diffusion.[136]

The obstacles to the mechanisation of Polish agriculture were numerous. For a start, a large acreage was in the hands of the peasants and the smaller gentry. The former did not have the means, and the latter did not feel the need to acquire the new technology. Even for those who did mechanise, the problems were considerable. The machines suffered numerous technical problems, which were compounded by the lack of skilled mechanics able to undertake repairs and maintenance. Where the labour dues were retained, it seemed more attractive to avoid the expense of machinery. The progress of several machines was hindered by inadequate field preparation. Machines could easily be damaged through mishandling by peasants ignorant of their use, and more easily still by farmhands hostile to their introduction. When combined with the conservatism of many Polish landowners, it is not surprising that several machines took decades to win widespread acceptance.

The problem of labour shortages needs some elucidation. In 1858 over 1.3 million landless peasants lived in the Kingdom, offering a huge potential labour force.[137] However, the deterioration of the peasant - landlord relations left most peasants preferring to squat or perform labour dues for wealthier peasants rather than hiring themselves out to gentry

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135. Bartyś, *Początki mechanizacji*, pp. 340-341; J. Flatt, 'O młockarniach', *Piast*, 5 (Warsaw, 1829), pp. 1-20.

136. Bartyś, *Początki mechanizacji*, p. 411.

137. *HKMP*, V, p. 242.

farmers. The expansion of arable area coupled with the retention of traditional methods of farming left many landlords faced with severe seasonal labour shortages by the 1850s. Given the low profit margins on which many landowners operated, it was unsurprising that labour savings were seen as so desirable.

A schematic representation of the diffusion of the four tools or machines is contained in table 4.10. In the case of reapers, it must be remembered that the diffusion took place within the last decade of the period under review. The Polish case is an example where economic conditions imposed a specific stamp on the diffusion process. Farmers who applied mechanisation to a wide range of operations remained a painfully small minority. The majority of those who did purchase machines were concerned primarily with the reduction of labour costs, rather than the general improvement of husbandry. Most attempts to calculate the benefits of the new tools and machines dealt with labour savings offered by threshers rather than increased yields resulting from the use of better ploughs and seed drills. The relatively scant progress in the adoption of machines which offered little or no labour savings would suggest that most Polish farmers, operating on very low profit margins, were far more likely to regard mechanisation as a cost cutting exercise than as an opportunity to improve agriculture. In this the approach of Polish farmers differed markedly from that of their British counterparts. As Mingay has pointed out, it is uncertain whether labour substitution was a major factor in the adoption of machinery in British farming during this period. The use of a range of machines such as seed drills, horse hoes and cultivators increased the number of operations per crop, thus the primary advantage gained from their application was the raising of the quality of the crops rather than labour saving.[138] This is not the whole story - there are parallels with the diffusion of the threshing machine in England, where the machine was adopted far more readily in areas of labour scarcity, while its spread remained sluggish where labour remained cheap, as in southern England.[139] Therefore such a phenomenon is not particularly unusual. What does seem absurd in the Polish case is that labour considerations should eclipse all other factors to such a degree that landowners would be willing to spend 2,000 zlotys on a threshing machine but would not spend 50 zlotys on a Small plough to prepare their fields. Whereas there was sound economic justification for buying a machine which offered labour savings, there was no such justification for neglecting an operation as fundamental as soil preparation. Such absurdities as the attempts to operate seed drills and reapers on fields

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138. G.E. Mingay, *The Agricultural Revolution: Changes in Agriculture 1650-1880* (1977), pp. 43-44.

139. S. Macdonald, 'The Progress of the Early Threshing Machine', *Agricultural History Review*, 23 (1975), pp. 74-76.

both badly ploughed and uncleared of stones suggests that many landowners had a somewhat unbalanced idea of the potential of improvements in equipment.

Table 4.10 Diffusion of selected tools and machines 1815-1863

Tool or machine	Advantage offered	Diffusion
Ploughing and soil preparation	Quality of operation (depth & quality of topsoil)	Negligible?
Seed drills	Quality of operation (even distribution grain savings)	2%
Reapers	Labour savings	>5%
Threshers	Labour savings	50%

d) British technologies and the Britophiles

It has been shown that developments within Polish agriculture did not take place as the Britophile reformers would have wished. Livestock cultivation failed to reach a satisfactory level, and the crops advocated by the reformers, together with crop rotations in general made only modest progress in this period. Most of the positive developments in the Kingdom's agriculture up to 1863, even those of short duration, owed little to the technological advances of the new farming and little to the vociferous efforts of the Britophile reformers. Neither the widening use of potatoes, the increasing cultivation of sheep nor the brief profitability of distilling were areas of major concern to the advocates of British style farming, and it was the relative profitability of these ventures which proved to be more decisive than any major publicity campaign.

In such an economy as that of the Kingdom, there were severe restraints on the degree of progress agriculture could achieve by its own means. The relative insignificance of Polish industry before 1863 offered minimal stimulus to the primary sector. Furthermore, the economic situation which offered such potential opportunities to Polish industries - the union with Russia - proved disastrous for several areas of agriculture, most notably cattle husbandry. The resulting apparent lack of incentives for fodder crops formed an important obstacle to the diffusion of more advanced crop rotations, undermining one of the most obvious paths to modernization. The enhanced communications which facilitated industrial

exports to Russia also reduced costs of agricultural imports from the Empire. This contrasted with the situation in the Poznań region, where the vibrant demand resulting from rapid industrialization encouraged a decisive response leading to substantial increases in yields and efficiency.

It was only in the mechanisation of agriculture that the efforts of the reformers brought significant results, but even in this case the outcome varied for each type of machine or implement. The diffusion of several types of new equipment was widespread where the economic rationale for introduction was high, as with threshing machines, but considerably modest where not connected with factors such as labour supply. In an economy with capital shortages and poor markets, lack of diffusion was as much a matter of lack of incentive as it was of conservatism or ignorance, though the persistence of poor soil preparation was an overwhelming case of the latter.

The Britophile reformers were correct in their praise for the new farming, but the promotion of even individual elements of British farming practices was fraught with problems given the realities of the Polish countryside and the unfavourable market outlook for Polish agriculture. Emulation of British best practices seemed even less likely with the advent of High Farming, which coincided with the beginning of the Zamoyski/*Roczniki* initiatives. The highly capital intensive nature of High Farming made it particularly unsuitable for Polish conditions given the modest capital resources of Polish landowners and the limited markets for their produce. Nevertheless, individual elements of British farming could be hugely profitable for some Polish landowners in specific circumstances, though the huge contrasts between the economies of Britain and the Kingdom made any sweeping adoption of British practices inappropriate to Polish conditions. In all fairness, this was recognised by the Agricultural Society activists, who were fully aware that only certain methods from Britain were realistic in Polish circumstances.

In such a case it is necessary to ascertain just how realistic the Britophile reformers were in their agitation for British style farming. Loudon was of the opinion that efforts of the late XVIII century reformers were of little use, being neither well designed nor steadily pursued. He was however, more impressed with the new reformers of the post-1815 period, though it is difficult to ascertain the extent of his knowledge of developments in the Kingdom.[140] Garbiński was perfectly correct in stating that many earlier reformers were proposing little more than blind imitation of British best practices, with little understanding of the different

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140. Loudon, *Encyclopaedia*, pp. 103-104.

circumstances in which British agriculture had developed. He was particularly scathing about the Anglomania of the earlier agricultural societies.[141] Bartyś recognised two types of reformers, gentlemen-snobs on the one hand and progressive, patriotic and serious farmers on the other. He suggests many of the former used reforms as a springboard for a political career or to gain social kudos. He added that whereas failures resulting from the unthinking introduction and application of foreign technology could discourage many from undertaking similar attempts, the efforts of this group were not neccesarily harmful to Polish agriculture. Although he included Stanisław Zamoyski in the first group, he admitted the usefulness of several innovations introduced by Zamoyski both in the *Ordynacja* and on his private estates. In his second group, he included such individuals as Pac, Chłapowski and Tomasz Łubieński.[142]

This assessment is perhaps slightly simplistic. Certainly the effects of the various initiatives promoted by the early Warsaw societies, whether the Friends of the Sciences or the two Agricultural Societies, can at best be stated as minimal. Most of the personnel active in the latter societies were also deeply involved in political life, both in the Duchy and after the creation of the Kingdom. Stanisław Zamoyski became a senator in 1815, and Biernacki was particularly active in the Polish parliament before becoming a minister in the insurrectionary government. Both could therefore be partly excused for not achieving more.

Some element of superficial snobbery was undoubtably present during what was, after all, a period when 'Englishness' was all the rage. The presence of over 300 English style gardens in Poland by 1824 underlines the extent of this phenomenon.[143] The cultural historian Lipoński has described contemporary Polish scepticism towards this fashion as exemplified by the plays of Polish satirist Aleksander Fredro, who offered some barbed comments about the thoughtless introduction of foreign - mostly British - innovations on Polish estates. It is fairly certain that whatever the sincerity of the early innovators, their frequent ignorance regarding the suitability of the innovations themselves usually resulted in failure.

Whatever the justified scepticism about inappropriate initiatives, hostility to change could still be immense. The experiences of Chłapowski underline the difficulties faced by the

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141. [Garbiński], 'Czyli życie', pp. 13, 38.

142. Bartyś, *Początki mechanizacji*, pp. 34-35.

143. K. Kretkowska, 'Scotland in the Life of the Polish Country Estate 1790-1830', in *Scotland and Europe 1200-1850*, ed. T.C. Smout (Edinburgh, 1986), p. 167.

innovators. The general was faced with incomprehension from the estate officials, who all left his service rather than adopt the new methods, and hostility from the peasants, who refused to use the new ploughs so that he was forced to introduce workers from elsewhere. His innovations caused consternation in the area, and several neighbours appealed to Chłapowski's father to restrain his son before he brought complete ruin on himself, as he had obviously gone quite mad.[144] It seems that an aura of ridicule surrounded Chłapowski in the early years, which obviously spread through all the Polish speaking lands and effected even those who should have known better.[145] Despite such attitudes, Chłapowski's practical approach obviously constituted the best application of British methods in Polish farming. The profitability of the Turew estate after its reorganisation - as demonstrated by the liquidation of a million zloty debt within a decade - can leave little doubt as to the suitability of the Chłapowski reforms. Such a sum - almost £25,000 - from relatively poor farmland obviously speaks for itself, especially added to the fact that the reforms had added a similar sum to the value of the estate. What is surprising is that Chłapowski found so few imitators for so long, as market conditions in the Prussian partition was not necessarily any more favourable in the earlier period.

The Pac initiatives are more difficult to assess. His adoption of several 'British' habits, including the construction of a Gothick castle at Dowspuda, was bound to arouse suspicion.[146] The introduction of foreign - usually German - settlers had a long tradition in the western parts of Poland. In 1803 the future minister Mostowski, who also held land in France, brought over a dozen French peasant families to his estates near Warsaw.[147] After the final partition of the Commonwealth, many Prussian landowers who acquired Polish estates made a point of introducing German peasants, who were generally regarded as making a positive contribution to progress in the area. The Treskow estates at Strzelce were an excellent example of this process. In 1859 the kingdom contained over 12,500 holdings farmed by settlers, of whom the vast majority would have been Germans.[148] What is certain is that none of these settlers caused such a stir as the Scots at Dowspuda. Pac was indeed fortunate to recruit settlers from a region where agricultural progress had

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144. Kalinka, *Chłapowski*, p. 68.

145. Lach Szyrma, *Anglia i Szkocja*, II, p. 5.

146. Bartyś, 'Działalność gospodarcza'. p. 46; a possible characature of Pac - as a Polish aristorcat posing as an English lord - appears in Mickiewicz's *Pan Tadeusz*, the best known work in Polish literature.

147. *PSB*, XXII, pp. 74-75.

148. *Zarys historii gospodarstwa*, II, p. 325.

made such great strides. In a country where good tenants were a particularly scarce commodity, the Pac experiment made good economic sense in a backward and remote part of the Kingdom. The leases granted to the Scots at Dowspuda suggest both a responsible attitude to his role as landlord and an understanding of the requirements of modern farming. What is unforgivable is the fact that the general did not devote more of his time and wealth to publicising his experiment after the fall of the second Agricultural Society. Ironically, the most tangible result of the Pac initiatives was to introduce Scots farmers who were able to inspire and aid Andrzej Zamoyski in his own activities twenty years later. It took a skilled publicist like Zamoyski to make best use of the human resources Pac had acquired.

The early writings on agriculture produced no more than meagre results. It would seem that such writings were preaching to a small number of converted. Measures advocated by writers such as Biernacki and Kurowski were being repeated in the *Roczniki* thirty years later, suggesting that the response of the landowners had been less than overwhelming, despite the tangible results of such innovations as demonstrated by practical farmers such as Pac and Chłapowski.

The initiatives of Andrzej Zamoyski, culminating in the Agricultural Society, must be seen in a totally different light to the earlier attempts to improve Polish farming. Zamoyski himself has attracted a huge amount of unjust critisicm from Polish historians. Postwar researchers showed considerable hostility towards all his initiatives. Kieniewicz has questioned both the results of the practical ventures and the general attitudes displayed by the Count on social and national issues. Thus the *Ordynacja* corvee commutation was dismissed as ineffective and damaging to the peasants, as were similar moves within the Jadów estate. Furthermore, the Michałów modernisation was dismissed as irrelevant to Polish conditions. Kieniewicz claimed the accounts gave a distorted view of the farm's profitability, and criticised Zamoyski for treating his venture as a model for Polish landowners to follow rather than a mere experiment. Lastly, the fact that the farm sustained losses following three consecutive bad harvests in the late 1840s allowed Kieniewicz to ridicule the idea of British style farming in a Polish backwater.[149]

All these criticisms are somewhat misleading. All Kieniewicz's objections to the published Michałów accounts were clearly explained in Zamoyski's initial article on the subject. Furthermore, the Count was explicit in stressing the experimental nature of his venture. As

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149. S. Kieniewicz, *Dramat trzeźwych entuzjastów* (Warsaw, 1964), p. 70; *Między ugodą a rewolucją* (Warsaw, 1962), passim.

for the losses following the bad harvests, few farms even in Britain could have avoided this in such circumstances.

Marxist historians have accused the Zamoyski initiatives as being little more than an attempt by the aristocracy to maintain their status and power in Polish society. Such views ignore the complete lack of political power under the Paskievich regime. Where Zamoyski himself could be threatened with deportation to Siberia for appearing to offend the Russian establishment, any notion of status or power is clearly absurd.[150] Zamoyski's insufficient political acumen during the 1861-62 crisis was unfortunate, but can hardly detract from his qualities as an agricultural reformer.

Rather than assessing Zamoyski's attitudes and activities simply in national or class terms, it makes far more sense to consider his stance as being a version of what he had seen at Holkham and in the Lothians. With the institutional showpieces - from the Klemensów gatherings to the later meetings of the Agricultural Society - based so heavily on British antecedents, it is far more accurate to regard Zamoyski as a man wishing to emulate what he considered to be the huge achievements of the British aristocracy as great transformers of agriculture. This was clear to most contemporaries, and was clearly stated in the *Roczniki*.[151]

On the more pertinent issues of the suitability of the reforms advocated by Zamoyski and his collaborators, later criticisms have often been misguided. Some of Zamoyski's earlier statements stressing the need to introduce certain British practices such as the encouragement of professional farmers with capital into tenancies were derided by Grabski, who pointed out the irrelevance of such a policy in a country which lacked both professional farmers and capital.[152] However, rather than concentrating on some earlier statements, it is better to concentrate on the general tone of the Count's pronouncements: the urgent necessity of long term measures to alleviate the backwardness of Polish agriculture and the desirability of adapting successful developments from elsewhere to Polish conditions. Zamoyski's later writings displayed a far more considered view of the suitability of British

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150. PRO, FO65/448; no 30, Apr. 8, 1854; Zamoyski had dared to invite the British and French consuls (along with the rest of the foreign diplomatic corps in Warsaw) to the annual reopening of the Warsaw Steam Navigation during the diplomatic crisis preceeding the Crimean conflict.

151. [L. Górski] L.G., 'O gospodarstwach wzorowych', *RGK*, 28 (Warsaw, 1856), pp. 260.

152. Grabski, *Historya*, II, pp. 122-123.

methods. Although he remained inspired by the image of Holkham, his view of farming was far from fossilised, as he kept abreast of latest developments in Britain and elsewhere. By championing latest developments in mechanisation, and particularly by his emphasis on the increasing importance of scientific research, Zamoyski showed himself to be fully aware of the crucial trends in farming, and fully understood the fact that agricultural progress was always be a continuous process.

The Agricultural Society was by far the most valuable single initiative in Polish agriculture during the whole of the nineteenth century. Although the role of British societies of this type has been downplayed by later researchers, the Polish society based on British models had a huge significance for the Kingdom's agriculture. As a mechanism for the dissemination of information, the Towarzystwo Rolnicze played a crucial role in the absence of a local press and regional societies. After the long gloom of the Paskievich regime, the Society achieved a massive success in stimulating the enthusiasm of a huge number of Polish landowners, mobilising them for the cause of reform and innovation. By underlining the need to apply only appropriate initiatives at every available opportunity, by encouraging competition and innovation at every step, the Society was able to achieve more in psychological terms in three years than individual inititiatives had achieved in half a century.

The unfortunate political circumstances which led to the suppresion of the Society were a great disaster for Polish agriculture. Like the Lubecki initiatives of the 1820s, the Society was swept away long before its endeavours could bear fruit. It proved particularly tragic that Polish agriculture was deprived of such a body precisely during the period when industrial growth was finally occuring after three decades of stagnation. Although industrialization survived the disastrous uprising of 1863-64, Polish landowners, who suffered particularly heavy losses during the fighting, were never again to demonstrate such concerted enthusiasm for innovation and progress.

Chapter 5

Aftermath and Alternatives

Between 1864 and 1914, the Kingdom's economy functioned in circumstances entirely different from those of the previous half century. With all lingering hopes of greater political autonomy finally dashed by the defeat of the 1863-64 uprising, Poland moved inexorably towards closer political and economic integration with the Empire. At long last the Kingdom had full access to, and direct railway links with, a larger economy with a government finally aware of the necessity of fostering industrial development. A summary of the Kingdom's economic performance up to 1914 highlights both similarities and contrasts between the two periods. This chapter will also consider several projected transfer initiatives which failed to materialise. The most notable of these was a series of proposals suggested by John Cockerill, involving huge investments in a variety of industrial sectors. Given Cockerill's famous generosity with technology as demonstrated in chapter 1.2, it is worth considering whether these proposals could have had made any significant difference to the Polish economy before 1863. Such an assessment leads inevitably to the wider question of the relative importance of supply and demand factors such as access to markets and entrepreneurial performance as determinants of Polish industrial performance in this period.

5.1 The Polish economy 1864-1913

With the outbreak of the last Polish uprising against Tsarist rule in 1863 the Kingdom's economy faced yet another turning point brought about by noneconomic factors. The uprising brought about the final demise of the last major transfer initiatives involving direct technological borrowings from Britain, but its effect on the economy was far from uniform, with greatly different consequences for Polish industry and agriculture.

a) The performance of Polish industry up to 1913

Although Polish industry experienced an obvious measure of dislocation as a result of eighteen months of guerilla warfare, the trend of steady growth which had begun in the late 1850s was barely interrupted by the insurrection. Although the aftermath of the insurrection saw the final erosion of the Kingdom as a separate entity within the Empire, retaliation against the Polish landowning class and savage punishments dealt out to

individual participants, unlike the post-1831 period Tsarist oppression did not include punitive measures aimed at harming Polish industry.

In such a situation foreign capital continued to enter the Kingdom in connection with various projects associated with imperial markets, and increasingly, Polish capital was also mobilised for industrial investments. Industrial output grow steadily for over a decade, until an increase in Russian tariff protection in 1877 created a decade of boom conditions for the Kingdom's producers, with foreign capital and enterprise flooding in to Poland to circumvent the tariff barriers. Table 5.1 shows the quantitative growth of Polish industrial output, illustrating the spectacular progress achieved after the 1878 tariff changes and during the major Russian spurts of the 1890s and 1906-13.

Table 5.1 Estimated value of gross industrial production 1862-1913 (millions of roubles)

Year	Value	Year	Value
1862	50	1885	187
1870	62	1890	216
1877	103	1895	277
1878	128	1900	600
1880	171	1913	1000

Source: J. Łukasiewicz, *Przewrót techniczny w przemyśle Królestwa Polskiego 1852-1886* (Warsaw, 1963), p. 309; A. Jezierski, *Handel zagraniczny Królestwa Polskiego, 1815-1914* (Warsaw, 1967), p. 152.

This growth came in several phases. The first decade after 1863 was marked by a gradual expansion of the textile and food processing industries, together with the construction of further railway links with the Empire and within the Kingdom itself. The first of these was a 27 km line linking Łódź to the Warsaw - Vienna, completed within a few months in 1865. Sponsored by the Polish financier Bloch in conjunction with the town's manufacturers, the line reflected the fortunes of the local textile industry, with tonnage carried rising from 15,500 in 1866 to 120,000 by 1872 and 507,000 tons by 1885.[1] The second important

1. J. Łukasiewicz, *Przewrót techniczny w przemyśle Królestwa Polskiego 1852-1886* (Warsaw, 1963), p. 305.

venture was the Warsaw to Terespol line, linking the Kingdom to a major Russian line being built from Moscow to the fortress city of Brest. Sponsored by a rival Polish financier Kronenberg, once Zamoyski's partner in the Vistula Steam Navigation, the Polish section was opened in 1867, but the Russian side was not completed until 1872-73, when for the first time the Kingdom possessed direct rail links with Moscow and the Ukraine. It was this link, rather than the earlier Warsaw to St. Petersburg line, which finally opened up Russian markets to Polish industries.[2]

The textile industry was the first to respond to the new opportunities. Although production had been rising slowly on the basis of home demand since the mid 1850s, it was only with the establishment of railway links first with the Warsaw & Vienna and then with the central Russian markets that output rocketed. Leading producers invested heavily in new equipment involving substantial transfers of end user technology. The foremost textile manufacturer in the Kingdom, the integrated cotton firm Scheibler of Łódź, had regularly reequipped since its foundation in 1855. Successive waves of expansion took the firm's spindlage from 26,000 in 1866 to 118,000 in 1873 and 215,000 in 1879, by which time the weaving department also possessed 3,500 power looms. When spindlage peaked at 230,000 in 1890, the spinning department of the firm was second in size only to the giant Krenholm plant near St. Petersburg, while in 1886 the weaving section was the largest in the Empire.[3]

Several other producers followed suit on a smaller scale, and the Kingdom's cotton industry increased capacity rapidly during the 1870s when large scale exports to Russia first began, and particularly during the 1890s boom, as can be measured by the growth of spindlage and power loom use as demonstrated by table 5.2. The Russian market was particularly important for the major concentration of production in Łódź, where manufacturers exported between 69% and 77% of their output between 1881 and 1893.[4] While textile production outside the Łódź region had declined since 1831, the new climate saw the development of another textile region centred around Sosnowiec in the Dąbrowa Basin. Value of output in the Sosnowiec district rose from less than 1 million roubles in 1875 to over 12 million in

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2. *Encyklopedia historii gospodarczej Polski do 1945 roku*, ed. Z. Pustuła (Warsaw, 1980), II, p. 315.

3. W. Puś and S. Pytlas, *Dzieje Łódzkich zakładów przemysłu bawełnianego im. Obrońców Pokoju 'Uniontex'* (Warsaw, 1979), pp. 40, 82-84; A. Milward and S.B. Saul, *The Economic Development of Continental Europe 1780-1870* (1973), p. 195.

4. I. Ihnatowicz, *Przemysł łódzki w latach 1860-1900* (Wrocław, 1965), p. 52.

1886, by which time the district accounted for 14% of the Kingdom's gross textile output by value.[5]

Table 5.2 Spindles (all types) and power looms in the Polish cotton industry 1862-1900

Year	Spindles	Power looms
1860/62	116,000	c100
1878	398,000	-
1885/86	505,000	10.572
1899	1,006,000	23,169
1900	1,125,000	24,089

Sources: Ihnatowicz, *Przemysł łódzki*, p. 77, 104; Puś and Pytlas, *Dzieje łódzkich zakładów*, pp. 83-84; Łukasiewicz, *Przewrót techniczny*, pp. 104, 107.

Table 5.3 Polish textile industry: output by value 1860-1913 (millions of roubles)

Year	Value of output	Year	Value of output
1860	13.7	1884	83.3
1871	18.1	1893	90.9
1877	26.2	1909	305.9
1879	50.8	1913	303.5

Data from 1879 onwards for large scale enterprises only

Sources: Łukasiewicz, *Przewrót techniczny*, p. 205; A. Kahan, *Russian Economic History* (Chicago, 1992), p. 83.

Other textiles experienced substantial though less spectacular growth at this time. The woollen industry also expanded on the basis of growing exports to Russia, while linen production was concentrated in the single plant at Żyrardów, where regular investment in new equipment ensured unchallenged predominance in imperial markets. In total, textile production accounted for over a third of all gross industrial production by value throughout the period up to 1913. The importance of the 1878 tariff changes and later upturns in the Russian economy for the rapid growth of Polish textile production are demonstrated by table 5.3.

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5. Łukasiewicz, *Przewrót techniczny*, p. 350.

In comparison with the situation at the beginning of the 1860s (table 3.6, column B) the Kingdom's cotton spinning industry had achieved considerable progress in terms of capacity, and had also proved successful in adopting newer technology appropriate to its market opportunities. Spindlage had increased more than elevenfold from 1861 levels by 1912-13, resulting in a capacity comparable with other small economies such as Belgium and even Switzerland. The adoption of ring spinning, more suited to the production of coarser yarn, was more widespread than that all the major producers except Italy, which made perfect sense given the low quality requirements of low income customers in Poland and Russia.[6]

Table 5.4 European cotton spindlage 1912-13 (000s)

Country	Spindles	Country	Spindles
UK	55,653	Russia	7,668
Germany	11,186	Austria	4,909
Belgium	1,492	Poland	1,322

Source: Milward and Saul, *Economic Development of Continental Europe*, p. 194, table 15.

Other industries also prospered as a result of the Russian connection. The Russian government's decision to extend tariff protection to domestic rail producers in 1876 led to the rebirth of the Kingdom's metallurgy via major technology transfers undertaken by French interests, with the takeover of the moribund Huta Bankowa by the Bonnardel group from Lyons. This was one of the most successful foreign ventures anywhere in the Empire before 1914.[7] German capital also entered the Kingdom in the guise of several ventures in metallurgy and coal mining founded mainly by Silesian entrepreneurs.[8]

Engineering, once one of the more promising sectors of Polish industry, had mixed fortunes during this period. Before 1878, progress was slow in the face of foreign competition, as only simpler machinery was offered tariff protection. It was in the 1870s that Polish firms abandoned the production of reaping machines despite the improvements which had been

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6. Milward and Saul, *Economic Development of Continental Europe*, p. 194.

7. J.P. McKay, *Pioneers for Profit: Foreign Entrepreneurship and Russian Industrialization 1885-1913* (Chicago, 1970), chapter 11.

8. J. Jedlicki, *Nieudana próba kapitalistycznej industrializacji* (Warsaw, 1964), pp. 283, 321.

carried out in Warsaw. Polish engineering was unable to achieve any of the breakthroughs demonstrated by other small regional economies such as the Hungarians with flour milling equipment and the Czechs with sugar processing machinery. Furthermore, as locomotive production in Russia had already been established for decades, Polish firms could not take advantage of this line of production.

Not surprisingly in such circumstances, engineering was an industry which failed to attract foreign investment, but the leading Polish machine makers were able to move into civil engineering and railway related output. Evans & Lilpop, which became Lilpop & Rau after the final withdrawal of the surviving Evans brothers in 1866, abandoned agricultural machinery in 1878 in the face of more lucrative opportunities elsewhere. The firm switched to bridge construction and specialised railway equipment, securing an important niche in Imperial markets.

Engineering was at least able to progress in certain areas because of a combination of sufficient demand and a substantial skill reservoir highlighted in chapter 3.1. Nevertheless, outside these areas the sector's performance was far from impressive. The technological gap which emerged during the decades of stagnation was never overcome, and only a handful of firms produced output of any sophistication.

Sugar refining performed highly credibly during this period, with substantial investment in up to date equipment ensuring increasing efficiency. Production rose from 15,000 tons in 1860 and 20,000 in 1870 to 190,000 tons by 1913. Although the Russian market provided a strong stimulus at first, exports to the Empire declined as a share of total output due to Russian competition and growing consumption at home.[9]

Other industries, less connected with eastern markets, foreign capital or skills fared less well. Despite some investment, flour milling failed to keep pace with home demand, and after the cessation of grain exports the Kingdom became an importer of wheat flour, worth 19 million roubles in 1910 alone.[10] The high returns from the Russian trade meant that both foreign and domestic capital tended to ignore those industries less connected with eastern markets.

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9. Łukasiewicz, *Przewrót techniczny*, pp. 276-290; A. Kahan, *Russian Economic History: The Nineteenth Century* (Chicago, 1992), p. 84.

10. I. Kostrowicka, Z. Landau, J. Tomaszewski, *Historia gospodarcza Polski XIX i XX wieku* (Warsaw, 1966), p. 223.

The Kingdom's economy derived substantial benefits from its links with Russia, but there were two main problems which hampered its performance and threatened to remove its advantageous position within the Empire. The first of these was the ever present problem of Russian acquiescence. Although Polish industries were allowed full access to imperial markets, certain forms of discrimination continued right up to 1914. Measures directed against specific groups of Polish manufacturers included the use of import tariff discrimination against the Łódź cotton industry by the imposition of extra duties on cotton entering by land routes. In 1879 this made raw cotton 15% more expensive for Łódź than for its Russian rivals. Further measures involving raw cotton were regulations requiring use of Central Asian cotton, obviously forcing up costs for Polish producers. One consequence of such measures was the increasing use of inferior quality cotton to compensate for higher raw material costs.[11]

Another measure which brought great harm to the Polish economy in general was Russian reluctance to allow adequate railway construction within the Kingdom. Russian military considerations prevented the construction of a potentially profitable direct link between Warsaw and Posen, and the Russians were particularly reluctant to allow new lines to be built anywhere in the western regions of the Kingdom. At the same time, new routes were constructed in the unindustrialized and sparsely populated eastern districts for the sole purpose of linking up with military fortresses. Up to the World War proposals involving 4,500 km of track had been rejected by the authorities, while the strategic lines in the eastern districts were used to less than 20% of their capacity. As a result, the majority of small towns were not linked up to the network, which was estimated as being 3,000 km short of the economy's requirements.[12]

Yet another form of discrimination had serious implications for the accumulation of human capital within the Kingdom. Among Russian measures designed to obliterate Poland as a separate entity was deliberate Russification via the exclusion of the Polish language from all levels of education within the Kingdom. Furthermore, most Polish students wanting to obtain higher education were obliged to leave the Kingdom to study at institutions within the Empire. In general, Poles had few chances of professional advancement within the Kingdom, and an estimated 600,000 Poles emigrated to the Empire before 1913. Unfortunately for the Kingdom, this number included a large proportion of professionals, including most Poles with higher technical qualifications. Although during this period Poles

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11. Ihnatowicz, *Przemysł łódzki*, pp. 53-54, 60.

12. *Encyklopedia historii gospodarczej*, II, p. 314.

were to earn a huge reputation as entrepreneurial and managerial experts throughout the Empire, these skills could have provided greater benefit to the smaller economy of the Kingdom.[13]

The more serious problem was the future of Polish industries in the face of Russian industrialization. Competition was already fierce in some sectors by 1913. Łódź textiles were being pushed out of certain areas of the Empire, and in turn Russian manufacturers had begun to penetrate the Kingdom, so that by 1898 Russian textile exports to Poland were worth 42 million roubles, almost half the value of Łódź output in that year.[14] With the construction of large metallurgical plants in the Ukraine, Polish iron and steel production rarely utilized full capacity after 1900.[15] The huge wave of foreign investment in the Ukraine and other parts of the Empire, in which rapid industrialization in the 1890s ensured higher growth rates than in the Kingdom, also posed a serious threat to the Polish economy. As foreign investment had been such an important engine of enterprise and technology transfer ever since 1858, the prospect of being sidelined while foreign interest moved directly into the Empire was particularly alarming for the Poles. With the advantage of the earlier start slowly disappearing, producers within the Kingdom faced the problem common to all early starters - the need to innovate continuously to stay ahead of the competition. Had the World War not intervened, the Kingdom's industries would have been forced to invest in the newest technologies or lose markets to competition from within Russia. It is reasonable to assume that the largely self financing textile industry would have responded to the challenge, but whether such investment would have been forthcoming in industries driven by foreign capital is doubtful in the face of the greater profitability of newer ventures in the Ukraine.

By the end of its hundred year existence, the Kingdom of Poland was easily the most industrialized region of the Empire despite the recent advances in the Ukraine and elsewhere. Manufacturing, metallurgy, mining, transport and construction accounted for 20% of the total workforce by 1897, gross industrial output was continuing to rise, and industrial raw materials constituted an ever larger percentage of imports from the west.

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13. Kahan, *Russian Economic History*, p. 89; Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza*, p. 233; A.J. Rieber, *Merchants and Entrepreneurs in Imperial Russia* (Chapel Hill, 1982), pp. 225-229.

14. Ihnatowicz, *Przemysł łódzki*, p. 125.

15. Kahan, *Russian Economic History*, p. 84.

Nevertheless, the Kingdom was still underdeveloped, and even the industrial progress which had been achieved was insufficient to overcome the backwardness in the primary sector.[16]

b) Polish agriculture up to 1914

Unlike industry, Polish agriculture did not achieve substantial progress in the half century following the 1863-64 uprising. For many gentry farms, the granting of land ownership rights to the peasants proved a severe financial setback, taking many by surprise just as Zamoyski had envisaged. Whereas the 1864 settlement granted ownership rights to 695,000 peasant holdings with a total area of 4.9 million hectares, the area under peasant ownership increased by a further 1.4 million ha during 1870-1909, mainly as a result of the partition of gentry farms unable to survive the new conditions. The area occupied by gentry farms fell from 5.8 million ha in 1864 to a low point of 3.6 mill ha in 1906 before a partial recovery prior to the war.[17]

The ukase granting ownership to the Kingdom's peasants was different in nature from that enacted in Russia proper three years earlier, in that it was primarily a punitive measure against the Polish gentry for its part in the uprising. Unlike the Russian emancipation, the Polish settlement did not create new structures binding the peasantry to the soil, and therefore the obstacles to the emancipated peasantry were economic rather than institutional. Zamoyski turned out to be correct in another prediction in that peasant ownership rather than renting led to excessive subdivision of plots resulting in exactly the type of 'chessboard' farming he had warned against. By 1892 41% of the land was occupied by farms with an area of less than 20 ha, comprising 92% of all landholdings. By 1913 over 7.2 million ha was owned by small farms, of which 80% comprised an area of less than 8.6 ha.[18] In such a situation excessive demand for new plots pushed up land prices, and as a result peasant resources were much more likely to be directed towards the acquisition of more land rather than the improvement of plots already held.

Excessive demand for land and subsequent subdivision of plots were exacerbated by one of the more unforseen consequences of the 1864 settlement: rapid population growth which

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16. Ibid., pp. 72, 87.

17. Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza*, pp. 110, 163, 223.

18. Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza*, p. 167; Kahan, *Russian Economic History*, p. 73.

continued right up until the outbreak of the World War. As table 5.4 demonstrates, the Kingdom's population more than doubled during this period.

Table 5.5 Population of the Kingdom of Poland and city of Warsaw 1863-1913 (000s)

Year	Kingdom	Warsaw	Year	Kingdom	Warsaw
1863	4,986	212	1897	9,402	601
1865	5,336	243	1900	10,000	686
1875	6,515	298	1905	11,312	768
1885	7,688	407	1910	12,129	781
1890	8,257	456	1913	13,058	845

Sources: T. Sobczak, *Przełom w konsumpcji spożywczej w Królestwie Polskim w XIX wieku* (Wrocław, 1968), p. 13; S. Siegel, *Ceny w Warszawie w latach 1816-1914* (Poznań, 1949), p. 5.

Even given the industrial expansion already noted, the Kingdom's economy could not absorb such demographic increases. As a result, increasing numbers of peasants found themselves unable to survive from farming alone. While permanent emigration failed to reach the high levels prevalent in the Polish Galicja province of Austro-Hungary where the problem was even more intense, seasonal migration became a way of life for large numbers of peasants before 1914. By 1900 100,000 peasants crossed the border to seek summer work on German farms. By 1913 this number had risen to 380,000, with much smaller numbers travelling even further to other countries for similar purposes.[19]

With little stimulus from Polish industry and continued competition from the Empire, agriculture in the Kingdom failed to live up to the optimism of the Towarzystwo Rolnicze period. Russian competition increased substantially as the completion of railway links to the Ukraine reduced transport costs for agricultural imports. Livestock husbandry, the cornerstone of Andrzej Zamoyski's programme, made particularly modest progress, as demonstrated by table 5.5. Sheep numbers continued to dwindle as a result of cheaper wool supplies from abroad, primarily from Australia. Despite the vigorous campaigns of Zamoyski, Kurtz and others, cattle husbandry also failed to make any significant gains in the face of Russian competition. Only pig numbers remained relatively stable, but the vast majority of pigs was kept by the peasantry.

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19. Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza Polski*, p. 233.

Table 5.6 Livestock in the Kingdom of Poland 1862-1910

Year	Cattle	Sheep	Pigs
1862	2093	3797	1012
1870	2231	4180	1104
1888/89	2518	3755	1295
1899	2957	2767	1193
1907/10	2494	1050	-

Source: *Zarys historii gospodarstwa wiejskiego w Polsce*, ed. S. Arnold (Warsaw, 1964), II, pp. 458, 466, 478.

Thus mixed farming never became established in the Kingdom, which remained heavily orientated towards grain production. This achieved some increases in yields and productivity, but the Kingdom's relative backwardness in agriculture actually increased during the half century following the uprising. Comparisons with the Posen province in neighbouring Prussia, once the Poznań region of the old Commonwealth and the Grand Duchy of Warsaw, demonstrate how Polish farming failed to keep pace with developments elsewhere in Europe. From an identical starting point at the beginning of the nineteenth century, with similar land productivity as late as 1890, crop yields in the Kingdom had already fallen far behind by 1912 (table 5.7).

Table 5.7 Crop yields in the Kingdom and Posen province of Prussia 1890-1912 (100s of kg/ha)

	Poland		Posen	
Year	1891/95	1912	1890	1912
Wheat	10	13	10.5	22.0
Rye	8	11	7.1	18.3
Barley	9	13	8.1	23.4
Oats	7	10	7.7	22.6
Potatoes	73	78	68.3	155.8
Sugar beet	173	206	226.9	305.6

Source: Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza Polski*, p. 160.

Thanks to huge demand from the rapidly growing German industrial base, coupled with some government protection, the mainly Polish farmers of the Posen province were able to achieve results above the German average and on par with leading producers elsewhere in Europe, while their counterparts in the Kingdom obtained yields comparable only with the more backward agricultures such as France, Hungary and Russia (table 5.8).

Table 5.8 Average European crop yields 1909-13 (100 kg/hectare)

Country	Wheat	Rye	Potatoes
Denmark	33.1	16.8	148.3
Belgium	25.3	22.1	186.4
Posen prov	22	18.3	155.8
Germany	21.4	18.2	137
France	13.2	10.4	85.7
Poland	13	11	78
Russia	9.1	8.5	74

Sources: For Poland and Posen province, Kostrowicka, Landau, Tomaszewski, *Historia gospodarcza Polski*, p. 160; for other countries, Milward and Saul, *Economic Development of Continental Europe*, p. 242.

The modest increases in grain yields were insufficient to maintain pace with home demand given the Kingdom's population increase. By 1895 the long tradition of Polish grain exports was a thing of the past. Henceforth the Kingdom was to become increasingly dependent on grain imports. By 1910 the value of agricultural imports exceeded that of exports by 12.8 million roubles.[20]

Even such a small selection of statistics shows that despite some success in developing certain industries, the Kingdom was never able to overcome the backwardness of its agriculture. Although far from stagnant, and considerably more advanced than its Russian counterpart, the Polish primary sector continued to hold back the rest of the economy, a problem which has been only partly solved during the twentieth century.

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20. Ibid., p. 223.

5.2 Alternative development possibilities

The course of Polish industrial development suggests most strongly that demand was the major determinant of success, and thus ultimately, the main impetus for technology transfer initiatives. Nevertheless, it is worth considering the possible impact of some supply driven transfer proposals involving foreign expertise and capital in order to ascertain whether or not such projects could have made any difference to the Kingdom's performance before 1863. These ranged from vague ideas to a major investment package proposed by the continent's foremost entrepreneur, John Cockerill of Seraing. As none of the early transfer proposals took the form of concrete plans, it is possible to assess impact and linkages only in the most general terms.

a) Early mining ventures

The help offered to foreign entrepreneurs under Staszic and Lubecki was obviously effective in attracting many manufacturers to the Kingdom, and appeared to be well known in Britain as well. During Wolicki's mission to Britain in 1825, a local manufacturer in Birmingham expressed willingness to set up business in the Kingdom if he could receive the generous terms already offered to other foreign entrepreneurs.[21] Lubecki, never interested in any venture which would allow foreign control over any transfer initiative, was less favourably disposed towards direct foreign investment in the Kingdom, turning down such proposals by French financiers.[22] At about the same time William Jacob reported on a group of British investors wishing to form a joint stock company to lease the Kingdom's iron ore mines for a ten year period. Although Jacob claimed the proposal was said to have aroused considerable interest in the Kingdom, it seems to have met the same fate as the earlier French idea, presumably on the same grounds.[23]

As no information on the British venture seems to have survived in Polish archives, it is impossible to assess what was on offer. The mining mania of the 1820s was the first British foray into direct foreign investment, and usually involved mineral extraction in the

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21. Archiwum Główne Akt Dawnych, Warsaw; Akta Komisji Rządowej Przychodu i Skarbu, 1449, Wolicki to Lubecki, Oct. 7, 1825.

22. S. Smolka, *Polityka Lubeckiego przed powstaniem listopadowym* (Kraków, 1907), I, pp. 193, 194, 485 fn. 22.

23. W. Jacob, *Report on the Trade in Foreign Corn, and on the Agriculture of the North of Europe* (1826), p. 89.

newly independent states of Latin America. Most of these ventures were wild schemes ending in failure, with negative results for both investors and the host economies.[24]

It is impossible to prove whether or not the Polish venture would have ended any differently. Iron ore extraction in the Kingdom, unlike coal mining or the non-ferrous metals at Olkusz, would not have necessitated the use of steam power for pumping at this time, so it is unlikely that foreign investment would have resulted in any significant technological progress, and it is difficult to see how this venture could have made any difference to the performance of the Kingdom's metallurgy. Success in the venture would presumably have stimulated greater British interest in the Kingdom's industries, but this can be no more than speculation.

Another proposal of equal vagueness dates from 1837, when the Bank Polski under pressure from the Russian military authorities announced its wish to lease out government coal mines and ironworks. Among the unsuccessful contenders was John Cockerill, whose plans will be discussed below, and also an anonymous entrepreneur from Newcastle, whose interest was related by British consul Barnett.[25] In the absence of Bank Polski records it is again impossible to ascertain the details of this proposal or even the identity of the person, so only speculation is possible. It seems certain that any genuine proposal to take over the state sector could have helped avoid the calamitous squandering of resources by the Bank Polski, but even this would have been dependent on the opaque relationship between Viceroy Paskievich and the Bank leadership.

b) John Cockerill and Poland

John Cockerill's numerous links with industry in Poland and elsewhere in Europe have already been noted in previous chapters. As the major early supplier of equipment to the Kingdom's woollen industry and a textile entrepreneur in his own right, Cockerill had been involved with several aspects of Polish economic life since the early 1820s. Towards the end of the 1830s he began to develop a more direct interest in the Kingdom, presumably in response to new opportunities arising from the prospects of industrial development and

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24. For details of the foreign mining ventures, see *An Inquiry into the Plans, Progress, and Policy of the American Mining Companies* (1825); also H. English, *A General Guide to the Companies formed for working Foreign Mines* (1825). For the outcome see L.H. Jenks, *The Migration of British Capital to 1875* (1928), pp. 52-64.

25. Public Record Office, FO392/7, C.J. Barnett, Report on the State of Poland, p. 62.

railway construction in central Europe and Russia. This interest was to culminate in a package of proposals which would have represented the biggest single investment in the Kingdom's industry before 1863, including substantial transfers of technology in engineering and metallurgy. Given Cockerill's generous attitudes towards technology, such proposals implied far reaching consequences for the development of skills and higher technological capabilities within the Kingdom. In the event, the package was shelved following Cockerill's untimely death during negotiations in Warsaw.

The first sign of increased interest from Cockerill came in 1837, when he made a bid for the state mining and metallurgy sectors. Cockerill offered the Bank 300,000 zlotys per annum (£7,100) for the lease. However, at the same time he declared that these plants would require further investment of 20 million zlotys and demanded a loan from the Bank amounting to a third of this sum. Already committed to its own heavy investment programme, the Bank refused his terms and the negotiations came to nothing.[26]

Despite this setback, Cockerill resumed interest in Poland in 1839. His fortunes had changed dramatically following the Belgian crisis of 1837. With vast amounts of capital immobilised in an overextended business empire, Cockerill avoided bankruptcy only by handing over part control of his ventures to a Sursis committee comprising four local businessmen and a government delegate. Naturally resentful of the restraining influence of the Sursis committee, Cockerill was determined to regain freedom of action, and at the end of 1839 he left Liege for Aachen, announcing his intention of travelling to Russia.[27]

The precise purpose for Cockerill's journey to the East remains unclear. The mission was undertaken on his own initiative, without the knowledge of the Sursis committee who were taken completely by surprise. What is certain is that Cockerill aimed to restore his fortunes by pulling off a series of brilliant coups in Eastern Europe, where his enormous reputation far outweighed his temporary financial problems. According to Hodges, Cockerill intended to create the impression he wished to negotiate the sale of Seraing to the Russian government, though he doubted whether Cockerill actually reached St Petersburg.[28] Westebbe, quoting the correspondence of the Dutch banker Hoevenaar and other

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26. M. Orłowski, *Zelazny przemysl hutniczy na ziemiach polskich do r. 1914* (Warsaw, 1931), p. 64.

27. T.B. Hodges, 'The Iron King of Liege: John Cockerill', unpublished Ph.D. Thesis, University of Columbia (1960), pp. 419-428.

28. Ibid., pp. 428-429, 433 fn.

anonymous sources, claimed that Cockerill mentioned prices of between 10 and 12 million francs for the sale of Seraing to the Russians.[29] Henderson claimed that Cockerill was primarily interested in securing orders for the construction of railways in the Russian empire, but was unsuccessful in persuading the Tsar to accept his ideas.[30]

Apart from rumours put out by Cockerill himself, there seems to be little evidence that he was seeking serious involvement in Russia at this stage, and he was certainly not connected with early Russian railway initiatives. Polish researchers, familiar with Russian archives, make no mention of any links between Cockerill and Russian railways. For contemporaries back in Belgium and for Hodges, the main mystery was whether Cockerill intended simply to extend his operations in the East, or whether he intended to forsake Belgium altogether in favour of the new base. From the Polish point of view, it seemed that Cockerill was firmly focused on the Kingdom, with a range of investment proposals involving several different industries.

During 1839-40 both Hoevenaar and the Sursis committee received news from Cockerill regarding successful deals obtained in the Kingdom. The banker was informed that Cockerill had sold textile machinery worth 2.5 million francs, with orders for another 4 million in the pipeline. The respective sums mentioned to the Sursis committee were 3 and 6 million francs, together with orders for 12 locomotives for the Russian government, presumably negotiated while in Warsaw.[31]

Curiously, Polish sources make no mention of these machinery sales, but the Bank Polski negotiators were convinced Cockerill wanted to construct machinery in the Kingdom itself, believing he had already received large orders for Austrian railways, and was hopeful of securing contracts for the planned Warsaw to Niwka line. He certainly toured the Kingdom at the end of 1839, and apparently announced he intended to use the newly completed ironworks at Niwka as his main source of raw materials for his manufactures.[32]

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29. R. Westebbe, 'State Entrepreneurship: King William I, John Cockerill, and the Seraing Engineering Works, 1815-1840', *Explorations in Entrepreneurial History*, 8 (Cambridge, Ma., 1956), pp. 224-225.

30. W.O. Henderson, *Britain and Industrial Europe 1750-1870* (2nd ed., Leicester, 1965), p. 133.

31. Westebbe, 'State Entrepreneurship', p. 225; Hodges, 'Iron King', p. 429.

32. H. Radziszewski, *Bank Polski* (Warsaw, 1910), p. 315; according to Radziszewski it was Cockerill who had first drawn attention to the advantageous position of Niwka as an ideal site for an integrated metallurgical complex, as far back as 1832; Ibid., p. 231.

For a manufacturing centre he appeared to choose the government works at Solec, which had recently returned to Bank management after the termination of the disastrous Perks lease. Cockerill offered 6 million zlotys (c.£140,000) for Solec, payable over 20 years in six monthly instalments.[33] The factory was to undergo considerable expansion in order to process 6,000 tons of pig iron per annum, five times the amount hitherto processed. By the end of February 1840 an agreement for the purchase of Solec had been concluded.[34] Rumours circulating in Warsaw suggested that apart from the railway orders, Solec was to execute large Russian orders for steam boats and engines. Furthermore, Cockerill was also planning to build a large wool spinning mill in Warsaw, and also offered to construct an iron bridge over the Vistula to link Warsaw with the east bank suburb of Praga.[35] Rumours reaching the Belgian press suggested that Cockerill was intending to supply the Warsaw & Vienna line with both rails and stock, and also planned another line from Warsaw to the Baltic. Apparently he intended to use Polish labour, Silesian coal and inexpensive pig iron, possibly from Sweden.[36]

Bank Polski chief Łubieński was convinced that Cockerill was planning to invest 53 million zlotys (£1.3 million) in the Kingdom.[37] In the event, nothing came of the projects, as Cockerill contracted typhoid and died in Warsaw in June 1840. The Sursis committee in Liege, preoccupied with the huge task of selling off the diverse elements of the Cockerill empire, were hardly likely to pursue such a package of vague proposals, and the matter was allowed to drop.

It seems clear that Cockerill was planning some form of venture in Poland. However, given the vague and contradictory nature of the information available, it is impossible to establish exactly what was being planned. It appears obvious that Cockerill's immediate priority was to regain his independence from the Sursis committee. The huge divergence between the different reports in circulation, mostly originating from Cockerill himself, suggest both deliberate misinformation to confuse the Sursis, and a self publicity campaign to restore his

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33. Ibid., pp. 352-353.

34. PRO, FO65/264, no 3, Feb. 24, 1840.

35. PRO, FO65/264, no 3, Feb. 24, 1840.

36. Hodges, 'Iron King', p. 431.

37. A. Bocheński, *Wędrówki po dziejach przemysłu polskiego* (Warsaw, 1966-1968), II, p. 240.

battered reputation as a brilliant entrepreneur. The most extreme possibility - that Cockerill had lost his grip on reality - also cannot be ruled out.

If Cockerill was deliberately misleading the Sursis, it is also possible to question his dealings with the Poles. Despite the optimism of the latter, Cockerill's precarious financial circumstances ruled out any substantial inflows of foreign capital into the Kingdom's economy. The sum of 53 million złotys was equivalent to 25 million francs, exactly equalling the total value of Cockerill's assets in 1838, though without taking into account his debts worth 18 million in the same year. Any investment in Poland would surely have involved the recycling of Bank Polski loans and profits from sales of Seraing machinery rather than new funds from Belgium or elsewhere. Although it can be assumed that Cockerill would have invested the capital in a far more efficient manner than the profligate Bank leadership, it is unclear whether the Polish negotiators were aware of Cockerill's serious financial position.

For the Polish economy, the ventures proposed by Cockerill offered mixed potential. Given his well documented generosity with technological information, the transforming of the Solec works would have certainly resulted in higher quality output and greatly accelerated the diffusion of engineering skills in the Kingdom. Furthermore, Cockerill's huge international reputation and network of customers should have facilitated the securing of export markets so necessary for the success of such a venture.

For the other elements in the package the rationale is less clear. The prospects for a large wool spinning mill would have hardly been bright given the still depressed state of the Kingdom's woollen industry as outlined in chapter 3.4, even if it had been intended as a showcase for machinery rather than a manufacturing venture *per se*. The choice of Niwka as a source of pig iron seems equally dubious, as Cockerill should have been able to ascertain that the local product was of poor quality, particularly as his old employee William Harris was employed at the plant. The problem of the Dąbrowa Basin ironworks could have been solved with the use of Silesian coal - an obvious solution enacted many decades later - but once again this would have required the surmounting of tariff barriers. As for the railway projects, it seems highly unlikely that Cockerill was considering investing in the Warsaw & Vienna himself. It is feasible that by lending his name to the project, foreign interest in the railway would have been greatly increased, though this cannot be proved.

In conclusion, it is difficult to see how Cockerill's proposals could have transformed the Polish economy, unless he was confident of: a) sufficient capital to undertake such

ventures; b) the acquiescence of Prussia and Austria in allowing the formation of a *de facto* multinational enterprise within the Kingdom trading across their respective tariff barriers; c) most important of all, the acquiescence of both the Tsar and the Russian establishment in Warsaw. it is extremely unlikely that all three conditions could have been fulfilled, certainly as Cockerill's bargaining power had declined hugely since 1837. Had Cockerill's proposals materialised before 1837, they would certainly merit more serious consideration, but his own actions suggest a desperate gamble rather than rational entrepreneurial behaviour.

c) Entrepreneurial performance in the Kingdom before 1863

It has been suggested above that none of the abortive transfer initiatives involving potential transfer agents would have made much difference to the course of technology transfer and Polish economic development before Crimea. Similarly, it would be worth considering whether a better performance by transfer agents active in the Kingdom could have achieved any greater success. Chapter 2.3 suggested that the utilization of British personnel by Polish transfer agents did not differ substantially from that occurring in other backward European followers. Moreover, apart from a few glaring exceptions, the Britons active in the Kingdom were certainly no less competent than those employed elsewhere on the continent.

As for transfer agents active in the Kingdom, a brief survey of entrepreneurial performance before 1863 would seem to confirm that the success of supply driven transfers was limited to the period before 1830 and after Crimea. Such initiatives had little hope of success during the crucial period of stagnation between 1830 and the late 1850s. The most successful entrepreneurs, whether Polish or foreign, were inevitably those who chose safer industries connected with state monopolies, or those who invested only in response to perceived demand.

Thus Kronenberg and Koniar, who both derived substantial wealth from risk-free state monopolies, were both rational entrepreneurs while Piotr Steinkeller, a tireless initiator of countless ventures between the late 1820s and early 1850s, was anything but rational. Kronenberg was immensely successful as a result of his involvement with the tobacco monopoly, and flourished after Crimea as both one of the Kingdom's leading bankers and one of the Empire's most vigorous railway promotors. By contrast, he lost heavily as a

result of his support for Andrzej Zamoyski's Vistula Steam Navigation in the early 1850s.[38] Koniar did equally well from the tobacco monopoly, but drifted into bankruptcy as a result of the dubious lease of the Bank Polski ironworks.[39]

At the other end of the scale was an entrepreneur like Steinkeller, whose activities ranged from the original promotion of the Warsaw & Vienna railway to the machine factory at Żarki, the steam mill at Solec and the London Zinc Works. Neither his enthusiasm nor vision could prevent him from becoming hopelessly overextended in the manner of Cockerill or Friedrich Harkort, and total bankruptcy was an inevitable consequence. Unlike the previous two, few of Steinkeller's individual ventures were to prove profitable given the circumstances of the Kingdom.[40]

For foreign industrialists active in the Kingdom, the situation was no different. The Evans Brothers were particularly cautious during the years of the Paskievich regime, while Wilhelm Rau, who had stayed in Warsaw as the manager of Solec after arriving as one of Cockerill's advisors, also had an undistinguished career until new opportunities arose after Crimea. Ludwig Geyer, whose Łódź textile mills brought him substantial success, suffered heavy losses when attempting to diversify into other sectors during the late 1840s and early 1850s.

Such a litany cannot be mere coincidence, and serves to demonstrate the high risks involved with industrial ventures during the critical quarter century of oppression and exclusion from the Russian economy under Paskievich.

5.3 The problem of demand

In chapter 1 it was shown that a major stumbling block of technology transfer is the choice of technologies suitable for the markets they are designed to serve. Most technologies originating during the British Industrial Revolution formed a crucial transitory stage between small scale artisan output and machine led mass production, a progression which found its

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38. *Polski Słownik Biograficzny* (hereafter *PSB*), XV, pp. 325-326; S. Kieniewicz, *Między ugodą a rewolucją: Andrzej Zamoyski w latach 1861-62* (Warsaw, 1962), pp. 30-32.

39. *PSB*, XIII, p. 502.

40. J. Kindelski, 'Monografia Piotra Steinkeller', and H. Radziszewski, 'Piotr Steinkeller: Przemysłowiec Polski', in H. Radziszewski and J. Kindelski, *Piotr Steinkeller* (Warsaw, 1905), passim; R. Kołodziejczyk, *Piotr Steinkeller* (Warsaw, 1963), passim.

fullest expression in the huge scale production so characteristic of American industry from the second half of the nineteenth century. Although it was only in the field of cotton, and to a lesser extent, woollen goods that such mass production occurred at this stage, it is clear that marketability of new technologies was dependent either on the quantity end of the market with ever larger scales of production, or otherwise on particular qualities such as excellence or uniqueness. Whereas the United States and Germany were able to achieve substantial success with a combination of both of these approaches, smaller followers such as Belgium and Switzerland also prospered by securing large export markets as a result of the quality approach.

In such a situation, the theoretical options open to the Kingdom of Poland were: larger scale production to serve substantial markets, or the pursuit of excellence. The latter approach would have required considerable investment in technology and human capital in an economy almost utterly devoid of skills, an achievement which proved far beyond the Poles. For such a backward economy, more basic capabilities were a far more realistic choice. Nevertheless, the problem of securing suitably sized markets for the Kingdom's industrial output was a problem which dictated the shape of Polish industrialization.

The Kingdom's industry could either attempt to break into international markets, or take the easier option of aiming to supply markets within Poland itself or the Russian empire. Exports to western Europe would have required output of a quality the Poles were unable to achieve. When even processed agricultural produce proved difficult enough to export, the Kingdom's relationship with the west remained what it had always been - a supplier of mineral and agricultural raw materials.

In such a situation, the only realistic option was the targeting of home and imperial markets, an option which has aroused fierce debate among Polish and Russian historians for over a century. With the debate being conducted on nationalistic or ideological grounds, no researcher has ever addressed the problem of technological choice in the relationship between Polish industrialization and the likely markets which the new capacity was to serve.

Early Marxist writers such as Luxemburg were concerned about the economic relationship between the Kingdom and the Empire, but post-war Marxist debate has concentrated on the relationship between the Kingdom's industry and Russian and Polish demand. Thus the starting point for the analysis of demand is Lenin's statement emphasising the decisive role

of internal markets in the process of capitalist industrialization.[41] Polish historians always made a distinction between the "external" or foreign Russian market and the "internal" or home market of the Kingdom itself.

As a result of Lenin's ideas and the distinctions between the Russian and Polish markets, all Polish post-war economic historians were obliged to make strenuous efforts to demonstrate the importance of the Kingdom as a market, frequently resorting to contrived arguments to make the reality fit Lenin's statement. Thus Jezierski could dismiss Russian markets as offering nothing more than superficial short term benefits for the Polish economy while another researcher could describe exports as a side street into which the Polish economy found itself pushed.[42]

Those authors who denigrate the importance of the eastern markets are partially correct in that investors were primarily interested in a small number of industrial sectors exporting to the empire while other sectors remained neglected. Thus while investment poured into textiles, agriculture continued to suffer severe capital shortages. Nevertheless, those authors are less convincing when attempting to suggest an alternative path of Polish economic development.

The standard Marxist-Leninist view held that Lubecki should have fully emancipated the peasantry at the earliest possible date in order to create an expanding internal market instead of opting for less reliable exports to the empire.[43] Given the experience of the Polish peasantry after 1863, it is hard to imagine how this group could have stimulated significant economic growth when such an achievement was obviously beyond their French counterparts. The equation of forced market participation with real purchasing power is highly dubious. To suggest that the Kingdom could have achieved economic growth based on its own internal markets, almost in the manner of American industrialization, must surely be dismissed as blatant nonsense.

If the peasantry had been drawn into the market at an earlier date, it is likely that internal demand would indeed have risen, but hardly to an extent sufficient to stimulate any

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41. A. Jezierski, *Handel zagraniczny Królestwa Polskiego 1815-1914* (Warsaw, 1967), p. 117.

42. Jezierski, *Handel zagraniczny*, p. 201; J. Górski, *Polska myśl ekonomiczna a rozwój gospodarczy* (Warsaw, 1963), p. 226.

43. Górski, *Polska myśl*, p. 226.

significant economic growth. When the Kingdom's industry was forced to limit itself to the Polish market between 1831 and the end of the 1850s, a period of painfully slow growth ensued. Only in textiles did investment in new technology prove to be justified in such conditions. Although Missałowa is largely correct in stating that the Łódź cotton industry satisfied solely home demand until the end of the 1860s, it is feasible that it was the possibility of securing Russian rather than Polish markets which motivated textile entrepreneurs. Thus in 1850, before the removal of the tariff barrier, the leading Łódź manufacturer Ludwig Geyer had considered opening a cotton mill in Riga to produce for the Russian market, but the customs union which followed shortly afterwards removed such a necessity, allowing him to expand operations in Łódź.[44] Thus although the absence of railway links delayed large scale textile exports to the empire for nearly two decades after the customs union, it cannot be assumed that the eventual likelihood of exports did not influence investment decisions at a much earlier date.

Marxist and non-Marxist researchers alike have criticised the decision to seek Russian markets on a variety of grounds, though the debate has frequently been conducted on somewhat confusing lines. Górski highlighted the unreliability of Russian markets, underlining the considerable difficulties faced by Polish industry after the loss of those markets in 1918. Decades earlier Boss stressed the folly of ignoring the west by adapting Polish industry to suit the needs of the Russian economy, particularly as Tsarist goodwill could not be counted upon. Luxemburg saw increasing integration between the Kingdom and the empire as amounting to an organic absorption of the former into the latter. Jezierski held that unlike later exports to the empire, the eastern expansion of Polish industry under Lubecki was an artificial phenomenon rather than a logical consequence of the division of labour within an integrated economy.[45]

All these arguments are flawed and miss several essential points. Górski's criterion for economic decision making cannot be taken seriously: Lubecki can hardly be faulted for not foreseeing developments a century later. It is equally pointless to talk about economic integration in the 1820s in such a vast area as the Empire before the advent of the railways. Whether the Poles liked it or not, the Kingdom and the Empire were part of the same political unit after 1815, and few realists who had just witnessed Napoleon's defeat in

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44. E.M. Sigsworth, 'Fosters of Queensbury & Geyer of Łódź 1848-1862', *Yorkshire Bulletin of Economic and Social Research*, 3 (Leeds, 1951), pp. 75-76.

45. Górski, *Polska myśl ekonomiczna*, p. 225; E. Boss, *Sprawa robotnicza w Królestwie Polskim w okresie Paskiewiczowskim, 1831-1855* (Warsaw, 1931), p. 16; Jezierski, *Handel zagraniczny*, p. 192.

Russia could seriously believe that the situation could be changed. In such a case, the Empire could hardly be regarded as a foreign or external market in the normal sense. With the destruction of Polish autonomy in 1831 and the gradual abolition of the Kingdom as a separate entity in the 1860s, economic integration of the Polish economy into that of Russia was an inevitable progression.

The unreliability of Russia and its rulers is a valid point which requires some amplification. Lubecki's initial concessions for Polish industry were secured against the wishes of many at the Russian court, and did indeed depend largely on Russian acquiescence, the withdrawal of which proved calamitous for the early textile industry. Nevertheless, the Kingdom had few choices but to hope for such acquiescence, though it proved particularly unfortunate compared to other dependent regions such as Belgium, Norway or Bohemia. The Poles were simply in no position to dictate the terms on which they entered the eastern markets, and could only hope for reasonable terms of access.

Whatever the Kingdom's problems with the Empire, general Russian attitudes towards industrial development under the three decades of Nicholas I made matters considerably worse. Thus no initiatives in the Kingdom had any serious chance of success between 1831 and 1855. Once Alexander understood the necessity of Russian industrialization following the Crimean debacle, the Kingdom's industries were allowed complete access to Russian markets despite continuing political unrest culminating in the uprising of 1863-64. Although several minor discriminatory measures remained in place until 1914, the Polish economy was never again dealt deliberate blows such as it had received after 1831.

Nevertheless, even without the fickleness of the Tsars or the troubled relationship between the Poles and the Russians, the Empire's economy offered very unreliable markets to Polish industry. it is ironic that while the Poles were able to export only raw materials to the high income economies of western Europe, all their higher value added industrial exports went to one of the lowest income economies on the continent. To a large extent the fortunes of a huge segment of Polish industry became dependent on the Russian harvest. This was apparent as late as the 1890s, when textile exports frequently dropped during bad harvest years.[46]

From the point of view of technology transfer, only access to a larger market such as the Russian could have justified substantial investments in technological capabilities. Kahan

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46. Ihnatowicz, *Przemysł łódzki*, p. 52.

stated that the limit of the Kingdom's domestic market dictated that only external demand could sustain high growth rates.[47] The same holds true for the technological capabilities acquired by the Poles. In the light of subsequent developments, many of the skills acquired in such sectors as engineering before 1830 were surplus to the requirements of the economy after 1831, a situation which no-one could have foreseen. Until circumstances were again favourable and suitable markets became available, technological acquisitions were rarely economically justified and usually resulted in failure. Once Polish industries were again able to penetrate the Russian market, this occurred as a result of substantial inflows of new technologies, and had the link with Russia continued beyond 1914, further technology transfers to the Kingdom would have become essential to maintain the Polish lead over Russian industries.

All this was achieved with the aid of lower technological capabilities. The beginnings of higher capabilities created before 1830 did not survive the 25 years of stagnation. When economic activity resumed, most technological inflows were controlled by the donors and rarely constituted anything more than internal transfers. Had Polish firms wished to maintain their lead over Russian competition beyond 1914, it is likely that higher capabilities would have been necessary. Such capabilities would have been obligatory if Polish firms had wished to make any impact in export markets other than the Russian, a circumstance that does not seem to have been considered while the eastern markets were still profitable.

The pattern of Polish industrialization up to 1914 seems to vindicate Lubecki's original plans, although this occurred in circumstances very different from those envisaged by the Prince. However, it must be concluded that a reliance on such an economy as the Russian for a suitable market was both risky and highly premature before the Russian authorities were themselves committed to development, before the Empire had undertaken the necessary investment in infrastructure which allowed the landlocked Kingdom access to Imperial markets, before the Empire itself constituted a worthwhile and reliable market with suitable purchasing power, and before the troubled relationship between the Poles and the Russians had been stabilised. Until these conditions were fulfilled, no technological capabilities created in the Kingdom could translate into significant achievements - and the market conditions under which Polish industry could operate were decided in St. Petersburg rather than in Warsaw.

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47. Kahan, *Russian Economic History*, p. 85.

Conclusions

The thesis offers, for the first time, an analysis of the Kingdom's economic development as a series of initiatives involving the transfer of advanced technologies originating in Britain to one of the more backward European followers. While these transfer initiatives took place in a framework typical for the European continent after 1815, the course of events was influenced by many factors peculiar to the Kingdom. The thesis has attempted to show that the economic development of the Kingdom of Poland up to 1863 has been unjustly neglected by western researchers, and that the course of events in the Kingdom deserve considerably more than passing mention in economic histories of the Russian Empire. Polish attempts to secure foreign technologies in industry and agriculture were more extensive than corresponding Russian initiatives in this early period. Furthermore, despite similarities such as social structure and agricultural backwardness, the problems confronting the Polish economy were markedly different from those facing the Russians. It is thus important that the economic history of the Kingdom should be considered separately, without merely treating Poland as another region of the Empire subject to the same constraints facing the economy of Russia proper.

The Polish transfer initiatives offer a mixture of impetus, modes and methods involving a wide range of technologies with an equally wide range of outcomes. Given the obvious fact that foreign technologies failed to bring any significant transformation to the Polish economy before 1863, not only would it be easy to dismiss the Polish efforts as unworthy of closer attention, it has proven possible for most non-Polish historians to be simply unaware that so many initiatives had taken place in the Kingdom. Nevertheless, a detailed study of the period has proved valuable in many ways. The many permutations of initiative and outcome offer valuable insights which allow the formulation of more refined statements about the opportunities and constraints of the transfer process, many of which have relevance not only for historical case studies but also for developing economies in the contemporary world.

I

The initial impetus for transfer stemmed from the need to reconstruct the Kingdom's economy after the devastations of war and partitions, coupled with a clear understanding of the extent of Polish backwardness. At first the Kingdom's authorities relied on traditional

methods, employing standard tools of state followership copied from counterparts in Prussia and elsewhere. The accession of Prince Lubecki saw the continuation of some old methods, but several new priorities began to emerge. It is remarkable that the minor aristocrat Lubecki, a landowner from the provinces unfamiliar with the political economy of the day, was able to formulate policies far more forward looking than those of most of his continental counterparts.

Thus before 1830 the Polish authorities came to advocate measures more usually associated with Meiji Japan half a century later, measures particularly essential for enhancing the capacity to absorb and assimilate advanced technologies. These included a policy of state intervention to stimulate the private sector, with the construction of demonstration plants which could be sold to suitable entrepreneurs, and an unwillingness to relinquish control of the transfer process to foreign firms or individuals, with discouragement of direct foreign investment.

Such policies brought tangible benefits before 1830 with the establishment of engineering and textile plants, together with the expansion of a metallurgical sector based on traditional technologies. While both state and private industrial plants gave on the job training to a growing native workforce, institutions for research and vocational training were producing a steady stream of graduates possessing both theoretical knowledge and a measure of practical experience gained at the workplace. While it would be ludicrous to suggest that the Polish economy underwent a huge transformation before 1830, the initial signs were encouraging, with successful import substitution, increasing exports of textiles to the Russian Empire and a general rise in confidence which saw the emergence of native entrepreneurs. As a follower economy, treading a fairly standard path emulating and assimilating British best practices, the Kingdom achieved a reasonable degree of success in circumstances far less favourable than those enjoyed by most European economies.

Political events ensured that the Kingdom could not continue the path of typical state sponsored followership after 1831. The military defeat had several serious consequences: the loss of political autonomy and a planned approach to economic development; the imposition of martial law and twenty five years of political oppression, destroying the confidence of industrialists and landowners alike; and the enactment of measures specifically designed to hurt the Polish economy, including the imposition of tariff barriers to exclude Polish textiles and the closure of the university and the other training institutions founded by Staszic and Lubecki.

The subsequent quarter century proved disastrous for the Kingdom's economy. The woollen industry was thrown into deep crisis following the loss of the eastern markets, never returning to 1829 levels of output by value before 1863. Even the slow emergence of cotton and linen production failed to compensate for the collapse of the woollen sector. Engineering, which had also made tangible progress under Lubecki, was forced to endure a period of painfully slow growth in a generally stagnant economy which posed the sector few technological challenges.

The customs union of 1850 brought little immediate benefit to the Kingdom's economy, which did not recover until the shift in Russian priorities following the defeats in Crimea. The prospects of direct railway links with a substantial Russian network gave tangible meaning to the customs union, while the political thaw boosted the morale of Polish society, with an immediate surge of confidence in the economy. From the late 1850s onwards industrial activity mushroomed as foreign capital and expertise began to pour into the Kingdom with an eye on the vast possibilities of the emerging Russian markets. At the same time, the textile industry underwent a period of self financed expansion generated by improved prospects at home.

For the Kingdom's agriculture, the course of events owed far less to major initiatives for most of the period under review. Largely neglected by both Lubecki and the Bank Polski, most agricultural progress resulted from the efforts of individual landowners. Whereas sheep rearing, potato cultivation and distilling all achieved considerable diffusion, wider initiatives such as improved crop rotations, the utilization of new tools and machinery across a broad range of farming operations, and the introduction of mixed farming with increased emphasis on livestock rearing were limited to a small number of the most progressive landowners.

The persistence of a small group number of advocates of British style farming centred around Zamoyski finally paid off with the formation of the Agricultural Society during the post-Crimean thaw. The new organization enjoyed remarkable success in winning over large numbers of the Kingdom's farmers to the cause of reform, with intelligent use of shows, competitions, public debates in addition to the *Roczniki* journal which had already earned a high reputation for the quality of its contents. The Agricultural Society offered the best chance of mobilising and coordinating the efforts and resources of Polish landowners, and achieved much during its brief existence. Its suppression after only three years left Polish agriculture in a state of turmoil just as industrial growth was accelerating after decades of stagnation.

The period of rapid progress in some sectors of industry and agriculture in the years immediately prior to 1863 could not undo the decades of stagnation between 1831 and the Crimean War. As a result Polish backwardness had increased in the half century after 1815 given the considerable progress achieved in Britain, the United States and parts of Europe. Foreign technologies were thus unable to transform the Polish economy before 1863. Although much industrial progress was achieved in the following half century up to 1914, it was essentially a case of too little, too late. Some Polish industries achieved substantial growth by supplying large numbers of low income consumers in the Empire, while Polish farmers suffered as a result of increased competition from their Russian counterparts.

II

The course and impact of transfers to the Kingdom allow several observations on the appropriateness of technological choices, involving considerations such as the timing of acquisition of new technologies, the role of resource endowment and the relationship between market size and production.

Given the backwardness of the Kingdom, it was inevitable that Poland should share the path of other backward economies in introducing ready made technologies in settings divorced from the original context of their development. Thus British technological solutions in several sectors, evolving sequentially over the course of a century or more were introduced in a short period in circumstances very different from those of the British economy during the Industrial Revolution and its aftermath. Where economic growth was vigorous, as in the United States or certain regions of Europe, this did not lead to negative results. Where economic circumstances were far less favourable, the results could be far more unpredictable, leading to premature or even dubious initiatives as highlighted by Pollard.[1]

Where transfers to the Kingdom of Poland followed a mixture of private and state involvement in response to perceived demand the results were generally positive, as in textile production and, to a lesser extent engineering. In the latter sector Polish developments differed from more advanced economies where the formation of a capital goods industry followed increasing use of steam power in mining or textiles and the gradual mechanization of certain processes in textile production. The Kingdom's engineering firms

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1. S. Pollard, *Peaceful Conquest: The Industrialization of Europe 1760-1970* (Oxford, 1992). pp. 207-215.

thus specialized in agricultural equipment with only occasional forays into more sophisticated tasks. The relationship between levels of development in different sectors over time is exemplified by the subsequent career of Edward Thomas, who left the Kingdom in 1827 after being recruited to manufacture steam engines. Within a few years his factories in Bohemia were producing not only steam engines, but a wide selection of specialist equipment for all branches of the textile industry, together with machines for agroindustries.[2]

In the Polish case, the overall stagnation after 1831 meant that the acquisition of machine making skills failed to produce optimal benefits as the sector enjoyed few opportunities in an economy which placed few technological demands on engineering firms. However, this could not have been envisaged by Lubecki or the entrepreneurs who pioneered machine construction in the Kingdom. The progress that was achieved in the 1820s did at least suggest the likelihood that Polish engineering firms would eventually be called upon to supply a much wider range of goods to a variety of end-using industries.

Such optimism regarding future prospects cannot explain the major transfer initiatives of the 1830s. In any economy where strategic investment decisions could be made by technocrats rather than entrepreneurs, supply driven transfers with little economic justification were all too likely where the planners were preoccupied with the possibilities of the newest technologies rather than current economic realities. In the Kingdom's case, early proposals to invest in coke-based ironworks were ignored while investment decisions were made by Lubecki rather than the planners. A practical realist, the Prince continued with the less spectacular but far more sensible investment in traditional charcoal-based iron smelting, which, although far from ideal in terms of location and scale of plant, was eminently more suited to the Kingdom's resource endowment.

Under the far less prudent direction of Łubieński, the same technocrats who had earlier lobbied Lubecki were able to squander vast resources on coke-based metallurgy without considering the appropriateness of such a technology or the likely demand for huge increases in smelting capacity. The ludicrous outcome, where the Niwka complex and several other projects were closed shortly after completion, and the Huta Bankowa survived only by shutting down most of its furnaces and processing charcoal-smelted pig iron brought in from traditional plants, offers an ample illustration of the folly of initiatives which ignored both resource base and market realities.

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2. *Mittheilungen für Gewerbe und Handel*, I (Prague, 1835), pp. 516-518.

The construction of the Kingdom's first railway was hardly a disaster of the same magnitude, but must rank as a costly mistake resulting from dubious motives of the financial decision makers combined with mistaken assumptions on the part of the planners. While the rationale for investment in technologies concerning transport infrastructure normally involves different considerations to those connected with manufacturing industries, it is clear that the introduction of new infrastructure technologies could have little significant influence on the course of development where all the other circumstances were so unfavourable. The charades over the choice of mode of traction and cost estimates can add only an extra element of farce to an initiative which could never be economically justified in the circumstances of the time. This indisputable reality seems to have escaped the notice of researchers in Poland and elsewhere who have enthused about the boldness of vision and the novel institutional arrangements connected with the Warsaw & Vienna project.

In the event, the Poles had to abandon the railway uncompleted, though not before considerable sums had already been spent. The line was reluctantly finished by the Russian authorities, but its problems persisted right up until privatisation in the new climate after Crimea. Shoddily constructed and poorly maintained, avoiding the few areas which actually did experience some modern economic development, making few demands on engineering, metallurgy or even coal extraction in the Kingdom, the Warsaw & Vienna railway was an expensive and doubtful asset before the post-Crimean change of attitudes. The rapidity with which foreign capital poured into railway projects in both Russia and the Kingdom after 1858 suggests that the construction of the Warsaw & Vienna in the 1840s was totally unnecessary, as it is not unreasonable to speculate that an equivalent line could have been constructed from scratch by one of the foreign-led consortiums vying to gain a foothold in the empire. It would not be flippant to suggest that before privatization, the main beneficiaries of the line were the Habsburgs, who, with Russian help, were able to use it to drive revolution out of their country, an outcome which belied the fears displayed by a previous Austrian emperor.[3]

In contrast with the evolving strategies of Lubecki and the cloak and dagger activities of the Bank Polski and its associates, technology transfers to the Polish textile industry were positively mundane in comparison. Although government policies under Staszic and Lubecki had favoured both the foundation of textile firms and their technological proficiency via generous loans often dependent on the employment of up to date machinery, the upheavals

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3. For the opposition of emperor Francis to early railway construction in Austria, see J. Blum, 'Transportation and Industry in Austria, 1815-1848', *Journal of Modern History*, 15 (Chicago, 1943), p. 26.

of the 1830s meant that the sector was effectively forced to rebuild from scratch once prospects became more favourable. Although Polish textile production always remained an end-user activity with no indigenous advances on foreign technologies, the acquisition of operational capability by the Kingdom's manufacturers was by far the most successful example of well-timed demand driven transfers, which were to prove immensely profitable for the agents concerned.

The appropriateness of British agricultural technologies was a far more complex issue because of the diverse nature of innovations in the primary sector. Whereas many elements of British agriculture were obviously far superior to traditional methods, the capital intensive nature of the new farming meant that it could not easily be copied where capital was in short supply. In the Kingdom, many early advocates of agricultural reforms attempted to introduce British best practices as packages with decidedly mixed results. Despite improvements on individual estates, such efforts made little impact in an economy where the traditions and standard of the primary sector were so different, and where market prospects for agricultural goods were so less favourable than in Britain.

The huge difficulties associated with the introduction of British farming practices in such unfavourable circumstances were finally recognised by the founders of the *Roczniki*. Garbiński's inaugural editorial for the journal poured scorn on the failures of early Britophile reformers, underlining the necessity of tailoring foreign methods to Polish realities, and stressing the need for a more eclectic approach to replace the earlier obsessions with Britain. Although Zamoyski's accession to the *Roczniki* group reestablished British agriculture as the ultimate example to be held up for Polish farmers to admire, the journal's programme remained sensibly eclectic and firmly rooted in Polish realities.

For a number of years, the mature outlook of the *Roczniki* was disseminated only to small numbers of committed reformers. With the formation of the Agricultural Society, the practical views of the *Roczniki* leaders achieved the significance of a national programme. Although Zamoyski's leadership ensured that British agriculture maintained its exalted position in the eyes of the reformers, the Society was at its most effective when it stressed the needs of the Kingdom's agriculture as the sole criterion for introducing innovations. Publicists were thus able to praise British High Farming as a supreme expression of the possibilities of new technologies while clearly dismissing it as inappropriate to the Polish economy.

The diffusion of many aspects of British new farming within the Kingdom followed general European patterns, while the spread of others can only be explained by circumstances peculiar to the Kingdom. Thus potatoes became increasingly important as everywhere else in Europe, but Polish landowners were slow to move away from grain even after the long term prospects for grain exporters were shown to be decidedly gloomy. As elsewhere, the diffusion of threshing and reaping machines was partially linked to the need to overcome seasonal labour shortages, and was most rapid where these shortages were most acute. In contrast, the adoption of other equipment followed a less predictable path. The scant attention paid to soil preparation, which led to so many absurd situations, can hardly be explained by economic rationality.

III

Given the modest success of the Polish transfer initiatives, it would be too easy to simply dismiss the initiatives as failures. Nevertheless, this would ignore the diversity of outcomes, particularly with regard to skill dissemination. Engineering skills were transmitted successfully within a relatively short time, and even the Bank Polski's farcical foray into coke smelting was accompanied by successful skill transmission at the refining and processing stages. The fact that many of these skills remained either redundant or underutilized until the post-Crimean boom serves only to highlight how the possession of a skill base was not in itself sufficient to change the course of Polish industrial development where other factors were so unfavourable. Nevertheless, such successes as the sale of the reaper innovations to Ransome & Sims suggests that some meaningful progress had been achieved. Whatever the overall performance of Polish industry in the period under review, the transfer initiatives had led to the creation of a pool of skills which facilitated rapid expansion and gave many Polish firms an advantage over Russian competition once market conditions became more favourable.

In the Polish case there was only partial correlation between the level of technological capabilities created and the overall performance of the industry concerned. Thus engineering as a sector made only modest progress up to 1863 despite the substantial acquisition of skills, while textile production, which never rose above basic end-user capability, stood on the threshold of rapid expansion. Although the half century after 1863 saw a better performance from the Kingdom's capital goods firms, this was easily outclassed by the success of the textile industry, which strengthened its position as the Kingdom's leading sector without any indigenous innovation in either product or process.

At first glance this would seem to devalue the concept of technological capabilities as a major yardstick of the success of transfer initiatives. Nevertheless, two points should be stressed. Firstly, the ability of Polish textile manufacturers to capture a large slice of the Russian market was mainly a result of regular and successful adoption of foreign equipment ensuring a lead over the majority of competitors within the Empire. Thus Polish firms were quicker to achieve operational capability than their Russian counterparts. Once Russian firms achieved similar levels of operational capability towards the end of the century, Polish manufacturers began to experience increasingly stiff competition, being pushed out of many regional Russian markets by Moscow textiles. Thus any advantage which the Poles enjoyed vis a vis the Russians amounted to no more than an earlier acquisition of the most basic of the capabilities rather than genuine technological leadership which would have accrued from the acquisition of higher capabilities. Without a genuine technological gap, Polish firms were thus much more vulnerable to Russian competition.

This lack of any significant technological breakthroughs also ensured that no Polish manufactures could hope to compete on international markets. If Russia is excluded as a genuine foreign market, no industrial goods from the Kingdom achieved the status of exportable commodities. Innovations which Polish firms were able to achieve, such as the reaper improvements, could not offset other disadvantages such as high raw materials costs and tariff barriers. The absence of major innovations on the lines of Czech sugar refining machinery or Hungarian milling equipment ensured that Polish industry had no chance of exporting to western Europe, and could look only to markets in Russia for as long as most Russian firms remained even more technologically backward.

The removal of autonomous Polish authorities and the emasculation of the Bank Polski ensured that technology transfers to the Kingdom were undertaken by the private sector at an early stage of development, when the state could have still fulfilled a valuable role in stimulating and coordinating economic development. In the new climate after Crimea, the Kingdom's private sector was unequal to the task of spearheading major industrial expansion, with the notable exception of cotton manufacturers. The largely foreign led industrial boom of the following decades did pose certain problems for the Kingdom's economy in that growth was limited to a small number of industries, particularly those catering for the eastern markets. Together with the continuing absence of institutes for developing human capital within the Kingdom, the predominance of foreign enterprise made it increasingly difficult for firms within the Kingdom to achieve anything more than operational capability.

IV

In wider terms the course of events in the Kingdom show that political factors could have a decisive influence on economic development and thus both the rationale and success of transfer initiatives. In most cases in nineteenth century Europe, the absence of political independence did not necessarily prove a hinderance to economic development. Belgian industrialization was greatly facilitated by the active encouragement of the Dutch monarch, while entrepreneurs and capital from Austria and the German states played a decisive role in the industrial development of Bohemia. Norway was another region which achieved substantial progress despite political dependence.

The Kingdom of Poland was not so fortunate. The claims of Berend and Ranki, suggesting that Russia did not hinder economic development within Poland and Finland, cannot be accepted for the Polish case.[4] On the other hand, it would be too simple to claim that the Russians pursued policies deliberately aimed to harm the Polish economy. The reality was far more complex, and underwent several changes in the period under review.

For the first decade after 1815, Tsarist attitudes towards economic development in both the Kingdom and Russia itself were generally favourable. This period saw the launching of valuable training institutions within the Empire, while St. Petersburg supported the Polish authorities in both their internal policies and their efforts to acquire equipment and capital from abroad. With the accession of Nicholas I to the imperial throne in 1825, official support for industrial development gradually evaporated. Even though growing Russian interference in the Kingdom's internal affairs in the years up to 1830 was primarily political in nature, this did sometimes frustrate Polish dealings with third parties abroad, particularly in the case of the attempts to float the London loan.

The only policies from St. Petersburg which were deliberately aimed at suppressing Polish industry were those enacted in the years immediately following the war of 1830-31. The imposition of punitive tariffs and inducements to entrepreneurs within the Kingdom to move east had a devastating effect on the woollen industry and discouraged expansion in several other areas of the economy. Equally damaging in the following decades was the political oppression resulting from Russian military occupation. Frequent arrests and confiscations acted as a powerful disincentive to investment in both industry and agriculture. Nevertheless, given the lukewarm support of Nicholas I and his governments for Russian

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4. I.T. Berend and G. Ranki, *The European periphery and industrialisation 1780-1914* (Cambridge, 1982), pp. 107-108.

industry, there was no serious attempt to turn the Kingdom into an economic colony of the Empire.

The worst period of political oppression and economic stagnation in the Kingdom coincided with the reign of Nicholas, under whom official promotion of industrial development in Russia itself lost the impetus of the early 1820s. This situation was changed dramatically as a result of the Crimean fiasco, after which the need to reduce Russian economic backwardness became top priority. Government support for private enterprise soon ushered in massive flows of foreign expertise and capital, particularly in connection with railway construction. The Kingdom also benefitted from this change of attitudes. Within less than a decade foreign capital had taken over the Warsaw & Vienna railway, constructing a crucial branch line and a major new link in the north west, and began to enter several other industries in the Kingdom. At the same time, domestic capital was mobilised on an increasing scale, linking up with the foreign railway consortiums and initiating massive investments in textiles, machine construction and food processing. By 1863 the prospects for Polish industry had looked more healthy than at any time since 1830.

Although the Kingdom was allowed to share the benefits of the Russian drive to industrialize, the limits of autonomous Polish action were demonstrated by the swift suppression of the first authentic mass movement concerned with economic development, Zamoyski's Agricultural Society. Although the Russians toyed with the idea of granting greater autonomy to the Kingdom, their plans did not involve handing over power to representatives of a body which commanded so much support within Polish society. No previous beneficiaries of economic growth within the Kingdom had enjoyed the moral leadership of society. Lubecki's encouragement of industry had alienated huge numbers of Polish landowners convinced that their interests were being neglected. Łubieński and the Bank Polski clique were distrusted by most Poles, while few major industrialists became involved in noneconomic matters before 1863. The dissolution of the Agricultural Society and the banishment of Zamoyski demonstrated to the Poles that the Kingdom's economic development was acceptable to the Russians only as long as it could pose no potential challenge to the existing order.

Any consideration of political factors affecting the course of Polish development should not ignore the troubled relationship with Prussia. The Prussians never forgave the Poles for Lubecki's tariff measures of 1822, and although it was Berlin which backed down to end the ensuing trade war, Prussian tariffs continued to discriminate against exports from the Kingdom throughout the period under review. As a result, few value added goods from the

Kingdom could hope to cross the Prussian border. Even more damaging was the Prussian stranglehold on trade with western Europe. This raised the price of many imports and seriously hindered the export of processed agricultural goods. British Consul Barnett was plainly aware of the limited military and political viability of the Kingdom without access to the Baltic, and of the restrictions the Prussians were able to impose on Polish trade with the rest of Europe.[5] Although the "Polish Corridor" has entered history as a twentieth century concept, its absence was felt acutely by both Poles and impartial observers. It is not unreasonable to speculate that free access to the Baltic would have given the Kingdom a much better chance of securing high income markets for processed foodstuffs and raw materials, a developmental path which proved so successful for many economies in the nineteenth century.

The Polish case allows the formulation of more general observations on the inadequacies of economic theory to explain economic performance where the course of events is heavily distorted by unpredictable political factors. Whereas some of the political factors influencing Polish economic development can be expressed in terms of economic concepts such as access to markets, other factors do not lend themselves easily to economic analysis. The Polish initiatives belong firmly to a broader European pattern, but the Kingdom cannot be grouped together with independent followers such as France or the German states, nor with the dependent regions which were allowed to pursue development without interference. At the same time, the Kingdom's political dependence equated neither with colonial relationships nor with contemporary patterns of economic dependence. Unlike India in the nineteenth century or much of the Third World in recent years, many of the Kingdom's economic problems resulted from political subservience to a state which was even more backward in most respects. Although Poland paid a heavy price for this subservience, it was not exploited either as a source of cheap raw materials or as a dumping ground for Russian industrial goods. Given such a complex situation, neither dependency theory nor more general theories relating to technology and development can explain the Kingdom's economic history.

V

The Polish case throws up a number of interesting pointers for future research. For specific Polish industries, sources identified in British archives charting transactions between British

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5. Public Record Office, FO392/7, Report on the State of Poland, f. 60 v.; FO65/294, no. 27, Dec. 24, 1843.

capital goods firms and Polish textile manufacturers promise to yield considerable information on the acquisition of operational capability by Polish producers in the second half of the nineteenth century. Hopefully, such sources should help to explain the impetus behind the reequipping of the Polish textile industry, shedding light on the long running debate about the role of the eastern markets.

For the wider question of British involvement in industrializing Europe, the extent of British activities in such a small economy suggests that British personnel were far more important than many researchers have appreciated. Despite the distance, bureaucracy and political oppression, not to mention the sluggish performance of the Polish economy, it is probable that over 200 Britons found employment in either industry or agriculture in the Kingdom: considerably more if the references to 50 Scottish families recruited by Pac can be believed. This would suggest that despite the absence of systematic emigration which took sizeable numbers of Britons to North America, it is likely that total numbers of British personnel active in Europe between 1719 and 1850 - the main period of foreign recruitment - were also huge.

It is certain that an exhaustive narrative of European industrial initiatives involving British entrepreneurs, engineers and artisans, on the lines pioneered by W.O. Henderson, would run to a large number of volumes. Furthermore, the Polish case has highlighted an aspect of British technologies invariably neglected by economic historians, namely the influence of British best practices in agriculture. In contrast to works dealing with the acquisition of industrial technologies, any treatment of agricultural transfers would be more concerned with agents in the receptor economies, particularly the activities of landowners, farmers and publicists. it is likely that studies of European agriculture would demonstrate that the role played by such channels of dissemination as agricultural societies and journals would be much more important than was the case in Britain.

Finally, the Polish case highlights the constant problems of small and backward economies. Most small economies which have achieved substantial economic success have been those which have applied appropriate technologies to secure competitiveness at home and abroad, with a much greater reliance on export markets. Since the nineteenth century, the problem of appropriate choices for small economies with limited internal markets has been compounded by the several factors. Firstly, technological advances have made the transfer process far more difficult and costly with the widening of the gap between the most advanced technologies and traditional practices, particularly as the newest technologies are increasingly scale specific. Secondly, the huge proliferation of independent states since

World War II, including the recent political fragmentation in eastern Europe, has resulted in the creation of a large number of small economies. In 1982 it was calculated that over 50 underdeveloped economies, roughly half the total, had populations of five million or less.[6] Such circumstances make it problematic for domestic markets can hardly to support many import substitution industries, thus the options of would-be acquirers of technologies can often be severely limited without either the securing of export markets or the establishment of regional agreements allowing the construction of large scale plants supplying several neighbouring economies. Given rapid technological advance and the escalating problems of underdeveloped economies, the need to acquire *appropriate* technologies remains as pressing in the contemporary world as it was during the early years of European industrialization.

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6. A.G. Kenwood and A.L. Lougheed, *Technological Diffusion and Industrialisation Before 1914* (1982), p. 213.

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