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Early Electrical Communications Technology and Structural Change in the International Political Economy—The Cases of Telegraphy and Radio

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ABSTRACT *It is increasingly apparent that the roots of current global transformation lie very much in the middle to late nineteenth century and the raft of basic political, economic, socio-cultural and technological changes that occurred at this time. This is mainly because of the development of a set of novel communications technologies that began the information technology-based transformation. This paper briefly reviews the period from 1845 to 1914 to highlight the role of the emergent information technologies of telegraphy and radio in the consolidation of liberal/international forces and then the rise of nationalist military–industrial tendencies. These technologies were primarily concerned with the control of processes associated with the particular forms of politico-economic development prevalent at the time, and as such were of fundamental importance in promoting structural change, including hegemonic transition as Britain was challenged by Germany and the US.*

Keywords: communications technologies, militarism, nineteenth century, radio, telegraph.

Introduction

A few years back it was popular to compare the rise of the neo-liberal new world order, or globalisation, with the earlier rise of international capitalism in the period after 1815. The apparent decline of nation states and associated militarism, the re-emergence of global finance and more particularly the spread of an international and tendentially global culture on the back of a vastly expanded international communications infrastructure seemed to reflect the halcyon years of the middle to late nineteenth century. More recently, the return of the spectre of Cold War, this time focused on the US–China relationship, but also perhaps immanent in the preparation of a European military force to challenge, one way or another, NATO, and of course the rearming of Russia under Putin, have placed militarism and geo-politics firmly back in the picture. Although the war against terrorism following the 11 September attacks has distracted attention, these structural changes are still occurring. Further, the war on terrorism may well increase long-term tensions in

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north Asia, with serious geo-political implications. Similarly, the emergence of a definite resistance to corporate-sponsored globalisation in both the environmental movements (mainly focused on global warming) and the explicitly anti-globalisation movements on both the left and the right have caused some to wonder whether the world is fast moving through the re-run of the golden nineteenth century to re-encounter the rather more difficult decades of the early to mid-twentieth century. In this period, amongst other things, the politico-economics of international growth transformed into the politico-economics of national survival. As a result various radical social alternatives were tried with resultant disruption, including world war and decades of Cold War.

There are arguably further parallels to be made between these epochs. The middle 1800s saw the beginning of the growth of electric telecommunications as core control systems for both commercial and governmental operations, a process very much sponsored by the hegemonic national power, Britain. In the 1990s we witnessed the rise of the new global telematics network, especially the Internet, under the sponsorship of the hegemonic power, the US. In its early phase international telegraphy was almost a British monopoly, and was very much shaped by the interests of British imperialism. The relative failure of Britain to lead the development of radio was symptomatic of the growing power of hegemonic rivals, specifically Germany and the US. In recent times some thought that US techno-military hegemony was being challenged by Japan, or even a northern Pacific power, but this view has waned with the 1997 Asian crisis and persistent weakness in Japan. At the time of writing, US hegemony seems secure; but it is also true that the old giant, Europe, is reawakening from its post-war slumber due to ongoing political and economic reform, most significantly the foundation of a common currency in the form of the euro.

In this article we briefly review the role of telegraphy and radio in reconstructing the international political economy in the years between 1845 and 1914 with a view to better understanding how communications infrastructure and technological development can affect political and economic relations at the highest level.

The Nineteenth Century International Political Economy and New Communications Technology

The second half of the nineteenth century was arguably the golden age of liberal capitalism.[1] If, for the purposes of understanding, we liken the development of this social system to a war waged by it against other forms of social organisation[2] (such as feudalism, socialism or fascism), then high finance constituted the strategic force and small to mid-sized business firms the tactical element. From the period spanning the end of the Napoleonic Wars to the beginnings of the new (formal) imperialism in the 1880s, the basic shape of social progress in Europe, and thus largely the entire world, was primarily determined by a relatively few high financiers acting in league with aristocratic statesmen. Finance as a primary geo-political factor had come into its own in the Napoleonic Wars; combined with the rising industrial power of Britain it had overcome perhaps the largest and most potent military force in history up to that point in Napoleon's army.[3] With the claim to global hegemony settled in Britain's favour, high finance[4] and the British state[5] set about reorganising the international economy to suit the emerging needs of mass industrial development:

> The result was a kind of international interlocking of national banking systems, which represented nothing less than socialization of capital on a world scale. It is easy to see that this interlocking had a distinctly hierarchic structure. The main centres of financial ties that enmeshed the whole world were Britain, France, and Germany.[6]

In effect, with the creation of an effectively transnational currency and finance system, what had happened was that a new global information code had been established. The specific form of this code was money (mainly sterling), internationalised through the establishment of the gold standard and the construction of an international banking network. The purpose of this information form was to better control social development, primarily through the capitalisation of business enterprise, but also through the political leverage of major loans to governments. Like any informational form, the new code required a functional transmission system, and in telegraphy the new international finance structure had just that necessary capability. Telegraphy, as a system which was early on comprehensive in scale but limited in actual information content, or bandwidth, promoted certain kinds of interaction over others. In essence, it promoted centralised, hierarchical control, otherwise known as exogenous control, over local or negotiated (endogenous) forms of control.[7] Thus, as Carey relates, telegraphy was instrumental in centralising control over far-flung colonies in metropolitan Europe and this capacity eventually helped instigate the new phase of formal imperialism:

> It is probably no accident that the words 'empire', and 'imperialism', entered the language in 1870, soon after the laying of the transatlantic cable. Although colonies could be held together with printing, correspondence, and sail, the hold, as the American experience shows, was always tenuous over great distance. Moreover, in colonial arrangements the margin had as much power as the centre. Until the transatlantic cable, it was difficult to determine whether British colonial policy was being set in London or by colonial governors in the field—out of contact and out of control. It was the cable and telegraph, backed of course, by sea power, that turned colonialism into imperialism: a system in which the centre of an empire could dictate rather than merely respond to the margin.[8]

Telegraphy and its Impact

The spatial expansion of telegraphy after the 1840s was a truly extraordinary phenomenon; this completely new means of communicating was soon a genuinely global presence. Only two decades after the first operational submarine cable was laid a nascent global telegraph system had been constructed. North America was connected up in 1866, India in 1870, Japan, China and Australia in 1871, the Caribbean in 1872, South America in 1874, and Africa between 1879 and 1886. The global character of this expansion is highlighted by the fact that in some cases domestic systems had not been constructed even as transoceanic connections were made at coastal points. Capability in terms of international trade and military reach were the determining criteria, not local population or local economic relations. In effect this process represented an early stage of the reconstruction of geography from regionally or nationally based to global, with the systemic control centres again being in Europe and the US.[9]

The international significance of the new technology was highlighted by the creation of the first international organisation in history to operate on a permanent basis in the form of the International Telegraph Union (ITU), created in 1865. Although initially set up by governments, private companies were soon also participating in ITU activities. Interestingly the US declined to involve itself in this novel entity seeing telegraphy as a private enterprise and disliking the censorship provisions. Nonetheless the ITU regulations became the *de facto* operating rules for transnational telegraphy that were followed by other non-signatory parties.[10] Despite the example of the US and some other countries, the willingness of countries that habitually treated each other with suspicion bordering on hostility to cooperate in order to set up an international communications coordinating system for presumed mutual benefit was a truly significant event.

By the end of the century the two most salient aspects of the telegraphic network were its true global scale and the dominance of British technological, industrial and financial capability. In 1895 there were over 300,000 kilometres of undersea cable and a million kilometres of terrestrial lines operational around the world. Between them these circuits carried around 15,000 messages daily. The cable system was completely dominated by the British: British control reached a peak of 70% of global capacity in 1887, and of this capacity the vast majority of systems were owned by private companies. The industrial impact of telegraphy in general, and cable in particular, was substantial: telegraphic systems equipment and operational needs represented cutting edge technology, and because of this, countries wishing to avail themselves of the new systems had to import equipment, methods and personnel from the core industrial nations, especially Britain. There was further concentration within these countries with only a few key firms dominating.[11] In the case of cable construction, the most technically demanding of all telegraphic technologies, the Telegraphic Construction and Maintenance Company, a British firm, made two thirds of all the cable produced before 1900, and three other British firms made most of the rest. French companies made some small cables after 1881, the Germans began to do so in the 1890s, but the US continued to buy all its cables from Britain right up until the 1920s. Furthermore, the British dominance in production was reproduced in cable laying and maintenance.[12] The cables themselves were very expensive, but they could last many years once an adequate technical level had been achieved. The main strategy of the cable companies was to concentrate on improving technological aspects of transmission, and to dissuade competition by organising the industry through cartelisation. By the end of the nineteenth century, albeit operating largely obsolete cables, the cable companies had stagnated to being comfortable but somewhat moribund industrial concerns.[13] US interests steadily began to challenge British power across the busy Atlantic, but one British group came to prominence by virtually taking over the installation of cables to link up the far-flung areas of the British Empire. By 1892 this group, the Eastern and Associated Telegraph Companies, controlled almost half of the world's cables and although acting without formal government support had effectively become the British imperial communications system.[14]

Generally increasing imperial tensions toward the close of the century[15] resulted in the relevant governments moving to reconsider the structural configuration of the global telegraph network. With vast, remote imperial interests to defend, Britain was primarily concerned with the problem that its strategic and commercial interests did not effectively coincide. As for the other major powers, they were more concerned about British dominance of the cable system, and the

capacity it gave Britain to manipulate it in its own interests.[16] Eventually of course the relationship between imperial reach and rapid communications had become apparent to all, and from the beginning of the 1900s governments became much more active in the cable business because of this awareness. They were conscious of the need to support transnational telegraphy because of its stimulating effect on trade, and they also became increasingly concerned about strategic issues, encouraging and sometimes financing new cables solely for military-related purposes.[17]

An important aspect of the new industro-military arrangements which arose towards the end of the century was the creation of huge corporate enterprises able to meet the market needs of entire countries.[18] The products of both state and private financial sponsorship, these organisations brought together a number of previously separate operations in factories distributed around a country but linked by post, telegraphy, and increasingly, telephony.[19] They were typically organised as strict hierarchies with minimal internal negotiation, and in constructing them out of a matrix of linked market relations, their progenitors created a number of potent sites of wealth generation and socio-industrial organisation.[20] The large corporation was initially (except in the US) in effect a virtual extension of the state,[21] which was itself increasingly portrayed as a popular, socially representative form of social governance. The large corporation would progressively claim more and more social resources until its wealth-generating capability and organising skills would make it a growing rival to the structural power of the nation-state itself.

The rise of the large corporation in the core countries was just one aspect, albeit an important one, of the general shift in the global political economy which was most centrally characterised by the reorientation from liberal-internationalist organisational principles to nationalist industro-military structures. At the root of this shift were the social dislocations at all levels brought about by industrialisation under predominantly capitalist (market) relations. National political economies were fundamentally restructured by the socio-political disruption caused by the material conditions of industrialisation, which, within those areas affected, completely altered the way human beings lived on a daily basis. In addition, capitalist economic relations increasingly concentrated money, and therefore social power, at new levels only notionally connected to the specific underlying social conditions which generated profits and capital accumulation. That is to say, the wealth and power resulting from the vast increase in industrial productivity did not necessarily flow to those doing the actual work, be they inventors, managers, engineers or workers, a fact that brought inevitable industrial unrest and political dissent. Thus, the formal imperialism of the last part of the century was itself partly a response to the political unrest brought about by this sustained and deep-seated social disruption.[22]

The industro-military tendency was fundamentally an international one, in that international pressures directly influenced it, but it was also realised in the form of specific national variations because it was in each case largely directed by national governments and nationally-based industrial interests.[23] Essentially, it arose in large part out of the recognition that industrial power increasingly determined military capability, and that, overall, military capability was becoming ever more potent due to both new weapons and new forms of military organisation.[24] The result of this, in a world where the ultimate relevance of military strength as the final arbiter of international power was unavoidable, was the rise of the need for state intervention

to develop the necessary strategic industrial base.[25] Ultimately, this represented an extension of the 'balance of power' concept into the relative national economies, as Sen explains:

> It (was) this apprehension of industrial backwardness in a world of industrially and, therefore, militarily advanced nations that prompt(ed) the State to intervene to implant and speed up the process of industrial transformation. Thus at bottom the motivation for rapid industrial change (was) almost invariably of a military nature. Other factors like the desire for economic autonomy (were) important, especially for small countries who (could not) affect the politico-military equation, but even economic insecurity ultimately (stemmed) from the underlying militarisation of international political relations.[26]

The Napoleonic Wars had demonstrated that war had moved to a new scale of operation with vast numbers of men and huge amounts of material being mobilised. One of the first telegraph systems (the Chappe system) was deployed by the French to warn of invasion, and subsequently force projection capability of all the major powers became dependent on the interconnected development of the electrical telegraph and railway technology.[27] This salient fact was illustrated by the central role of telegraphy and rail in the mass mobilisations of the Austro–Prussian and Franco–Prussian wars of 1866 and 1870–1:

> While the world held its breath, Prussian mobilisation and deployment during the wars against Austria and France proceeded with a clockwork precision that could barely be imagined until then. Hundreds of thousands of men were called up, formed into regiments, the regiments formed into divisions, the divisions into corps. Each unit was then issued with arms, merged with its supporting services, marched to designated stations where they were awaited by specially designated trains, and transported to the border where unloading proceeded with the same relentless efficiency. In both cases, so superior were the Prussians in utilising telegraphs and rails that the outcome of the conflict was decided almost before the first shot was fired.[28]

War became increasingly systematised, and by a series of small steps the major powers became effectively integrated into a continental-scale war machine. This was because mobilisation by one nation inexorably led to a response from others in a domino effect. Ultimately, even the supreme commanders of each nation could not individually control the product of this operational integration which was an inherently unstable international order ready to explode into actual war. As van Crevald observes, 'In 1914, with the would-be commanders standing helplessly by, it played a major role in dragging the world into the largest war in history to that point'.[29]

The immediate and resounding victories of the Prussian army exemplified the centrality of industrial strength in relation to overall military power. However, due to its global strategic importance and use of high technology, the most significant aspect of industro-military rivalry was naval. Britain was still the dominant maritime power and remained the pre-eminent global power overall. In that country the impact of naval competition greatly changed the course of industrial development generally, and since battleships were at this time high tech *par excellence* this activity

had an even greater affect on general technological development.[30] Led by high ranking military men, such as Admiral Fisher, and heavy industrialists in search of lucrative arms contracts, a strong constituency for greater spending on the military arose in Britain after the 1880s. Their efforts were generally successful and this pressure was effectively translated into government policy in a context increasingly formed by industro-military competition with Germany where similar forces were at work. The Royal Navy budget increased five times over from 1884 to 1914; by 1913 fully one sixth of the male work force were on the payroll of the Navy or naval contractors.[31] What had occurred was that the major area of technological innovation in an otherwise fairly sluggish industrial landscape was the manufacture of arms. As a result the major arms companies became overall industrial leaders. Vickers and the British Small Arms companies were, by 1914, through their subsidiaries Wolseley and Daimler, the largest car-makers in the country.[32] Party politics was fundamentally affected by this shift in national resources: by the mid–1890s the rise of the military-minded heavy industrialists in Britain had led to a split in the Liberal Party. This in turn resulted in new approaches to international relations which were decidedly more favourable to the industrial interests.[33]

Radio and its Impact

The fundamental shift in basic politico-economic structural arrangements was shown clearly in the development of the new telecommunications technology, radio. Radio as a communications and control technology found its first major usage in the coordination of shipping; that is, as an additional control system for an existing, highly developed transport technology. Britain was the centre of early developments because that country possessed the most important naval and merchant marine resources in the world, but other maritime powers were also involved, most significantly the rising powers, the United States and Germany.[34]

At this point the growing conflict between the logic of transnational techno-commercial development and nationally based politico-militarist tendencies became manifest in relation to the vital new communications technology. Because of his proprietorial control over the technology, Marconi, the inventor of radio, an Italian who was based in Britain, attempted to establish a worldwide technological monopoly in the growing marine communications field. However, this enterprise was resisted by American and German radio developers, who had entered the field in 1903, and their respective governments. Marconi's initiative resulted in an international conference in Berlin in 1903, convened by the German government; Marconi, supported by the British and Italian governments, refused to yield ground. The conference did carry a resolution that coastal stations were obliged to communicate with any ship, whatever the brand of radio equipment, but this proved meaningless as the British refused to enforce the rule.[35] A second conference was held in Berlin in 1906 and this time Marconi was forced to accede to demands to communicate with non-Marconi operators. In addition, specific regions of the spectrum were allocated for commercial and military use, and other technical standards were adopted (although the US refused to ratify the treaty, however, because of concerns over the international regulation of 'American ether').[36] In 1908 an agreement was made to accept all transmissions at international stations; later, in 1912 and the sinking of the Titanic, legislation was passed in Britain, the USA and other maritime countries requiring ships over a certain tonnage to carry radio as a safety measure. Detailed regulation of low and

medium frequencies was also implemented (in the US, Congress passed the Radio Act of 1912 and allocated administration to the Department of Commerce).[37] Marconi's marine radio monopoly was well and truly broken and the general possibilities of radio established, which also greatly assisted Marconi, still the major commercial entity, as well.[38]

From the outset radio was fundamentally different to telegraphy as a communications technology. To a significant degree it was the character of this difference that enabled the challengers to British hegemony, basically Germany and the US, to erode that nation's dominance in international telecommunications. Radio did not necessitate a comprehensive, networked physical infrastructure in the same way telegraphy did (hence its early name, wireless). Instead because radio signals were beamed or broadcast the only forms of equipment that were needed were the transmitter and the receiver. As such the economics of radio operation were very different to those of tethered systems with their comprehensive and expensive infrastructural investment. Furthermore, radio's optimal performance occurred over water, and here in particular the economics of radio were much less determined by the distance covered. The Marconi company, which originated the first functional radio system, understood that it controlled a totally novel kind of operation which was intrinsically international in scale. Attempting to exploit its situation the company tried to establish a global monopoly in the same way telegraph and telephone companies had tried to establish regional and national monopolies. Marconi's attempt at monopolisation, however, depended on the construction of technological systems that were compatible and patent law that could enforce Marconi's position. This was entirely different to the situation with tethered communications which revolved around systems economics and the concept of natural monopoly.

There was no competition at all to radio in maritime communications, and Marconi saw this fact as the key to commercial domination. The company had broken its formal ties with the British state, in the form of the post office, but it found that governments were still primary actors in international affairs. National rivalries were still more important than any international commitments to unfettered commerce, and Marconi found that the important German and US governments supported their own radio manufacturers when it came to international negotiations.[39] The abiding problem of maintaining systemic integrity was solved not by the establishment of an institutional monopoly based on technical criteria, as Marconi wanted, but was instead achieved through intergovernmental agreement. In spite of their growing enmity, governments found common ground in the intent to establish technical standards on which to base the emergent communications technology.

Marconi learned that power, including commercial power, does not inevitably proceed from technical superiority. Instead, a whole other set of issues entered into the calculation, including political aspects. In the case of radio the very strength of Britain in transnational telegraphy impacted on the way in which the new radio technology was received by British interests.[40] But it was exactly this condition that made radio more attractive to certain other nations.[41] All in all, Britain's inability to exploit the advent of radio as effectively as some other nations also indicated the decline of British Imperial hegemony, to the benefit of putative challengers like Germany and the US. The new communications technologies altered the underlying conditions of international dominance, especially in terms of commerce and military power. At this juncture the structural power of the nation state

was reasserted over the trend to transnational techno-commercial development. Furthermore, the pecking order of the nation states themselves also underwent change. Earlier, Britain had successfully exploited the then novel telegraph technology to consolidate its global hegemony, but as the hegemon its interest lay in maintaining the status quo. Due to both its commercial and military importance, radio was the sort of technology that altered politico-economic paradigms. Britain had appeared set to lead in radio development because of the pivotal role of Marconi, but in the longer run it was incapable of doing this. In other words, as the dominant power the British basically wished to maintain existing conditions, geo-political and techno-economic, whilst the rising challengers, notably the US and Germany, took the opportunity to promote technologies that would alter those conditions. In 1914 the outbreak of war, many years in the making, brought these matters to a head. War both exposed the real strengths of the belligerents—industrial, organisational and otherwise—and highlighted the capabilities of various emergent technologies. Thus, whatever doubts were harboured about the technical viability of radio were dispelled by wartime experience when mobile communications became essential and all major industrial nations had to take a hard look at the still relatively new wireless communications technology.[42]

> The 1914–18 war gave an enormous impetus to the development of radio for the use of the fighting services. The usefulness of radio for point-to-point communications became apparent, even to those who had been the most skeptical. While people in England had been unwilling to see radio services established, other countries had adopted a different attitude.[43]

Conclusion

How, then, can we sum up the relationship between the early electrical/electronic communication technologies and the wider processes of political and economic development through the latter part of the nineteenth century and early years of the twentieth? Electrical communications technologies first emerged around the middle of the nineteenth century in the context of an already existing global political economy centred on Northern Europe. This essentially hierarchical arrangement was effectively controlled by a relatively small number of men who operated at the rarefied levels of state policy-making and international high finance. But the countries these men lived in were also the industrialising countries of the nineteenth century, and the broad industrialisation process itself began to change the basic character of society. Even as it supported and promoted the growth of the global political economy, industrialisation steadily changed the nature of emergent technology, social relations generally, and international relations. Industrial processes, which were becoming increasingly systematised, complex and large-scale, required more complete control over materials, technology and human beings at various levels of interaction. This necessitated new organisational arrangements, new control technologies, and new political relations. Industrial interests, their bankers, the professional classes, and finally the working classes all pushed in their various ways, sometimes collaboratively, sometimes in open conflict, for increased economic and political power as the century's end approached.

The geographically extensive but low signal capacity character of early communications systems effectively accommodated the control needs of the high

level finance–political strata in their global operations. The highly abstracted messages of financiers and diplomats were readily coded and worth the expense of doing so. However, these long distance control systems also promoted the rise of formal imperialism, and increasingly national military coordination, which fuelled the late nineteenth century arms race. When radio technology arrived around the turn of the century its development became enmeshed in this process of growing industro-military competition. The broad result of new communications technology inserted into an already nascent global political economy was further consolidation of those prevailing post–1815 power structures which operated most effectively on a global scale. These were the international financial institutions and the high level political, diplomatic and military networks; only to a lesser degree were the most successful operations in the form of industrial firms. As Schwartz has argued:

> The telegraph network sufficed to create a global market in money, linking primarily banks and stock exchanges and only secondarily firms. Firms had to rely on physically moving people and information via the mails and regularly scheduled shipping . . . This made it virtually impossible to manage firms from a distance.[44]

Historical comparisons are in the end always somewhat facile; history never simply repeats due, if nothing else, to changes in technical capacity. But we need appropriate stories to arrange our thinking about social change, including the structural effects of new technology, and histories are as good as any. This paper has discussed certain structural changes associated with the emergence of new information technologies in the latter nineteenth century and in passing suggested parallels with current developments. Certainly some of these parallels seem relevant; the conflict between tendentially global commercial and technical logic and that of increasingly strident nationalist social programmes seems an obvious one. It is difficult to make more specific claims: for instance, it is not yet the case that satellite communications promises to threaten US, or a least Western, politico-economic dominance in the same way that radio came to work against British hegemony. However, various technical developments in cheaper satellite or other high altitude communications systems may yet make such a change more likely because they would allow less developed regions to avoid the cost of setting up expensive terrestrial (wired) systems and leapfrog straight into the mobile communications age.[45]

We might also make a comparison of the emergent US–China competition with the US challenge to Britain in the nineteenth century. The development of telegraphy and then radio enabled the US to maximise the exploitation of its popular and physical resources in a context of national mass-industrial growth. These new communications technologies largely negated the problems of distance, allowing an effective aggregation of wealth and capacity to challenge Britain's own, highly concentrated power. It may be that China, and perhaps even India, can exploit the new telematic systems with comparatively more efficiency than the US due to their very large but increasingly well-educated populations.

Those possibilities all lie in the future, and to some degree, of course, what actually happens will depend on just what lessons leaders do take from the past. One clear lesson is that substantial shifts in core technologies can play a fundamental role in the progress of nations and effect change in the basic structures of global development. In the period preceding World War I telegraphy

and radio were technologies that were instrumental in the eclipse of one global hegemon and the rise of a successor, and crucial to the associated transformation of the international and emergent global political economy.

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