

LANDES

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Well briefly it begins in England because it's in England that the pressure of demand of the market is felt most acutely. And it's in England that the older system, mode of production, is proving itself inadequate to deal with this market, with this demand. AND that is just the beginning and then you have to break it down and ask why is demand so strong in England? And why is the mode of production no longer adequate? And I think the answer is the English, before anyone else, moved to a new way of making things. Of making cloth, textiles, and various fibers and so on and selling them. And the way they did this was to move production from the towns and the cities into the countryside. To start using women and children as well as adult males. And this system of cottage production made it possible to reduce costs considerably. And so they were in a much better competitive situation, position than other producers in other countries. Often tied to the rules of the guild system and limited in their possibilities. So the English begin to sell their products not only in the home market which is already substantial, but abroad in large quantities. And that means that the opportunity is there to make more goods and to make more money.

The question is how do you do that? Given the cottage system, the way you do it is to find more workers. AND to move farther and farther afield, look for more and more people at greater and greater distances to make the yarn and to make the cloth and so on for the finished product. And what they found was, after a while, that this became more and more costly. That costs rose rapidly with distance from the central market place, the town where the goods were to be delivered and so forth. And what's more they ran into shortages of labor that increased their costs considerably. In addition they found that the workers did not respond to the normal incentives. If they offered them higher wages, the workers would produce less. Because they had a sense of what they wanted and what they needed and when they'd worked enough, they would prefer not to work and enjoy the opportunity of leisure. So you've got a very strange rhythm developing. Workers who would deliver their product on Saturday, say, take the money and start celebrating immediately Saturday night, Sunday, and Monday was known as St. Monday because that was also a holiday. They'd sort of straggle back to work on Tuesday and Wednesday get serious. Thursday work a little harder and Friday maybe work around the clock in order to get the goods in on time. It's the sort of rhythm that we're familiar with from students in university. Who have papers to deliver and so on and ride in the beginning and relax. And then as exams get closer and so on they work harder and harder toward the end. So you had this, you had this rhythm, I mean there was nothing you could do about it because these people worked at home in their cottages. And you couldn't supervise the work and you couldn't compel them to work. Normally you would expect they would work if you paid them more. But you add, what the communists call a backward redundant supply curve, the more you paid them the less they had to work.

This is a perfectly legitimate choice of leisurists against work but it was very frustrating to the manufacturers, very frustrating. In addition, the more the demand rose, the more valuable the materials the workers worked with, the greater the incentive to steal these materials. The worker would not have called it theft. The current word in the 18th century was embezzlement. The point is the worker is entrusted with these materials and anything he could set aside for himself he could then work up and market the final product himself at some greater profit than simply what he could earn when he sold to the manufacturer. So these are weakness in the system. What are sometimes called internal contradictions which became worse and worse as the market grew, as demand grew and the manufacturer is getting more and more frustrated. So they had a great incentive to find some way to substitute capital for labor. To use machines rather than people. And to use machines to impose discipline on the work force. By bringing the workforce into, what came to be known as, the factory. Into mills, into buildings where the workers would no longer be working at home at their own pace but working under supervision at the pace set by the manufacturer. So everything conjoined here in terms of opportunity for profit, in terms of the weakness of the old system to promote this introduction of a new mode of production. Which came to be known as Modern Industry, a Marxist term, or a machine production or factory system.

Whatever the term used, it refers to one or another aspect of this gathering workers under one roof, to work under supervision, using machines that are driven, not by animal power or force but, by machine power. Of course the question of where the power came from is crucial. And in the earliest such mills, the power came from water, falling water. THE earliest mills were built in the

country typically on streams and used water wheels and so on. The steam engine comes in only later. The earliest mills in the 1760's, well actually the very earliest were actually animal driven. Using oxen or horses to work huge wheels and to walk in a circle driving the wheels that would then drive machinery. But that was a particularly expensive way of doing things and that system was dropped very quickly in favor of water wheels. Which were a technology well known that went back to the middle ages which had been used to drive corn mills and other kinds of mills and were now used to drive spinning mills. So initially its a dispersed industry on water just like the Slater mill, here where we sit today, was built on a water course. Where there's a fall in the water which would drive a wheel and then would drive the machines.

The steam engine which was invented much earlier is not available for use to drive machines until the 1780's, 10, 15 years later. Before that it had been used primarily in mining, in pumping. And it was only when new devices were developed to use steam power to use wheel work, to turn wheels as again simply to work back and forth to turn pumps. Not turn pumps but work pumps, that you got a new age of manufacturing. You got the steam engine as a new symbol for a for a industrial revolution. But initially it's the water wheel.

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Well, of course history abhors leaps and technology does too. And there is almost always some basis on which to draw in order to create new devices, new techniques and so on. AND so here, there was some experience with machines. Indeed there were even machines in textile manufacture. Some 30, 40 years earlier, the British built the silk throwing mills which used a special machine to throw silk and to prepare it to be turned into yarn, to turn it into yarn for weaving.

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So there was this. There were knitting machines. There were ribbon machines. So there was some experience with articulated devices with moving parts which worked together to produce motions and to manipulate threads etc... There was also, and this in some ways was even more important, considerable experience with this type of work and the building of these devices in one particular branch and that was, clock making. 2:05:00

And its not an accident that when they looked for workers to build these machines and to maintain these machines, they advertised for clock makers. This is the pool of experience and know how that they could draw on to do this sort of work. And they called the wheel work of these machines the wheel trades and so on. They called them clock work. That was a great advantage because England did have a substantial pool of such people. Who could be drawn over to the textile industry and to any other industry that began to work with machines. And could draw on their earlier experience. They had a particular advantage because making things like clocks and watches is excellent training in precision work. This called for considerable experience with devices to cut, gearing and so on. And cut them with great precision. And as a result these people were particularly well prepared. The clock making industry was in a way the pioneer in the construction of machine tools.

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That is the tools to build machines and to work metal. But from the point of view of the clock making industry this was machinery on a very small scale physically. These were small devices to work with small objects on a small scale. But they could be translated into a instruments that could work on a larger scale.

The other area of expertise that the British could draw on were the so-called mill wrights. There was a profession that had developed over the centuries building the mills that ground the corn, that worked with water wheels. That installed water wheels.

Connected the water wheels to the various devices that they were intended to drive. These mill wrights were also very important in the construction of the early textile mills.

So there were these two pools of experience that the British were particularly well provided with. And we know that to some extent, although similar pools existed in other countries, they were not as rich, either in experience or not so mobile as the British pool was. That is if they had been it would have been less necessary for these people when they tried to copy the industrial revolution, it would have been less necessary to draw on the knowledge and experience of British artisans. But they do in fact import people from Britain.

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Because the British seem to have been better equipped to do this kind of work at least with these textiles. Now I don't want to imply that somehow Britain was far in advance technically or scientifically, far in advance of the countries across the channel. Particularly a country like France which had its own long manufacturing tradition.

The British were moving ahead in a branch which was destined for enormous expansion. Which was a branch which had great market potential because it was a cheap fabric. Because it could be sold at low prices to a large and growing market of ordinary people. Whereas the French, who made some of their greatest technical advances in the manufacture of silks had obviously a much more limited possibility there. You could make silks better. But you could never make silks as cheaply as you could cotton. And in fact that was from the British point of view, the accidental aspect of the story.

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They always got into cotton by accident. Their first machines were actually built to manufacture woollens. Because the woolen industry, the woolen branch was much more important than cotton. Cotton was a new branch. The branch with the big future. And the British very quickly learned, by a kind of happy accident again, that machines worked better with cotton than they did with wool. That wool was a more difficult fiber. A more, how shall we say, recalcitrant fiber, it didn't lend itself so easily as cotton did to manipulation by machinery. And so that happy accident also moved them over in the direction of just that branch of textile manufacturing which had the biggest sales possibilities. That combination of accident and preparation yielded what came to be the industrial revolution which starts in cotton. And that's not an accident. There are machines earlier but the main thing is that the take off occurs in the area where the market opportunities for expansion are greatest. And the British were there as against other countries.

ANTONELLO: IS THERE A RELATIONSHIP BETWEEN THE DEVELOPING TECHNOLOGIES AND WAR???

Well war does make a difference. But from this point of view the connection is very indirect at least as far as cotton is concerned. The market for cotton is one that does not depend on war. Although obviously cotton fabric can be used to clothe armies and so. But there was an enormous domestic market in England. There was considerable demand for cotton abroad. Cotton was a fabric that lent itself to wear in warm, tropical and semi tropical climates. So it was the sort of thing that had great possibilities for world wide distribution. And war was not what mattered. But war does come to matter in an indirect way, as I said. In that it did a great deal to establish Britain as the dominant nation in global maritime expansion and so on. The British as a result of a series of war, primarily with France in the course of the 18th century really drive there biggest rival the French from a number of key points which turn out to be of considerable advantage, a substantive market advantage and substantive market expansion. I'm thinking of the way they drove the French out of India and out of North America. And the British clearly profit, but I don't think I would link that too closely with the industrial revolution itself. The big pay off here came later on.

On the other hand, for the French, this kind of loss did impose an effort to try and find substitutes. The wars, the revolutionary period, the Napoleonic period limited considerably the ability of the French to obtain various commodities that they were used to and wanted, sugar for example. The island of Santo Domingo which we now know as Haiti was the great sugar island in the West Indies for the French. A source of considerable wealth. And the demand for sugar was enormous. And war led the French to develop a new source of sugar in the form of the sugar beet. Using technology that hadn't existed before. And the same is true of the French development of things like alkalis. In connection with textile manufacture, bleaching and so on. Alkalis are very important. Again the war made it difficult. And using the knowledge developed by a chemist named LeBlanc (?) this is a rather interesting early instance of the marriage of science and technology. But deliberate marriage. One in which there was a link here between the work of the scientist and the technological objective.

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They developed a process for producing such as alkalis chemically that was substantially more efficient than the older method of deriving them from seaweed, kelp and borax (?) and so on which was much slower and costlier. And which the British stayed with for some years while the French went ahead here. Because of this war time stimulus.

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But to some extent war was a disappointment. I'm thinking now of these same revolutionary Napoleonic wars. Was a disappointment from the point of view of potential technological change. That is it inspired projects. But it also interrupted these projects. Aborted them. I think of the interest of the French in going over to interchangeable parts. And producing a number of objects like muskets, like gun carriages, like clocks and watches using machines and producing parts that would be truly interchangeable. Well big schemes were developed to work along these lines. And they generally proved abortive. They didn't work out. On the other hand, if I look at these same objectives in England and the US it's interesting to see that there war and military interests do play a role.

I mean among the earliest production of objects of an interchangeable character were the production of various components of pulleys for rigging, naval rigging at the Portsmouth Arsenal in England in the early 19th century. In an effort to produce these things rapidly the whole thing was reduced to a series of processes in which special purpose machines did one particular aspect of the work. And a whole series of these machines combined to yield these pulley wheels and so on. And this was Maudsley (?), one of the great machine makers of his day who, Babbage and Maudsley, who developed these new devices. The same for the manufacture of locks. But that's not so much connected with war. But of naval gains these were promoted by military concerns. And in the US also, there was an interest in promoting the manufacture of muskets in large numbers. Mass production by means of machinery.

So one can look at the question of the effect of war on technological and industrial change in terms of specific technologies. And here there's no question that the war can in fact promote or compel certain adaptations or inventions by way of responding to unexpected interruptions. Or by responding to the needs of the military. But I think that from a larger point of view, wars on the whole had a negative effect in development. In the case of the Napoleonic, first the revolutionary and then the Napoleonic wars we're talking about a generation of war running from about 1792 to 1815 with only one or two interruptions. The effect of these wars on the British economy was clearly to divert important resources to non economic uses. Whether in the form of subsidies to allies on the continent or in the form of supporting sustaining destructive military actions. The essence of military action is usually to destroy. And under the circumstances there is a retardation in the process of economic change.

For the continent, I think the generation of war, really slowed their own development down for about a generation. I don't mean by that they stood still. They made an effort to import machinery and skilled artisans from England. They introduced textile machinery for example both in France and in the Low Countries, what's now Belgium in the early 19th century. To be sure, as you might expect, a generation of machines that was already out of date in England, they were using an earlier generation of equipment brought over and used to start their own textile industry. So even trying to keep up to imitate or emulate, they were falling behind. But in the end they lost a lot of time.

The same was true in metallurgy. And modern British techniques of smelting iron for example don't come into France until the 17 I'm sorry, the 1820's. So I mean the British brought these techniques into use already in the first half of the 18th century. That is more than a half century earlier. The French explored these devices at one place, _____(?) in the 1780's. It never really spread from there. And its only in the 1820's, after a generation of war that the French get down to business and start trying to catch up with the British. From this point of view I think the war is on a whole a diversion, costly, a distraction from more serious and productive work.

ANTONELLO: WHAT'S THE RELATIONSHIP BETWEEN WAR AND TECHNOLOGY BEFORE AND AFTER WWII??

We know that there were many devices that grew out of the war. That became important in war, which later developed on a very large scale in the production of civilian goods. I just think such things as electronics, radar and so on, new electronic devices anticipated during the war. And then after the war many of them found real fruition. Because during wartime obviously they were still confined to military use. They were often secret or quasi secret, not available to general use. And so there were delays here to. And also there's a strange mix of stimulus to innovation for particular uses and then at the same time constraint on use. Confinement to special purpose uses and you don't really move on in these areas until after the war on a large scale.

ANTONELLO: DID THE SAME THING HAPPEN IN THE STATES AFTER WWII???

Well of course after the war there was considerable support for further technological development coming from the military. Coming later on coming 20 years later from the space program and so on with technological fallout. With consequences for industry in general for technology in general. I think again a lot of the work done with electronics found realization in subsequent developments. But you know I think the whole pharmaceutical industry the concern with antibiotics during the war starts with the sulphur drugs. And before the end of the war we get a considerable development in penicillin which goes back to the 1920's but which was very badly needed in connection with military medicine. And then really becomes available to the civilians only afterwards. So there is a way in which the war tends to promote or accelerate certain areas of development which have been moving more slowly and then which are needed for military purposes. But again there is I think this mix of diversion of resources that for example the large expenditure of monies, not on military technology, not on research supported by the military and so on. But simply to support the military. Large numbers of people in camps abroad and so on. Armies of occupation armies that are part of larger defense programs. Bases military bases, all of that sort of thing is an expenditure which would yield greater economic growth and greater technological change if applied to more productive uses.

So there is this sort of mixed picture. If you ask military men when they testify before congress, they'll stress the various devices that have grown out of these programs. Just the way NASA will talk about various devices that have grown out of this effort to walk on the moon or to send rockets. So gains in fuel technology, gains in ceramics and the creation of special ceramics, gains in miniaturization in order to produce smaller devices that will work in a very limited space reducing the weight of the payload, all the rest. So they will stress that. Obviously they won't talk about large outlays for things that don't have that kind of payoff. And I'm not sure whether this has ever been calculated in any categorical way. But my guess would be that if you used that same money for industrial investment for technological research and so on the general payoff would be larger.

I think Japan and Germany are two countries whose growth has benefited considerably from the fact that they have not had this burden. And in fact have been sheltered by what has largely been an american umbrella which has enabled them to devote a far greater share of resources to industrial technology.

ANTONELLO: WHAT WERE THE SOCIAL CONSEQUENCES OF THE APPLICATION OF THE FACTORY SYSTEM??

There's no question that workers did not take to factory discipline kindly. Especially workers

None of the workers who had learned to make textiles in their own homes, in the cottages and so on, at their own pace, working when they pleased, stopping when they pleased, going to the toilet, when they pleased and so on..None of these people was prepared voluntarily, willingly to go into a situation where the time belonged to the employer not to the worker. Where the worker had to be there at a certain time, work there a certain time, needed permission to leave the job. Needed permission to relieve himself and so on. All of this was highly distasteful, to say the least, to these people. It really marks an entirely new time pattern, temporality, if you will. Which these people found it hard to submit to.

And it's not an accident therefore that the earliest workers in these mills, at the very beginning of the industrial revolution, were people who couldn't say no. You see what I mean. People who could be put to work and were in no position to refuse. So we're talking about children. Children particularly from work houses and orphanages and so on. Who could be assigned to work in a mill as a way of making them useful. Otherwise they were seen as public charges. People thought this was a wonderful economy to assign these people to work in mills and the like. And that this made all the difference. So you have a great many of these so called pauper apprentices. Apprentices not in the old guild sense of the word but in the sense that they were indentured for a period of years. Contracted for, compelled to work for a period of years under these circumstances.

The other major new source of labor was women. Because women also were the daughters or wives, were in no position to say no. So very often the husbands sent their children off, they sent their wives off, they sent their grown daughters off, if they were not yet married, to work in these mills. While the men continued to do the sort of thing they had done which gave them much more freedom. Now it could be said that for certain operations, after a while, men were necessary, even in the mills. The earliest mills did not need men to much extent except for things like lifting and transport and the like. Machine maintenance was typically a man's job. But all of the ordinary work of spinning and so on was done by women and children.

But with the invention of what was called a mule which was a machine with a very heavy carriage that had to be thrown back each time after it reached full extension and which weighed more than women could be expected to handle. They began to need adult males. And these adult males began to be brought in as sort of sub-bosses. That is they were really bosses within their spinning rooms. And they hired their own helpers whether it be children or women or what have you. And they took these jobs because they were like sub contractors, sub employers within the system. So that it took actually about two generations to develop a work force that consisted as much of adult males as females and children. The kind of work force that one found in older modes of production. And this took, as I say, 2 to 3 generations.

A whole new discipline had to be learned. It wasn't easy. We know how much these people found it difficult to accept this because we have the rules of some of these early mills and factories. And the rules show what were the things that were the biggest problem. Absenteeism, lateness the heaviest fines were reserved for this sort of thing because this was the greatest weakness of the new work force. It was the expression of their resistance. This was the expression of their inherited values from the older system. And it had to be somehow eliminated. And so very heavy fines. The turnover was tremendous in the beginning. Very hard to get people to stay very long. There was also, aside from the stick to beat them with, a carrot to try and give them an incentive. The best workers, the ones with the best attendance records, the best promptness records were often given prizes, of

what, CLOCKS. Because the clock was a kind of symbol of what the employer was trying to do. To teach these people this new temporality. But the irony was of course that the clocks were given to the people who seemed to need them the least. It was the workers who were coming late who needed the clocks. Now it was the prize for the ones who were always prompt and punctual. Still over time, the workers learned this new discipline. And they had to learn it because these factories were where the jobs were.

You could try to resist going into the factory. And there were workers who clung desperately to older forms of production. Weavers for instance, the handloom weavers were very reluctant to move into weaving sheds using machine looms. They stayed and worked at home and they survived only by accepting lower and lower wages. And at the end they were, in a sense, exploiting themselves in order to remain independent which gives you a sense of the price of independence. The people were willing to exploit themselves so fiercely and so cruelly in that manner to avoid going into the mills. In the end of course, all of this was replaced by machinery. And people learned to work in factories or they didn't work in industry anymore.

So there are measures that indicate improvement in a number of areas. On the other hand there are other measures that are less happy that indicate that at least temporarily some aspects of life worsened. In particular the data we have on morbidity and mortality show clearly that in the first half of the 19th century it was not safe to live in a city. In a sense that the rates of disease and death were higher for urban dwellers than for country, for rural dwellers. And that is surely related to the fact that the cities were places of great crowding and that the social overhead capital, that is the facilities for delivery of clean water, for removal of waste and so on, were still in course of construction and were not keeping up with the rapid population growth of these cities. Though industry had something to do with that obviously. The growth of industry created a number of cities. And these cities, in some instances, found it difficult to provide appropriate housing for the new influx of workers and employees and so on. And so they were the scenes of some pretty horrific conditions of life and death. On the other hand it's clear that the process of meeting these new needs was improving apace.

That is there is beginning in the 2nd quarter of the 19th century a systematic effort on the part of the larger cities to come to grips with this problem. To produce proper sewage systems, to improve the water delivery system and the like. The food delivery system, the marketing of food all of these things began to improve with time. And it's interesting to ask oneself why this effort of improvement. Well certainly one reason for it was a larger social and humanitarian concern for the conditions of these people, these victims of rapid urbanization. But also, I fear that, it was also because those who had the means to live well were concerned that disease and that sort of thing has no respecter of persons. That can attack not only poor neighborhoods but rich neighborhoods. And so they were equally concerned with conditions of health and sanitation and the like, public hygiene, that sort of thing. So there was a general consensus that something had to be done about it.

I'm reminded in that regard of the historical impact of the cholera epidemic in Paris in 1832, which killed among other people the Prime Minister of France. Which was of course a shock because if you could have a disease that not only killed people in the poor quarters but could kill the Prime Minister himself, well clearly this is something that everybody had better get to doing something about. In any event it was a general program. As usual, individuals mattered. There were people who devoted themselves to this kind of project. It was one of the great environmental, to use a 20th century term, one of the great environmental tasks and campaigns of the era to improve this sort of thing.

The same of course kind of concern was found in regard to conditions of industrial work. Not thinking simply of the way people lived but the hazards, the accident hazards connected to work. And here to people were concerned to establish better standards. But here the gains were slower. It was much easier to mobilize funds and public support for improvement of conditions of life in the cities and towns than it was to penetrate into the factories themselves and try to improve conditions there. Even so things did get better, in the long run, in terms of for instance setting a minimum age for employment. Preventing people from hiring tiny children and putting them to work under factory conditions. There were improvements in connection with funds often organized by the workers themselves for accident insurance and the like, and health insurance.

There were various controls placed on employment of women. Its not an accident that women and children are the first protected. Because the societies of that day were very reluctant to impose conditions on contract, on what was seen as voluntary contract. A worker took a job he was seen as an independent agent. He's old enough to know better. He takes the job and he takes his chances so to speak. Like a buyer who has to beware when he buys a commodity. And the worker was expected therefor in a sense to be smart enough to know whether or not to take the job, and to know whether or not to accept these conditions and to leave it if he didn't like it. So the state was reluctant to move in to such circumstances. And they move in first in regard to employment of women and children by using the argument that these people are not entirely free agents. So that when they engage in such a contract, an implicit contract, they are not acting as an adult male could be expected to act. And this was true. So, for instance in England, the first protections go to pauper apprentices and other children from work homes and orphanages and so on that were not free agents, and then children in general and then women. And only after the middle of the century do you get the first laws designed to protect the working conditions of adult males. On the grounds that there was a larger public interest in better working conditions. Even so thats a task, I must say if you look at the history of it, thats a task that is still unfinished today. There are still areas of potential improvement and potential hazard in the workplace today. One point that I would make in this connection though one must not think that working conditions under the mode of production that prevailed before industrialization were somehow idealic. That accidents didn't occur, that people were not injured or poisoned and so on. There was plenty of it. There was plenty of room for that sort of thing in the older system. But in the older system there was less sensitivity to what was happening to a very obvious manifest proletariat. Which was there, concentrated, which was beginning to be a political force, which was seen in some places as a potential social danger, a political danger and so on. And which had to be attended to. Which had to be considered in a way that the work force of an earlier era was not. And so from this point of view, its true that industrialism, modern industry did in fact create dangers that hadn't existed before. It did not invent the hazards and dangers of industrial employment.

ANTONELLO: WHAT ABOUT THE RISE OF THE WORKING CLASS??

Well, this ...the rise of the working class as a political force was clearly linked to the establishment and the expansion of the new mode of production. The older system with its emphasis on cottage industry, made use of a work force that was much more dispersed, had much less of a possibility of joining forces and in a sense expressing its desire and its will and so on. I shouldn't be to categorical about that because we do know in the older way of making things there are coalitions of workers that do take place. There are efforts on the part of workers to interfere with production that they consider unfavorable to their interests. There are riots. There are machine breakers and so on attacking installations or equipment that they perceive as threatening or competitive. But on the whole the force of the workers as a cohesive political group is very much limited under these circumstances of diversion of autonomous work in the home and so on. Its only when you start getting a factory work force which comes together in large numbers, which has a chance to compare notes, to hear one anothers grievances and complaints, which has a chance to meet and talk about doing something about it that you have a prospect of a serious working class movement.

But based on industrial change. From a political point of view, its not an accident therefor that the earliest manifestations of worker politics often come from workers who are not in the factory system. Its coming from artisans, the agitation is coming from people like printers who are aboe to read and able to develop political consciousness earlier than others. Its coming from the sort of people who would be the first to resist the factory system and reject it. And that's why much of the early working class movement is in some ways reactionary. By that I mean was hoping to turn the clock back, was hoping to block development of the factory system. Saw it as competitive and hostile to everything that they valued in terms of their own tradition of work and their own mode of work and so on. So for example, its not an accident that in the middle of the 19th century when workers lead the move for new political forms, move to revolt agaisnt the existing powers in Europe, in continental europe, in Paris and Berlin and elsewhere in central europe, that many of their demands are demands that call for the re-enforcement of older guild controls and older rules of operation. Which antedate the industrial revolution and are in a way contradictory to it and inconsistent with it. And thats one of the strange ironies of the working class movement.

In a country like England when you have for the first time after the middle of the century a labor movement thats able to establish important unions. The initial role of the unions is to defend a kind of working class which is dominated by craft workers, again even though this is an industrial working class, its more concerned with skilled workers than it is with the mass of the proletariat. Its not

until the end of the century that a new unionism develops. Which wants to merge the crafts with the mass of unskilled and semiskilled workers. So that you get a move to a much more democratic trades union operation. In the United States, it's not until the inter-war years, I'm talking about the 1930's with the CIO that you had a major effort to create a union movement that would include the unskilled as well as the skilled. The older American Federation of Labor, A.F. of L. was primarily a crafts trade union movement. Concerned primarily to bring in the more skilled workers. So there is in the course of this a kind of maturation of the working class which takes a long time, which takes a hundred years or more. And which entails the ability to surmount the hierarchy within the working class. We were inclined to think of the working class as a homogeneous, powerful, collective body with common goals. Well this was an ideal put forward early but long in the achievement, slow in the accomplishment. Because there was in the working class these same categories, hierarchical categories that characterized the rest of the society. These divisions slowed down the development of a truly representative working class movement.

The diffusion of technology is a problem in the transfer of knowledge. This knowledge might take the form of hardware or software. Hardware, machines and similar devices and software, knowhow to use these devices effectively, to maintain them, to adapt them, to change them, improve them and so on. Both of these are part of the story of the diffusion of technology. Now England, being the leader of the industrial revolution, the first country to industrialize, or as one author put it, the first industrial nation, England was the place that people looked to in order to learn these new techniques. England knew this and was reluctant to export the equipment and the knowhow because it wanted to maintain an effective monopoly. It should be the workshop of the world and the other countries would buy its manufacturers and send back food or raw materials and the like. What we now call the international division of labor.

So the English had passed laws, some of which went back a long way, prohibiting the export of certain kinds of machines. And at the same time forbidding the emigration of skilled workers, artisans. And these prohibitions of course posed a problem for countries which wanted to learn this new technology. Now I like to say that this is like, love's laugh at locksmiths, it is hard to close it in to cage it in. And people will find ways. They found ways either to go directly to England to learn things by hiring on in various industrial enterprises and then leaving. You see as foreigners they could. And going back home with the knowledge. Or they arranged to smuggle out machinery. Sometimes by breaking it down into component parts. And shipping the parts separately and reassembling them in the destination, the place of destination. And sometimes they were able to smuggle out artisans. Who escaped and brought the knowledge with them. Now I think on balance, it was easier to get machines out than it was to get the knowledge out. What really mattered was the knowledge.

There are records for instance in the United States, the young US, the new nation just established, of machines that were imported from England somehow got here. Then were left standing because people really didn't know what to do with them. How to work them, how to install them and so on. So it was not for example until Samuel Slater, who had worked with the Waterframe in the manufacture of cotton yarn, until he came, that these machines could in fact be successfully installed. Beginning with the mill here in Pawtaucket, you have the beginnings of the American cotton manufacturing industry using machines. And one factor that was a great advantage to the Americans in this regard, was that it was a country in which people spoke English. And in which the English emigrants would feel at home. And so many of them left and they were of course promised, in some instances favorable wages and so on. They came to a country where they could feel comfortable from the beginning. Those who went to other parts of the world, France for instance or central Europe or eastern Europe even, many of them stayed and settled but it wasn't easy for them. And we know from the records that some of them lived a very lonely and unhappy life. They were paid well but, they used the pay to get drunk and forget their unhappiness and their homesickness and so on. And so America had a real advantage in learning the ways of the industrial revolution. Because America was in many ways a more attractive destination for English emigrants.

And the history of American industry is to a great extent a history of immigrants from England bringing with them the knowhow and finding ways to bring the machinery with them. Of course very early on the Americans learned to make these machines. And I think that was because there was a native pool of skilled workers and also there were English workers, machine builders and so on. Who also were drawn here, brought with them the techniques, and learned to make these devices in the US. So early on the Americans were making their own steam engines, their own textile machinery, their own machine tools to build machines. And we

know that for example, as further developments took place, the americans learned to imitate these as well and emulate these as well. And this was a big advantage from the point of view of copying the British example. But essentially, that's the story just about everywhere. It's a combination of hardware and software. And the software is best transmitted by people rather than by instructions. Even blue prints are not necessarily enough.

I'm going to jump in time, but I remember one of the vivid examples of this was that in WWI, France needed help. And had lost control of a good part of its manufacturing capacity because much of its industry was in the north and in the east and this was now under german occupation. So they couldn't get this. So they turned to the US for help in the manufacture of the famous 75 mm artillery piece, which was the backbone of French artillery. And in order to do this the French were really willing to help because they needed it. And they sent over the blue prints which had been highly secret and so on. And they even sent workers. It was not until they sent the workers that the americans, working from the blue prints could actually produce this kind of device. It was a most exceptionally high precision, well tooled, piece of artillery. The saying had it that it could fire, you could put a glass of water on it and none of the water would spill when it was fired. That's how well it dealt with recoil. So it was a very sophisticated object. But even with blue prints we couldn't do it. It was not until they sent their own craftsmen and technicians over that we learned to make this artillery piece. I don't doubt that we would have learned in the end, in the long run. But it gives you an idea about how important personal experience is when it comes to the transfer of technology.

ANTONELLO: WHAT ABOUT THE PECULIARITIES OF THE AMERICAN SYSTEM COMPARED TO THE BRITISH SYSTEM??

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The thing called the american system of manufacturers is very particular to the US. It is not unknown to, or a matter of indifference to, european manufacturers, not only the British but also the French and so on. But it gets its start in the US. And essentially the principle of the system is that one tries to standardize the product as much as possible and then one tries to manufacture as efficiently as possible by making use of similar parts. So similar that they are effectively interchangeable. And this is a form of manufacture, a mode of manufacture that is particularly relevant to machines, and to other articulated devices in which moving parts fit together and move one another and eventually do the work of the machine. AND produce whatever has to be produced by the machine. Do what ever the machine is supposed to do, drilling or whatever. But anyway making these machines in such a way as to make them effectively the same object for a large number of objects and buyers. Now the americans were not alone in being interested in this. I mentioned earlier that there was already an interest in this as a result of the effort to increase output, for instance in France, during the period of the revolutionary wars and the Napoleonic wars, and the same was true in Britian in an effort to increase naval ouput in the arsenals and all the rest. All of these things required some effort to try and standardize. So long as an object was a run off piece, made each one maybe similar but different enough so that when you fitted the parts together you had to file them and adjust them and make them fit separately so that once you filed and adjusted them they would work in that piece but not in another piece. That was a highly expensive way to do things. Required very skilled labor. Required high cost labor because skilled labor cost more. And of course took more time and time is money. So that the aim everywhere was to do this sort of thing.

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But the americans were the quickest to do it. And I think it has to do with two things in particular. First is that ordinary labor in the US cost more than it did in England or France and so on. I won't say that skilled labor was the consideration here. I think it had to do with the fact that unskilled labor cost a lot. And this high wage level meant that there was much more pressure to find labor saving devices. I think also the shortage of skilled labor was acute in the sense that the big pool of such labor was in Europe. Ans sure you could import such people but you weren't developing a pool comparable to the european pool in the US except over a

long period of time. So we were paying high prices for both unskilled and skilled labor. And were looking for ways to make these objects by using less labor and more capital.

Now in order to do that you needed to move to standardization. And here I would like to stress my second point and that is the American consumer was much more accepting of standardized objects than the European consumer was. The European consumer was used to the kind of object, the kind of product that was made by skilled artisans to the taste of the consumer. And this which applied to consumption objects consumer objects like clothing and so on also applied to producers' goods. Typically and quite late in the 19th century for example, the British when they ordered for example, machines and machine tools and so on were specifying particular aspects, particular features to these machines such that every machine was slightly different from the next. Whereas the Americans were early on led to accept the notion that if you wanted something, this was, in many ways, still a frontier society, a society in which you had to import these things from a distance, and in which the readiness to spend on special characteristics was not there, in which the effort to respond to demand was precisely to simplify and standardize.

The Americans were more ready to accept standardized objects. And we see this not only in machines but we see this in consumer objects, for example, just in glassware, glass for windowpanes. Now that's something that is not a highly sophisticated object. You have to make the glass and you have to cut it. And foreign travelers point out that in America windowpanes are built to standard size, are cut to standard size. And they are cut that way because the kinds of mills that are milling the wood and producing the actual frames to hold these windowpanes, these mills are already making windows and window frames to standard dimensions. And we have the testimony of one French visitor who speaks of the French who thought they would crack this market and sent a lot of windowpanes over, for sale in the US and found they couldn't sell them. Because they weren't cut to standard size. They were typical French panes which were somewhat larger than needed and then were to be cut by the glass cutter, the *vetrier*. Well you know as recently as 50 years ago in the streets of Paris you would hear the man going around in the street calling out *vetrier*, *vetrier*, glass cutter, glass cutter. And householders and housewives and so on on the street and lean out the window and say, "I have some work for you" and he would bring up a sheet of glass and he would cut it to fit the frame and that's it. That's the way he worked. And that's why he was needed. Whereas in the US a person would go to a hardware store and order a sheet of glass, a pane of standard cut to fit in his particular window. This goes back already to the early 19th century, to the beginning of the 19th century. Already this characteristic is there.

So Americans for two reasons, both from the point of view of the cost of labor and their readiness to accept standardized objects are more open to the idea of this kind of mass production. Now of course the traditional story was that it came first in military objects. And it is true that the military was willing to spend a lot of money to produce interchangeable parts in the manufacture of muskets. Which are not a simple object at all. The locking mechanism, the trigger mechanism is rather complex. It wasn't easy to do and it took a lot of money. And the work that was done at arsenals like the Springfield arsenal was in some ways a major chapter in the development of interchangeable parts and the so-called American system of manufacture.

But in fact newer research makes it clear that it was the civilian industry that was even earlier in adopting this mode of production. And it comes first in clocks. In the manufacture of wooden clocks. These are clocks of which almost all the parts are made of wood. So it comes in clocks and it comes in hardware and it comes in furniture and it comes in windowframes and other work by wood working shops and so on. This is where the first steps in this direction were taken to assemble a doorframe, to assemble a windowframe and so on. All of these things being done on a large scale, very early before the military actually succeed in doing this for the manufacture of muskets. It's in the first decade of the 19th century that clock making contracts for the production of thousands of clocks of the same model of First Past, and Eli Terry is the founding father here. Is the pioneer. And many of the people who work with him then go out and set up shops of their own. But this is the first place where the so-called mass production using interchangeable parts makes itself felt commercially and is successful commercially.

Now there is a technical point that I want to make here. That is why does it happen in this area instead of some other. Why does it happen for instance in the clock manufacture before the method is worked out in the manufacture of muskets. Which comes about 10 or 15 years later. And the answer is tolerances. The key issue in successful manufacture of interchangeable parts is how

much error can you put up with? What is the tolerance for variance? Can the part, must it be accurate within an 8th of an inch, a 100th of an inch, a 1000th of an inch and so on. So tolerances are the key. And there was considerable tolerance in the manufacture of wooden objects as compared with manufacture of metal objects which have to be cut much more closely to whatever dimensions are desired. Because they have no give. They don't lend themselves to adjustment and so on. They have to be filed to fit properly and all the rest. So the first devices are the devices where the tolerances are greater and the machines can work without the precision that they are required to work with later. And so clocks come first, watches come later. Why, watches are smaller, the parts are much smaller. The precision has to be much greater. You can't allow the same kind of error you can in a clock etc... And so on for so many other things.

Well the history for the american system of manufacturers is one that combines high standards of accuracy and precision with planned manufacture. Planned arrangement of the equipment. Machines that will meet these standards and very early on the notion of the single purpose machine. When the europeans started moving in this direction, they couldn't resist the idea of having machines that could do all kinds of work. A machine that could be turned to do this part of the job and then that part of the job and so on. The americans much earlier realized the importance of having single purpose machines that would do one part of the job.

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Well the key consideration in the successful adoption of this mode of manufacture, this so-called american system was obviously that you had to have machines that could supply whatever parts you were making with the tolerances needed., And I made the point that different materials have different tolerances. Wood is obviously more forgiving in this regard than metal. Which is much harder and more unwilling to alter its shape or position in any way. So when you move to metal objects you need more powerful machines. And what the americans understood and which took the europeans a while to understand was that if you want to build powerful enough machines to work these materials you have to build single purpose machines. Europeans were fascinated with the idea of the versatility of machines. And they built machines that could do everything so to speak. And could move from one stage of the product to another and could be adjusted and readjusted. Well even single purpose machines will require adjustment obviously depending on the kind of part you are making. But the point is that they could be made and were built much heavier and because they were heavier they could do their work more accurately, with greater precision and they could work with harder materials because of their weight and their force and so on.

So the americans quickly found that they could make objects that were assembled with much more accuracy. Hence no need for filing and finishing and so on. Where you could assemble the parts and where you could count on these parts remaining reliable and fitting and working well over a fairly long period of time. And for this of course you need harder materials. I mean one of the crucial parts of the story when you moved into the production of interchangeable parts using metal is the problem that you wanted to use steel if possible. Steel being much harder than wrought iron and at the same time being workable, forgable, manipulable, cuttable, drillable and so on in a way that cast iron being even harder is not capable of. So you wanted to go to steel but if you wanted to go to steel the question is what would you use to cut the steel. Well you needed harder cutting tools to work the steel you were working. And there was the problem making the steel not only workable but then hardening it afterwards you see by tempering it. You had to at the same time give it a kind of strength and consistency that it didn't have in the working. And what the americans with their heavier tools found was that they could, earlier than others, work with tempered steel in a way that europeans could not at first.

I remember visiting a watch factory in europe, which was one of the first to introduce machines to produce watches, with standardized movements using interchangeable parts. And they showed me the machines and I took one look at the machines and I said, "these look like very light machines, what kind of materials were you working with? and he said, pretempered steel, I said what kind of waste rate did you have? Because the tempering process will usually alter the weight of the steel. He said, "Well we

used to throw away 50 - 60% of the parts" Now if you can work with hardened steel with stronger machines, you save that. You save the time, you save the material and so on. So these were all things that had to be learned over time. The Americans started very early with the desire, with the need and using the kind of materials that were more forgiving. Eventually moving into the harder metals and producing more complex things demanding higher degrees of precision.

Well the Europeans, beginning in the 1840's began sending visitors to the US to see how we were doing these things. The British for example sent over people from arsenals in England to find out about the manufacture of muskets by the American system, using interchangeable parts, producing interchangeable parts. And these people took the lesson back to England. And eventually the British, the French they all moved in this direction. They had to and there was still all kinds of things to be learned.

One of the more interesting parts of the story was the fact that in order to get at high level production and save the cost of finishing and so on, the effort was made to produce objects whose parts fit so well in the beginning they required no adjustment at all. This took a long long time to do. And it became particularly important in regard to the automobile. Which was an object, highly complex object with thousands of parts which had to fit. And which also required special metal and special machine tools and all the rest to work this metal etc... Well of course what's often overlooked is that when these objects were finished and sold to the consumer they weren't by any means completely adjusted, perfectly fitted and so on. They were sold to the consumer and the consumer was told now you have to run this car in. You have to run it carefully. For the first 200 miles, don't go more than 40 miles an hour. And for the next 200 miles you can go 50 miles an hour. And for the next 200 miles so much. And after the first 100 miles you should change the oil because there will be a lot of small little shavings and pieces that will come off the moving parts of the motor as a result of this running in process. So you'll want to get rid of that and try and put in new oil and so on to get started. Or you would use a special running in oil there were often special oils used for running in just to make it possible to deal with the problem of waste in the oil. Well now you don't do that with a car anymore.

And you might well ask the question, Why is it now you can buy a car and pretty much run it at whatever speed you want from the day you take it out of the sale room. And the answer is we're now making things with greater accuracy that fit better from the beginning with harder metals and so on. And these problems don't arise at first. But we're now talking about 20th century manufacture. We were talking about a process that began at the beginning of the 19th century. In the first decade with wooden clocks then moves to high precision manufacturer of motors and so on using special metal alloys, very hard very often, cut very accurately with special machine tools and fitting very well from the beginning. The same with watches despite all the talk of interchangeable parts in watches, they are not truly interchangeable until the 1930's or the 1950's with the Timex. Using special techniques learned in WWII, there's a process which was developed for use in the production of military machinery during the war and carried over into the production of a consumer's good after the war. And so we're talking about a process that has taken about 150 years.

ANTONELLO: WHAT WERE THE SOCIAL AND ECONOMIC CONSEQUENCES OF THE CIVIL WAR?? DID THE WAR CONTRIBUTE TO THE DEVELOPMENT OF NEW TECHNOLOGIES???

The Civil War gave a big boost to mass manufacture of objects used in war. So guns, even watches benefited. The American machine watch industry began with Waltham owed its initial success really to the Civil War. It was Waltham that in a sense saved itself, there had been earlier enterprises that had tried this technology and not quite succeeded. But it was the Civil War that saved Waltham by enabling it to make a relatively cheap watch for sale to officers and soldiers in the army and for manufacture by the highly mechanized techniques using the new heavy duty, single purpose machines and the like. So the war did make a difference to the success of some of these new technologies.

On the other hand once again the war was highly costly of capital, terrible diversion from productive industrial and technological development. It obviously had a higher purpose which was not only the maintenance of the American Union but also the elimination of slavery, which was an important consideration in the North in spite of some reticence on the part of the government. There's no question that the North saw this as a major goal and this was important because slavery is not conducive to large scale industrial development. Dynamic technological change is encouraged by costly labor, by high cost labor and so on. Not by the availability of slave labor. So from that point of view this was indirectly and in the long run an important encouragement to the new industrial system and the new technologies. But I think in terms of the shorter run, the diversion of capital to destruction and conflict, I think the war like most wars was not a good thing.

Well there are various explanations. One of which is the existence of essentially of free land which set a floor to the price of labor. And if you didn't want to pay labor enough it could go off and take a piece of land and farm it. And that makes a big difference. It is very hard to maintain a system of low wages when there is a real alternative in the system of land ownership out there not very far away. So that was certainly one of the objects. The other thing was that this was a rich land with important resources. This of course was a strong incentive for industrial development. It paid as a result higher wages than Europe could pay because it had to pay them. And also because you could sell the objects of such labor to a population which had a very strong demand. It's interesting in this regard that Adam Smith writing "The Wealth of Nations" in 1776 alright that's a famous year in American history but in economic history it's known as the year of "The Wealth of Nations", writing then and talking about conditions in the American colonies because these were still colonies in those days. He already notes that wages in NY in the port of NY are higher than they are in London. That the Americans are paying more for their work than the British are. Now the British are richer, they are more sophisticated economically, they have a more advanced technology but labor relative to other factors is more abundant in England. And America is growing faster and this is a tremendous pressure on the supply of labor and hence the price of labor. So from this point of view it's rather interesting to see that from the beginning going back to the pre-national era, America is paying more for the price of labor than the older European economies are. Even though it's still a less advanced economy.

ANTONELLO: WHAT ROLE DID MANAGEMENT AND THE ENTREPRENEURS PLAY IN THE AMERICAN SYSTEM AND IN THE FACTORY SYSTEM OF EUROPE???

This is a crucial aspect of any industrial story. These are the decision makers the people who decide to invest the money. The people who make it a point to either learn the technology or maybe they have it with them when they start their enterprises or to hire people who know what has to be known and so on. These are the people who organize production and so forth. And they are crucial from the beginning even before the factory system, under the older industrial mode of production. These are the people who play a crucial role. I spoke earlier of the importance of the precocious recourse by English manufacturers to rural putting out to rural cottage industry. The role it played in promoting the success of British manufacturers. The widening of their market, the enhancement of demand and then in reaction to the failure of the supply to respond fast enough, the recourse to a new mode of production based on machinery and factory organization.

It was the merchant manufacturers who played the key role here. Who early decided there was that untapped source of labor in the countryside. These were often guild masters themselves who had worked in the older system. But who, because maybe they made a better product or whatever were beginning to be pressed for orders. And began to look around for people who could supply them with additional merchandise. And who turned to the still untapped labor force of the countryside and turned it to the manufacture of goods for a wider market. And this role is absolutely crucial, I think it's found in a wide variety of places. It often appears where you least expect it. Often these entrepreneurs in the early days were farmers who had a sense of where the opportunities were. Or as I say they were guild masters who for various reasons realized there was a big market out there and that they could do something with it. And who organized the work accordingly.

These were the people who made Adam Smith's model of division of labor and specialization come true. Adam Smith you know in "The Wealth of Nations" poses this basic principal that division of labor is a function of the size of the market. The bigger the market, the more you can afford to specialize. You can afford to break down the industrial process and with specialization get higher productivity. People make the same thing repeatedly. It may be dull, it may be in many ways dispiriting. But it is very important in the sense of developing familiarity with a particular process and doing it rapidly. And so division of labor makes for more productive techniques or a more productive mode of making things.

And specialization in turn, because it makes possible a cheaper product, widens the market and so you have a kind of cycle of growth and development. You have a wider market, you have specialization, you have cheaper labor in the sense of paying less per unit of production, you are able to charge less for the final product. The final product, costing less, finds a wider demand, the market grows, it now pays to divide labor even further etc...So the people who were making these decisions and organizing that, these are the entrepreneurs that made possible industrial development. These are the heart of the process. They're often workers originally who turn into masters. But whether they are workers originally or merchants originally or farmers originally or whatever, they're the people who make the decisions that make possible a new way of manufacture.

We've been talking about diffusion of technology, how it moves. And I've stressed the fact that it's a movement of knowledge. Which can take the form of embodied knowledge, in the form of hardware machines, equipment and so on. Or it can take the form of knowledge as carried by people. Or it can take the form of knowledge expressed by the word found on the page or by the image in the form of designs and so on. In any case we can call all of this software. And I stress the fact that you must give heavy weight in this regard to the role of people. That is that even with detailed descriptions of processes and method and equipment there's no substitute for the person who knows this equipment and knows these processes and can make sure that the machines work and work properly and so on. And this....

We were speaking earlier about the diffusion of technology and pointing out that it travels from place to place in the form of embodied knowledge or human knowledge. Embodied knowledge in the form of equipment, machinery and the like. And human knowledge in the form of the people who know these things and who carry the knowledge with them. It can also be in the form of the word diagrams, written information that can be read by people who know how to read these things and can then be applied. But the role of the human being is critical and it was never more so than today. And we see today for example that the transfer of these technologies to the poorer, more backward countries in the world depends very much on import of know how via visiting technicians.

And one particular manifestation which is especially striking is the role of the multi-national enterprise in creating productive units in backward poor countries and manufacturing there. Bringing with them the equipment, the up to date equipment, bringing with them the technicians and supervisors required to operate this equipment. And hiring labor from among the local population. Of course that's the heart of the matter. The aim is to produce with cheaper labor. And this has always been true in the history of economic development and the diffusion of industrial technologies. That one of the key motivations is the movement toward low cost labor. Because one aspect of growth and development is that wages tend to rise. As productivity increases, labor is worth more, wages tend to go up and so the industrialist, who is in it for the money, no need to apologize for that, that's why he's doing this, is always looking for some cheaper labor supply. And so you have these factories and mills built along the US border with Mexico, along the strip of Northern Mexico. You have similar enterprises being built in Malaysia, the Philippines, Thailand and so on. And all these places manufacturers are looking for cheap labor as I said, reliable labor, they look for political stability, very important, and they plant the enterprise there.

Now at that point, you know you can denounce this as a form of neo-colonialism as a form of exploitation. They are coming in to pay us a lot less than they pay their own people for instance. And that's surely true. The multi-national would not have gone there in the first place if it had to pay as much as it did at home. On the other hand they typically pay more than local enterprises

do. And indeed one of the major sources of opposition to these transplanted enterprises is comes from local competitors. Even if they're not directly competing for the market for a particular product are competing for local labor. And the example of these immigrant enterprises, which do pay higher wages typically, is one that is resented by local industrialists who are not interested in trying to match this higher wage scale. That's one thing.

There still remains though, whether or not this can play the role in the development of these countries that these countries hope for when they invite these enterprises in. When they invite them with incentives, with subsidies with exemptions from taxes and so on. They bring them in because they bring capital, they create jobs, and above all they are presumably going to teach people in that society how to do similar things. Because if they don't do that the society has reason to believe that this will never be a pathway to development. It will be what I like to call an industrial plantation. Just as in the 17th and 18th centuries, europeans created plantations in the americas to grow sugar or to grow tobacco or whatever. Just as these were in a sense dependent enterprises that do not really provide a basis, a foundation for further development, for the introduction of new modes of production, new knowledge into the system. So these industrial plantations will be just that. They will be segregated, closed off sectors of modernity in a sea of backwardness. So the heart of the matter is to see whether they can create a new kind of technical population. Technical work force which can then go out create enterprises of its own or work in other enterprises and make possible domestic development. It's always the same process you try to move people with the know how and then the local people are expected to learn from them.

One of the most salient aspects of the Japanese story, which is a story of great success. Is that they too of course introduced the european style of manufacture when they began to industrialize after the M____(?) restoration in the 1870's they were doing this. And one of the key aspects of course was that they brought in a lot of european technicians to show them how. And often to manage the thing. But they set as their goal the replacement of these people by native people who would learn from them etc.. And this was a very successful policy. Within about 15 years they were able to send almost all of them back home. And this is something which third world countries today, poor countries today have not been so successful in doing. And that of course is a sign that they are not picking up as quickly as one would hope from these examples.

Now there's a reason for that, obviously and one is that the kind of knowledge that they have to learn now is very different from the kind of knowledge the Japanese had to pick up in the 1860's, the 1870's and the 1880's and so on. That is the nature of technological knowledge now is increasingly science based. It is opaque to ordinary workshop experience. Just because you work at a bench with electrical equipment doesn't mean that you'll be able to understand electricity or that you'll be able to go on from that equipment to new kinds of electrical equipment and so on. The whole thing is in a sense invisible. It can only be learned by formal schooling. The same is true of a great many chemical processes and so on. More and more electronics, all of that, require systematic formal education now. Now in these third world countries that are picking up or inviting in multi-nationals, they have the opportunity to learn, but only if its combined now with formal schooling and instruction. And here they have a real handicap. Often their own school systems are not well equipped to do this. And if they send their children, their young people abroad to learn, its not often clear if they'll come back. Because for many reasons the kind of things they get to know in the advanced industrial countries are often such that they are happier in these countries than they are back home. That's strange its a kind of great paradox. Because these are countries that are often, by no means necessarily hospitable to strangers. prejudices and so on. Nevertheless, the kind of life that is possible in these societies is often far more attractive. It's richer, it's more abundant, it's more interesting, it's more varied, it's politically safer, it's more secure, it's more stable. So in many ways, the people who go out are often reluctant to return home. So these countries, poor countries today are caught on the horn of a dilemma. On the one hand they need this knowledge and they may have to go outside to get it. On the other hand, its not clear that they'll get the people back, once they send them away. As the old song put it, "How you going to keep them on the farm after they've seen Paris?" How are you going to keep them somewhere in Africa, or South America or Asia in a country that is still quite poor after they've been to Paris, London, Cambridge, Berkeley or what have you.

ANTONELLO: ARE THIRD WORLD PEOPLE THE NEW SLAVES OF THE 20TH CENTURY???

No, I don't want to say that. I specifically made the point that these people are paid better than other people in their country. That is the multi-nationals set higher wage levels and often, sometimes at the insistence of the govt, establish healthier, better working conditions. From that point of view, I don't think of them as the new slaves. What I was thinking of when I used the image of a plantation was that unless things take root and connect up with the rest of society where they are, they're really simply offshoots of the advanced industrial country. They're like a long branch going out rather than something that actually takes root and becomes an indigenous plant in the society where it appears. So, yes it's a plantation in the sense that it's put there from outside. But unless it can somehow break down the walls that initially separate it from the society around it will always be just a distant branch of another society with a higher technology and so on. And this is what is going to happen in some places and what won't happen in others.

And it's clear that there are countries that are taking advantage of this and building up their own workforce. The Japanese case is as usual the model of how it should be done. I don't think that other people will necessarily do it so well as they do but you can find similar examples in Taiwan and Singapore and so on. Singapore is a particularly interesting example of a society which has been a favorite place for offshore enterprise. Where German camera firms and Swiss watch manufacturers and computer firms have been sending technicians and so on, bringing in the software, bringing in the programs and so on, bringing in the machines. But the Singaporeans are at the same time have been generating a great many local technicians who learn how to do these things themselves and are able to produce for their own. So there, that's a case study in successful, how shall I say, successful importation of foreign enterprise, foreign know-how, but with local assimilation, with indigenous acceptance, _____ (?), adaptation and all the rest. And this is what's required to escape from a plantation status.

ANTONELLO: WHAT'S THE RELATIONSHIP OF TECHNOLOGY AND THE IDEA OF PROGRESS??

BETA 136

The question is the link between technology and progress.....

Are we better off because of technology or worse off? Would the world be a better place if we could go back to the garden of Eden and live on the fruit of the trees and the bushes and not have to worry about all these machines and all this crowding and the noise and dirt and pollution and all the rest. This is a question that's of course very topical. Very much in the forefront as a result of fears and concerns about what's happening to the world. What all this economic growth is doing to the atmosphere, to the earth's surface, to the weather around us, to the food we eat and everything else. And one can understand that people are of two minds here. On the one hand it's technology that's given us a far higher standard of living than anyone enjoyed in the old days. You and I live better today than the kings of France did 200, 300 years ago. We also typically live longer, when we're ill we get much better care. We have far more in the way of opportunities for diversion, for recreation, for curiosity, we lead in effect far richer lives. If we don't, it's not for want of opportunity and choice, it's there. This is not to say that we've abolished poverty, this isn't to say that we've abolished disease, we have obviously serious problems. But on the whole technology has made possible a richer, higher standard of living. And there are not many people who would, if they could, go back in time and live in an earlier stage. Certainly, if they had a chance to change their mind, they'd probably come back. That's my sense of the world we live in.

On the other hand, let's face it, technology is not an easy thing to master. It has a logic of its own. People in a sense start something and once technology gets started, once the opportunities are there for growth and profit etc...it has a way of running almost faster than we can keep track of. And so there are changes that take place that we haven't necessarily been able to master. And we have this feeling sometime of loss of control, we also have a feeling of increased stress. One aspect of technological development has been a speeding up of the rhythm of life. A new attitude toward time. We have the feeling that we're prisoners of time. That we live in some kind of temporal cage. That we're not as free as we used to be. People run off on vacation to try and

relax and put their watch away so that they won't know the time and all the rest. And in the meantime they'll go to the Club Med and the _____(?) will call them to assemble at such and such an hour and for this activity at this hour and that activity at that hour. There is an intensification even of recreation and leisure.

So all of these things have given people sort of a mixed feeling about technology. On the one hand it's good on the other it seems to be bad. Certainly if we look at the world and the division between rich and poor, it's clear that people would much rather live in high technology societies than low technology. Whether we want to or not there's been a kind of loss of paradise, loss of innocence. Even those societies which, we are told, lived in great harmony with nature and in a sense could do without all of this. Once they are exposed to it they want it.

I have two examples, if you will, of this contagion. This demonstration effect which has a way of pulling people in to a new attitude toward life, a new dependence on technology.

One is a movie that some of you may have seen about this coca cola bottle which drops from an airplane in Africa. And what it does to the tribe which finds it. How it turns their lives upside down. And pulls them out of a kind of innocence into the risks of contact with and relationship with more advanced societies or cultures. To the point where in the end the big problem is to get rid of it. To get rid of this bottle because the bottle embodies as it were all the hazards of a different kind of civilization. That's one thing that occurs to me in this connection. Another is the way in which the people of the islands in the South Pacific, once they got to know the americans, they became so dependent on various artifacts, the objects, the material things the americans kept with them that the people in a sense altered their entire lives. And built a new kind of life around the availability of these objects. And then when the war was over, it was the 2nd WW, and the americans left, these people were at a loss. They had nothing with which to buy these things, no way of getting these things. And there actually appeared a new religion. A new cult called a cargo cult. This cargo cult was a cult of people who thought that with the application of appropriate magical rituals and formulas they could bring the ships back. That's why it was called a cargo cult. They could bring the ships back. Those ships that used to bring with them all the goodies that they learned about including things like cigarettes and chewing gum, many of these things you know hardly healthy things to know. Hardly good for them, but things they wanted very much.

So the relationship between progress and technology is one of the great ambivalences, the great paradoxes of history and the modern world. You can't do without it and it's not always easy to do with it. It requires a great effort of will, understanding, collective cooperation and so on, to deal with it, to cope with it, to alter it, to use it as a response to problems. Nevertheless when all is said and done we would never abandon it. We depend on it to solve our most difficult problems. If we're having difficulty such as the ones we seem to be having with the environment its only technology that's going to pull us out of it. It may have gotten us into it but its only that which will pull us out of it. In other words, in a way, its a kind of re-living of the old mythology. You will ct that you must give heavy weight in this regard to the role of people. That is that even with detailed descriptions of processes and method and equipment there's no substitute for the person who knows this equipment and knows these processes and can make sure that the machines work and work properly and so on. And this....

We were speaking earlier about the diffusion of technology and pointing out that it travels from place to place in the form of embodied knowledge or human knowledge. Embodied knowledge in the form of equipment, machinery and the like. ANd human knowledge in the form of the people who know these things and who carry the knowledge with them. It can also be in the form of the word diagrms, written information that can be read by people who know how to read these things and can then be applied. But the role of the human being is critical and it was never more so than today. And we see today for example that the transfer of these technologies to the poorer, more backward countries in the world depends very much on import of know how via visiting technicians.

And one particular manifestation which is especially striking is the role of the multi-national enterprise in creating productive units in backward poor countries and manufacturing there. Bringing with them the equipment, the up to date equipment, bringing with

them the technicians and supervisors required to operate this equipment. And hiring labor from among the local population. Of course that's the heart of the matter. The aim is to produce with cheaper labor. And this has always been true in the history of economic development and the diffusion of industrial technologies. That one of the key motivations is the movement toward low cost labor. Because one aspect of growth and development is that wages tend to rise. As productivity increases, labor is worth more, wages tend to go up and so the industrialist, who is in it for the money, no need to apologize for that, that's why he's doing this, is always looking for some cheaper labor supply. And so you have these factories and mills built along the US border with Mexico, along the strip of Northern Mexico. You have similar enterprises being built in Malasia, the Philippines, Thailand and so on. And all these places manufacturers are looking for cheap labor as I said, reliable labor, they look for political stability, very important, and they plant the enterprise there.

Now at that point, you know you can denounce this as a form of neo-colonialism as a form of exploitation. They are coming in to pay us a lot less than they pay they're own people for instance. And that's surely true. The multi-national would not have gone there in the first place if it had to pay as much as it did at home. On the other hand they typically pay more than local enterprises do. And indeed one of the major sources of opposition to these transplanted enterprises is comes from local competitors. Even if they're not directly competing for the market for a particular product are competing for local labor. And the example of these immigrant enterprises, which do pay higher wages typically, is one that is resented by local industrialists who are not interested in trying to match this higher wage scale. That's one thing.

There still remains though, whether or not this can play the role in the development of these countries that these countries hope for when they invite these enterprises in. When they invite them with incentives, with subsidies with exemptions from taxes and so on. They bring them in because they bring capitol, they create jobs, and above all they are presumably going to teach people in that society how to do similar things. Because if they don't do that the society has reason to believe that this will never be a pathway to development. It will be what I like to call an industrial plantation. Just as in the 17th and 18th centuries, europeans created plantations in the americas to grow sugar or to grow tobacco or whatever. Just as these were in a sense dependent enterprises that do not really provide a basis, a foundation for further development, for the introduction of new modes of production, new knowledge into the system. So these industrial plantations will be just that. They will be segregated, closed off sectors of modernity in a sea of backwardness. So the heart of the matter is to see whether they can create a new kind of technical population. Technical work force which can then go out create enterprises of its own or work in other enterprises and make possible domestic development. It's always the same process you try to move people with the know how and then the local people are expected to learn from them.

One of the most salient aspects of the Japanese story, which is a story of great success. Is that they too of course introduced the european style of manufacture when they began to industrialize after the M____(?) restoration in the 1870's they were doing this. And one of the key aspects of course was that they brought in a lot of european technicians to show them how. And often to manage the thing. But they set as their goal the replacement of these people by native people who would learn from them etc.. And this was a very successful policy. Within about 15 years they were able to send almost all of them back home. And this is something which third world countries today, poor countries today have not been so successful in doing. And that of course is a sign that they are not picking up as quickly as one would hope from these examples.

Now there's a reason for that, obviously and one is that the kind of knowledge that they have to learn now is very different from the kind of knowledge the Japanese had to pick up in the 1860's, the 1870's and the 1880's and so on. That is the nature of technological knowledge now is inceasingly science based. It is opaque to ordianary workshop experience. Just because you work at a bench with electrical equipment doesn't mean that you'll be able to understand electricity or that you'll be able to go on from that equipment to new kinds of electrical equipment and so on. The whole thing is in a sense invisable. It can only be learned by formal schooling. The same is true of a great many chemical processes and so on. More and more electronics, all of that, require systematic formal education now. Now in these third world countries that are picking up or inviting in multi-nationals, they have the opportunity to learn, but only if its combined now with formal schooling and instruction. And here they have a real handicap. Often their own school systems are not well equipped to do this. And if they send their children, their young people abroad to learn, its not often clear if they'll come back. Because for many reasons the kind of things they get to know in the advanced industrial countries are often such that they are happier in these countries than they are back home. That's strange its a kind of

great paradox. Because these are countries that are often, by no means necessarily hospitable to strangers. They are not without racist prejudices and so on. Nevertheless, the kind of life that is possible in these societies is often far more attractive. It's richer, it's more abundant, it's more interesting, it's more varied, it's politically safer, it's more secure, it's more stable. So in many ways, the people who go out are often reluctant to return home. So these countries, poor countries today are caught on the horn of a dilemma. On the one hand they need this knowledge and they may have to go outside to get it. On the other hand, it's not clear that they'll get the people back, once they send them away. As the old song put it, "How you going to keep them on the farm after they've seen Paris?" How are you going to keep them somewhere in Africa, or South America or Asia in a country that is still quite poor after they've been to Paris, London, Cambridge, Berkeley or what have you.

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