

SCIENCE AND ECONOMIC
LIBERTY.

A Comparison of England and America.

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I must really start with an apology; to begin with my title is dreadfully vague, though from my point of view that is a great merit, for like Mr. Winston' Churchill's head, it will fit any hat. Then, again, I must plead guilty to knowing very little about America. I stayed there for the first time last year and on the strength of that visit I intend to pose as an expert. This is a capital idea, but suffers from one defect, for when I decided to do this, I did not realise that I would have the unexpected pleasure of bringing an American friend of mine along with me to-night, but such is the case, and now I am in the position of the man who, having told a fishing story, was unexpectedly confronted with the fish.

However that may be, I stayed in America just long enough to realise that I was witnessing one of the most far-reaching revolutions that the World has ever seen and it is about this and the ideas connected with it that I wish to talk tonight.

Perhaps the connection between Science and Economic Liberty is not quite obvious, but I do most firmly believe that economic liberty cannot be achieved without the wholehearted help of science.

*Phil Johns in
came with us*

Before going further, perhaps I had better meet the man who may rise up and slay me as a gross materialist. Scientists and Engineers are often accused of not having a soul above Iron and Steel, Motor-cars and material progress. And yet when we talk of the progress of civilization we do not merely mean the march of discovery and the growth of mechanism; as I understand it, civilization stands for far more than that. Civilization probably means something rather different for each one of us, but I expect we will all agree that it is somehow bound up with the fullness and the quality of life, of our thoughts and ideas.

But, if we mean something essentially mental by civilization, why do we measure it in terms of our material possessions? Well, it is all very well to talk of the triumph of mind over matter and the value of mental activity, but how can you expect a man to make the best of his mind if he has not the means to cultivate it? Who can enjoy music or reading on an empty stomach; or enjoy the country without some means of getting there?

In short, I suggest that there can be no such thing as a fully civilized nation until we all have the necessary material conditions to live in reasonable comfort and security with ample opportunities for filling our minds with ideas and experiences.

It is the possession of these material conditions that I call Economic Liberty and it is because we all know this

Liberty is necessary for civilization that we so often measure civilization in terms of material progress.

A good fire on a cold day may not in itself be civilization, but it is a very civilizing agent.

Let us consider our material condition for a moment. I have no recent figures by me, but I remember before the War reading that if all the yearly income in England were shared equally, each breadwinner would have less than £2 a week for himself and his family. Now, I ask you, how can we have a healthy, progressive, and happy population on a wage like that - Of course the material things of this world are not evenly distributed and that accentuates the picture. Up to the present, most of the efforts to improve things have taken the shape of trying to secure a more even distribution. Witness, for instance, most of the activities of Trades Unions: this has done something, and there is more, much more, to be done; but we must never forget that shuffling and reshuffling a pack of cards will never produce more than 52 of them. In other words, distribution even at its best is not production, and it never can be.

If we really care for civilization we have got somehow to provide everyone with the necessary material conditions, that is to say, we must produce more, far more, than we ever have in the past, and we must achieve this, whilst, at the same time, liberating men and women from the crushing grind of monotonous work. A reasonable amount of work we must probably always have

and it is no doubt good for us, but there can be no brief for the present state of affairs.

Yet, if we do not wish to do the work ourselves, we must get something else to do it for us.

The Romans and Greeks tried to solve this problem for their own nations by capturing men and women from neighbouring countries and turning them into slaves, and on this foundation of human misery they built their civilizations: it worked for a bit but it did not and could not last, and when Rome was finally sacked by the Barbarians, she was decaying under the rule of a liberated Eunuch reigning in Constantinople.

Now, in place of the slaves of the Ancient World we have substituted machinery, and the main problem, as I see it, is how to extract the last ounce of work out of our mechanical slaves. That is the problem, not of distribution, but of production: how to make machinery take the place of manual labour and so not only lighten our tasks, but also produce far more for us than we can possibly make for ourselves. This is our work, our great grandfathers began it, but there is no limit to its possibilities. And this I think is where science can help, for if we are to produce more with less human effort, clearly we must have better materials and a better knowledge of how to use them.

We must know more about Nature and control her to more

purpose and, after all, what is science if not a systematic study of nature, her laws, her materials and their applications. To be precise, in order to improve our material conditions, we *need the help of scientists & they must have* ~~need~~ money for laboratories, equipment and experiments.

I should like this evening to suggest briefly the sort of way that a nation should foster science and to see how far this has been done both here and in America. But before doing this, it might be interesting to notice how science has progressed in the past in its task of liberating mankind.

One is rather too apt to think of a successful scientist as a man who is gifted with a happy knack of "having an inspiration" or being "struck with an idea", usually, I regret to state, under rather ridiculous circumstances.

Newton saw an apple fall off a tree, so we are told, and being a scientist, he dashed into his house, wrote a volume or two of rather intricate mathematics and launched the world into modern science. You and I would have eaten that apple and the result would have been, not a revolution in science, but a mild attack of indigestion.

Of course, all that is picturesque nonsense; the fact is that discoveries grow like all other ideas; they pass through several hands and finally reach a stage where they become practically useful. At that moment the invention gets heard of by the general public and the last man in the line is called the inventor, and then everyone is disgusted when a company

promoter bolts with the profits. But the fact is that the inventor is only the last link in the chain, sometimes a very big link like Newton and often a small link like Marconi, who has done good work, but is certainly not the foremost man on the scientific side of wireless.

The point I want to make is that both now and in the past scientific progress has been a matter of growth and steady travel rather than a series of Heaven sent explosions; but the great difference between the past and present is that we are learning the proper methods of investigation, so that a competent scientist who tackles a problem now-a-days can be fairly sure of leaving that problem in a more healthy state than he found it. We know how to plan a series of experiments, each experiment giving us a little of the information we seek, and perhaps, most important, of all, we are learning to apply our knowledge.

For instance, Newton elaborated a certain kind of mathematics - the differential calculus - and from a purely practical point of view no use was found for it for many generations. Now it is the basis of all design - no ship is built, no locomotive and no bridge of any size without its help. In fact, we all use it daily, though, fortunately for our peace of mind, we don't realise this, but nevertheless we make use of knowledge and things which have been obtained with its help, yet it took many

generations to find a use for Newton's calculus.

Again, Newcomen was one of the first men to build a stationary steam engine, and he sold these engines to Cornish mine-owners to pump their mines.

After selling a number of these Newcomen seriously feared that his market would give out: the mine-owners had their engines and he could think of no other application for steam.

The application of ideas and inventions is done better and more quickly now. I can just remember the time when there were very few bicycles; no cars or aeroplanes; no telephones, cinemas or wireless; when electric light was rare and everyone was bucking about that wonderful new invention, the electric telegraph, and yet here we are to-day with all these things around us.

From the point of view of humanity, by far the most important discovery ever made was none of these, but the discovery of applied science, which has made all these inventions possible and by applied science I really mean, the best and most systematic ways of applying scientific knowledge to practical things.

It took a few hundred years to apply Newton's work: it would have taken as many weeks to-day.

But even now we are only just beginning to learn how to apply our science to the needs of industry. The National Physical Laboratory is an outstanding example of national money

spent in applying science to industry. You have there men applying science to the design of aeroplanes and airships, to problems in the chemical industries, the electrical industries, whilst others are investigating the properties of metals and so on. One department has been studying the way that heat flows through different materials such as wood, cork and other things, as a result of which ^{it} ~~he~~ has improved the arrangements for keeping fruit chilled on its way from S.Africa to England, and the fruit saved by this improvement would, I am told, soon be sufficient to pay for the whole cost of the ~~MR~~ N.P.L.

But greatly as the N.P.L. has grown it is quite dwarfed by what has been done in America and I had the good fortune to go over the Bureau of Standards at Washington, which is the same thing as our ~~MR~~ N.P.L.

The Bureau of Standards has about three times as many scientists as the ~~MR~~ ^{N.P.L.} and at least ten times as much equipment. I spent two days going round it and only saw a small part. I will not bore you with a detailed description of what I saw, but I would like to tell you of one thing to give you some idea of the scale on which the Bureau works.

Shortly before I went there a large contractor asked the Bureau to advise him as to the best way to build brick walls. I know nothing about brick walls, but obviously, a number of things are involved: the quality of the brick and the mortar;

the best thickness of mortar; the best way to lay the bricks, for if the wall is say two bricks thick, the bricks have to be laid some along the wall and some across in a regular pattern, and several patterns are possible, and so on.

Well, the Bureau had a number of walls built each on a sort of long trolley, so each wall could be separately moved about, and each wall was different from the others in some particular respect: the mortar was different or the brick or pattern. I saw some of these walls: they were (give size). Well, each wall was run under an enormous crushing machine, which was capable of crushing the wall, whilst a number of instruments recorded exactly where the wall gave way, and how it collapsed, and the force exerted. In fact the dying agonies of those walls will live for ever ~~I~~ I imagine that by the time ^{they were all} ~~all those walls~~ were crushed the Bureau would know something practical about brick walls.

After looking at these walls and the enormous machinery involved, I asked the head of the Department what his bill would be for this investigation and the answer was nothing! The contractor got his information free! But the results were always published and so were available for all contractors all the world over.

A number of interesting points arise from this:

In the first place, at the ^{NPL} ~~Ac~~ if you want some information

involving work you have got to pay for it, and as experimental work is not cheap, it is an expensive matter for a manufacturer to seek knowledge from the ~~the~~ N.P.L.

Then, as the manufacturer pays the information is his private property and is not always available for other men in the same industry, hence the value of the investigation to the country is largely lost.

In America, if a manufacturer requires scientific help he gets it free, and the results of any investigations undertaken are public property. And it is an interesting fact that in the United States manufacturers are far more ready to pool their knowledge than they are in England.

Now, if the contractor had been an Englishman and had gone to the ~~the~~^{N.P.L.} I do not think I am exaggerating when I say that the test walls would have consisted of a few bricks with mortar between them, not because our scientists don't know the value of large scale experiments, but because we have no money available to build machines capable of crushing a full-sized wall.

This naturally has a bad effect on our manufacturers who wonder, not without some justification, whether it is worth their while to pay for experiments that are not carried out on an adequate size, and their doubts as to the value of science are not removed when they get the bill.

I could go on multiplying instances like this indefinitely but instead I would like to mention another American Institution

which is in some ways even more remarkable. I refer to the Mass. Institute of Technology at Boston.

This Institute corresponds roughly to the Imperial College of Technology in London, but is of a vastly greater size. It grants degrees and has 2,600 students.

The Buildings and plant are worth over £2,500,000 excluding the value of the land. Over and above this the Institute has an invested capital of £6,000,000 bringing in an income of about a third of a million. But beyond this money is pouring in from manufacturers from all over the country.

In England, whole Universities have been floated on less money than this, and I asked the Head of the Institute of Technology how it was that manufacturers were putting such enormous sums at his disposal. He replied that when a student was put on to a research care was taken to ensure that the research had a definite practical application to some industry and the same thing applied to the research work of the staff. In consequence, manufacturers were brought to realise the enormous practical importance to them of an Institution such as this, and not only give money and plant freely but also give jobs to the young men who have done well at the Institute, thus securing a proper mixture of science and industry.

Curiously enough, the present Head of the Institute of Technology, Dr. Stratton, was the original Head of the Bureau of Standards, and is responsible for its present position.

Probably no man has organized more applied science than Dr. Stratton. In the course of our conversation he asked me how it was that England spent so little money on applied science. I answered that we were far less wealthy than the United States and in addition that we had been through the World War and were nearly bankrupt. I shall never forget Dr. Stratton's reply to this. He said that we were far too poor to afford the expensive luxury of neglecting science - and he was right.

He also stated that in his experience, outlay on research for an industry was saved by that industry within twelve months by the improved methods discovered by that research. Now that is the key to the whole problem and emphasises the point I made earlier of the enormous advances made in applying science during our lifetime. Science, in fact, is no longer a gamble, but an investment which not only matures quickly, but yields an interest compared to which money lending is a sweated industry.

In addition to all these public laboratories, there are in America literally thousands of scientists engaged by private firms to research on their particular problems and several firms actually have laboratories of their own comparable in size to the ~~N~~ N.P.L.

Oddly enough, Henry Ford states in one of his books that he has no use for scientific research, but that is because Ford, although a genius, does not always know what he is talking

about. In the same book, he gives a description of the experimental work going on in his shops and it is quite clear that he is responsible for more applied research than most living men, only he calls it "experimenting", and does not realise that it is scientific.

The net result of all this cooperation between Industry and Science in America is that in material prosperity America leads the way, or to put it differently, there are more material things in America per head than in any other nation in the World, and on the whole, in spite of a very haphazard distribution, the average man has a far better life than over here.

For instance, every second family in the United States owns a motor car; there are in fact enough cars over there for the entire population to travel by car simultaneously. In this connection, I was very impressed by a statement of Henry Ford's to the effect that people did not own cars in U.S.A. because they were well off, but were well off because they owned cars. I think Ford is right; what he meant was that every tool - and a car is a tool - gives an increased power of making more things

Of course, the stock answer to all this is that America is a virgin country with unbounded resources, but this answer, although it has a grain of truth, won't really do. Our engineering firms are at least as close to their supplies as are the Americans, and since after all we do use steel, it is no good

to plead the Virgin County excuse as a reason for our steel being inferior to American steel. The raw materials available for our foundries are as good as theirs; the real fact is that we have not undertaken the necessary research. The same argument applies throughout our industries.

We often hear another argument put forward as a reason for not improving our mechanical appliances, namely, that every improvement throws men out of work.

Moreover, many people are scared by the spectre of over-production, namely, that the world might be filled with more things than anyone can buy. There is just enough truth in ~~and~~ this to prevent some people from seeing that it is all wrong. There are only a certain number of things in England, and if we distributed them all evenly, each family would have rather less than can be bought on a wage of £2 a week - I am quoting pre-war figures, but much the same applies now. Now, I would like far more things than that, and so we all would. In fact, I don't know anyone so well off that he would not prefer to have more. And what it all comes to is this, there are not nearly enough goods, - that is, actual things like motor-cars, books, wireless sets, etc. - in the country to go round and we have got to have more. We can make things a little less intolerable by distributing the things we have more fairly, but that only touches the fringe of the problem: we must buck up production and simultaneously reduce hours of labour. As I have been saying all along

this can be done - in America it is being done fast - but it can only be done by trying new methods, by research, in fact, and the nation that won't invest its money in research will never achieve economic freedom.

Of course there is such a thing as over-production of a given article, for instance, we should not want a dozen hats apiece, but we would require other things. In other words, production can be and often is badly balanced, but there is no such thing as overproduction as a whole until we have got everything we can possibly want, and I suggest that is not and never can be achieved.

Then again, we can have unemployment for yet another reason, namely, that the distribution has broken down, and this is what we are suffering from to-day. Millions of people in this country all want hundreds of things they have not got and practically everyone is willing to work, but the complicated organization of credit and distribution has been thrown out of gear by the last war and cannot easily be set going again. In fact, there are many causes for unemployment, but the one sure thing is that unemployment is never caused because people have all they want.

And here, I think, we have reached by far the most important problem that faces the world to-day. Are we determined to liberate mankind, giving them all a decent standard of living,

material well being, or are we not? It can be done: it is being done in America, where you see the happiest and most self respecting people in the world - but it can only be done on one condition, namely, that we improve our mechanical slaves, and the way to improvement lies through science. There is no by-way possible; the nation that refuses to organise its science is doomed; but in one short generation America has jumped from the European level to a degree of prosperity and widespread happiness that is undreamed on our side of the water. I shall never forget my feelings when I returned to this country after my visit to the U.S. and saw the familiar sight of young men looking for work, badly dressed children, and a general air of grinding poverty, all of which could be swept away for ever in one generation if we only had the vision to use our science.

Now I think that all this has a very special message to us who belong to the Labour Party. The day is not very distant when our Party will be in power and when that day comes we intend to put our principles to the acid test of practice. Yes, but what principles? To begin with we intend to educate our children and our young men and women: that is splendid and is the beginning of all civilization. But what do we intend to do to bring the material conditions necessary to any civilization to the homes of our people? Here I am filled with anxiety: it seems to me that the Labour Party has suspiciously little to

offer. I suppose nine-tenths of us are socialists and wish the means of production to be in the hands of the Government; personally, I belong to the other tenth, but the whole thing seems to me to be far less important than is commonly supposed. Whoever owns the property, it will finally be run by the Average Englishmen with his usual passion for muddling through; we muddled through the war with hardly any real military experts; we muddle through our business with hardly any industrial experts; our engineering drives on without benefit of science, and finally one day the Labour Party is to muddle us through to Paradise - I use the word 'muddle' advisedly: we are to have socialism - or not - it really doesn't matter, but in any case, the country will be free, everyone will have his chance. Yes, but how? Good feeling is very desirable, but it is not enough. The problem is a difficult one and hard thinking is our one hope.

Now, throughout this lecture I have been trying to persuade you that PRODUCTION is the key to Paradise, and that science is the only road to Production, and I ask you to think of all the Labour legislation, education apart, that has been bottled up for future use. All the more important schemes are schemes for DISTRIBUTION. Here we are with plenty for all waiting for us, and our main energy is directed to elaborating schemes for distributing the one stale loaf that happens to be in our hands.

Of course, I shall be told that the Labour Party has every

intention of increasing production, that fairer conditions will increase production: so it will - a trifle. The Labour Party intends to offer science every facility - so it does: in a good natured sort of way, but good nature never organised anything. Where are the detailed and well-thought out schemes for the training and direction of scientists and of Laboratories, and the machinery for linking all this with industry?

For years past the country has been ringing with schemes for distribution: socialism, guild socialism, communism, and so on. Literally, thousands of books have been written on distribution; all Utopias have been founded on distribution. But when has England ever rung with the cry of Production? Where are the Utopias founded on production - where indeed? Nowhere.

Of course, I am not suggesting for one moment that the problems of distribution should be neglected, far from it, but before you can distribute anything you must first obtain it, and this is the truth that the Labour Party seem to me to be in danger of forgetting. Perhaps it would be more fair to say that very few people realise that a real sufficiency is obtainable at all. And this is the trouble; it is so very recently that science has come to its own that its power is not in the least understood.

In the past people have written books describing their notion of an ideal society. The first of these that I know of is "Plato's Republic" and it is probably the most famous; then centuries

later Moore wrote his Utopia; later again Tom Paine wrote a book called "The Rights of Man," and we have all heard of Carl Marx, who had very decided opinions as to how a state should be run. Of course, there are dozens of others, the Russian, Kropatkin, for example; All these men had widely different ideas as to how a nation could be best organised; but I think you will find that they all tacitly agree about one thing - they all assume a static world; and by this I mean that they all assume a world which is not going to change very rapidly. So far as all but the latest writers are concerned I think they were roughly correct, their world did move very slowly, and in consequence they were not led to wonder how they could change the forces of Nature and the power of man. They took all that for granted and then tried to make the best of things. The natural consequence was that they all devoted their ingenuity to seeing how to organise society in such a way that the obvious shortage of material things should cause the least possible inconvenience to everyone concerned, and if you once accept their *premis* of a static world, that is about the only thing left to do.

As I said before, hundreds of books have been written on the problem of distribution in this style and, with the exception of the very latest writers, they were quite right for the world as they knew it. But though it may have been right once

it seems to me quite fatal to think of the World in this way now. We are living in an age of revolution - not only ^{or} ~~an~~ even mainly political - but scientific. A new weapon has been put into our hands, but hardly any nation, with the single exception of America, has yet used it, and the result there is frankly stupendous: plenty exists to a degree we can't imagine, education is booming, Universities are springing up everywhere, and are so crowded that university teachers can hardly be obtained of the necessary quality quickly enough, and I venture to predict that in the next generation the United States will give us the first example of a really civilised nation that the World has ever seen.

And don't be misled by newspaper accounts of boot-leggers, murders, religious reactionaries and other stunts, into thinking that I am exaggerating. The newspaper accounts are mainly true: I reckon that there must be more murderers in America to the square inch than in any other part of the world; their Government is rotten, and their religious reactionaries are, to put it mildly, crude. But all this cannot alter the fact that when 120 million high grade people suddenly discover the secret of universal economic freedom, and having discovered that, when their first impulse is towards a nearly universal higher education and a vigorous spreading of culture, something is going to happen; and remember it always looks crude to be

forging ahead, trying experiments as fast as they can be made; if you explore unknown country you are bound to make mistakes. To look really mellow, you should sit by the side of the fire with a tankard in one hand and a churchwarden in the other, then nothing can possibly happen and you can't go wrong.

Now, clearly, in a dynamic world like this, the problem of distribution, though still important, is subordinated to the problem of production, and that organisation is best which encourages progress and is elastic enough not to impede it; and it may well be that the organisation which will enable us to travel faster ~~and~~ towards the promised land is too yielding to give the theoretically best distribution of material things at any given moment. I don't want to be dogmatic here, because the subject is far too vast for me to have thought it out, but it seems to me quite possible that a society which overpays the successful pioneer may have something to say for it, certainly that is what happens in America and it seems to work. However that may be, it is clear that we are faced with a new World and a new Problem, and neither Carl Marx nor any one else can help us here: they never knew a scientific world and have nothing to tell us.

This is the problem that the Labour Party has to face if it is to rise to its opportunities. It has to see that the country is helped, to increase production to such a level that, with

reasonable and healthy work, we can all enjoy the great blessing of a real civilization. This means detailed schemes for the training of scientists and engineers, the provision of adequate laboratories and the organization for linking the work of these laboratories to the needs of Industry.

Of course, the Labour Party has a scientific committee and no doubt some sort of scheme for the advancement of applied science. But it is clear that the directing brains of the Party do not realise the enormous power that science has put into the hands of mankind. Science is very rarely mentioned in political circles and I have never once heard it hinted that this science is capable of revolutionising our whole national wellbeing in one generation: it has done it in America, and it can be done here. Yet this is surely by far the most important message we gave for the country. It is a new message this: **THE REVOLUTION OF PRODUCTION BY SCIENCE:** and a nation learns slowly, moreover the Trades Unions, for much the same reasons as the writers, have their eyes glued to the problem of distribution. This was inevitable and they have done magnificent work, but none the less their present attitude is a real danger to a revolution in production. The ground needs to be prepared everywhere; our Leaders seem to me to be in the dark, and even more the rest of us. But it is because our Party is the one effective political force that has the necessary vision

to tackle this vital task that it is so necessary we should
break with the past and rouse our country with the cry of
Production.

Scientific Production .