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Soddy's critique of the theory of economic growth and Lancelot Hogben vs. Hayek

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SODDY'S CRITIQUE OF THE THEORY OF ECONOMIC GROWTH

The ecological critique questions the definitions of the terms of economic discourse, such as "production". To that extent, it has always been destructive of theories of economic growth, though this does not mean that the early ecologists were technological pessimists.

One persistent critic of economic theory who could not always be called a "technological pessimist" was Frederick Soddy (1877-1956). He worked with Rutherford on the initial research into atomic desintegration in Montréal and subsequently at Scottish Universities. He discovered and named the isotopes, and obtained the Nobel Prize for chemistry in 1921. In 1919 he had returned to Oxford as professor of chemistry, on his second attempt to secure a chair at the university where he had been an undergraduate (Merton College). Neither the scientists nor the economists paid any attention to his economic doctrines and he remains an unknown name to this day even among the economists of his old university, despite the recent articles by Trenn (1979) and Daly (1980).

From 1903 onwards Soddy believed that radioactive energy from the disintegration of atoms could change the economic prospects of mankind, though he was doubtful about the possibilities of developing the technology for accelerating the rate of fission of the self-splitting atom. We shall learn more about his views on atomic energy at the end of this chapter.

He gave the title Cartesian Economics to the lectures delivered to L.S.E. and Birkbeck College students in 1921 to emphasise that his critique was not at all based on romantic gloom about the technological prospects but on a rationalist approach to economic

on our side wish
categories and to economic science. We ... /to emphasise the
title he gave to his lectures, since it is now the fashion
to set "ecological thought" in opposition to the scientific method
and to analytical thought (for instance, in the work of the
Californian mystic Fritjof Capra, 1982), a fashion much favoured
by the irrationalist philosophies of science prevalent in the
1960s and 1970s (cf.Newton-Smith, 1982).
In those lectures, Soddy took issue directly with Keynes' views
on long term growth, as set out in Economic Consequences of Peace.
Soddy defined wealth as a flow, which could not be saved, only
spent. Real wealth came only from the flow of energy from the sun,
which was consumed as it arrived and could not be stocked. Part of
this wealth took the form of so-called capital goods and was care-
fully measured as financial capital, i.e. as credits against the
community. Real wealth, in the form of a wheat crop, for instance,
would rot if stored for any length of time, whereas the wealth
which took the form of so-called capital goods, and was registered
as financial capital, was supposed not to rot but, on the contrary,
to grow independently at compound interest, ad infinitum. This was
a convention of human society, subject to contingent ethical values.
Such values could indeed be historically variable, but they could not
run permanently counter the principles of thermodynamics. One could
readily agree that a chauffeur had a spiritual life which transcen-
ded the mechanism of his car, but if his spirit should move him to
run the car on petrol already spent, we would consider him an ass.

The economists were victims of this delusion. Keynes seemed to
believe that wealth -and not debt- increased according to the
rules of compound interest, a "fact" which he opposed to the
Malthusian population "law". He had written that one geometrical
progression could overcome another, and that the nineteenth century
had been able to forget the fertility of the human species because
of the dizzy virtues of compound interest. Capital, according to
Keynes, was something like a cake which, one day, thanks
to compound interest, would be large enough to satisfy
everybody, unless it were prematurely consumed in a war.
Once the stock of capital had increased sufficiently, excessive
work, overcrowding and hunger would disappear, and mankind
could devote itself to the exercise of its nobler faculties.
Now we all know, remarked Soddy, that we cannot have our cake
and eat it. Capital could not really be stored, as it was
subject to a law of continuous decrement, because, in physical
terms, it was energy embodied in certain objects, subject
to the law of entropy.

What do capital and investment mean?

If part of an income is saved and invested, it will increase
the stock of capital, i.e. it will increase productive capacity.
If demand is not lacking (and in the short run demand will have
been stimulated by investment itself), production will increase
and in the long run it will be possible to remunerate that
investment with a part of the increased production. Soddy had
his doubts about this way of looking at the economy and
implicitly asked: are we not investing too much?
Soddy's approach, in all his economic writings (including
the second edition of Wealth, Virtual Wealth and Debt, published
in 1933) took a line different from the so-called"technocrats"
(e.g. Fred Henderson, 1931), who emphasised that "so far as
production is concerned, our capacity is so great that practi-
cally any demand for goods could be met without delay...Vast

power, continuously expanding to vaster power, has been brought under control and is visibly up to its job if it gets its chance" (Henderson, 1931, p.10-11), and who attributed economic problems to lack of effective demand because of the ill-distribution of income. Soddy was also worried about income distribution, and his ecological critique of economics is directed against rentiers and capitalists. However, he emphasized supply problems, rather than lack of effective demand. His implicit question on excessive investment was not promted by a worry that productive capacity would surpass effective demand. His thoughts ran in a different direction, that economists have great difficulty in understanding.

In a physical sense, investment means the expenditure of energetic and material resources on the construction of installations which are intended to increase productive capacity. In the financial sense, investment means buying a piece a paper which gives the right to an interest or dividend and therefore to a part of production. Now, Soddy said, many investments do not increase productive capacity in the physical sense, but rather increase the destruction of non-renewable resources. Simultaneously, debts are increased. The economists believed that the issuing of shares and bonds, or of public debt, would increase productive capacity provided that the money collected in this way were invested. Production would increase in the short run up to the limit fixed by productive capacity, due to the effect of the expenditure on investment, and it could increase in the long run pari passu with the increase in productive capacity.

Investment, i.e. the expenditure of money on buying capital goods, ought to increase production in such a way that both interests (or dividends) and the principal of the debt itself

could be paid over time. However, investment, with exceptions such as the construction of a water mill, did not increase productive capacity but rather accelerated the depletion of the stock of fossil fuels, both in the manufacture of the capital goods themselves and in their use once they had been installed and were fully functioning. Now, the rule of a capitalist economy was that all credit advanced to firms or to the State in order for an investment to be made, had to be repaid and, in the interim, was expected to earn at least the current rate of interest. Therefore if investment does not, in fact, increase production but rather increases only debt, creditors, who are the owners of the scraps of paper we call shares, bonds and public debt titles, will receive an increasing portion of a scarcely growing, stagnant or even falling production. To the extent that a large part of the investment was financed fron the public debt, this would lead moreover to what we would now call a fiscal crisis for the State.

This was Soddy's analysis, which naturally led him to deal with financial questions, since the value of such debts, in terms of production, would depend on monetary factors. Soddy's analysis was based on the impossibility of an exponential accumulation of capital, not because of crises of effective demand and the consequent drastic oscillations in investment, and therefore in total demand, caused by excessive productive capacity due to such cumulative growth, but rather because of the physical absurdity of mistaking the expediture of energy for the accumulation of productive capacity.

The "social credit" proposals put forward by Major Douglas and A.R. Orage were interesting -wrote Soddy- but impractical, because they were also based on the hypothetical virtues of compound interest which they wanted to extend to everyone and not just to a few owners of capital assets. Their idea of running

the system not just for the benefit of its creditors but rather of the true creators of wealth was commendable, but misguided. Of course, all these authors lived in cities, far from any real contact with nature, and they thought that the peculiar customs and rules that were applied to urban businesses could be generally applied to the world economy. Any member of a rural community who knew how wealth was really produced -by the process of photosynthesis- would find it intelectually difficult to bown down in this naive way before the institution of usury.

He wrote that economists used to explain the origin of the first capitalist as a sort of Robinson Crusoe, a man of exceptional ingenuity and application, perhaps because, as children, they had been taught the myth of Genesis. The advance of knowledge had shown, however, that if Adam was an animal, the first capitalist was a plant. Plants accumulated solar energy, whereas we only expended it. Coal burnt was burnt forever. We cannot burn it and keep it in the cellar, and still less can we continue to accumulate interest on the value of burnt coal, which was precisely what happened with the economists' and entrepreneurs' so-called "capital". That wealth had not been saved, but spent, with a counterpart in the form of a receipt, whose holder could go on accumulating interest every year on the amount of the debt: this was purely a social custom.

Not only entrepreneurs and shareholders were in fact usurers, despite the efforts genuinely made to increase wealth. Now we could all be usurers, since during the war many people had learnt to buy war debt bonds, which paid interest. Such social conventions defied the laws of physics. Aristotle had despised usurers, but today even the Rectors and Wardens of the most ancient seats of learning, where Greek thought and culture were supposedly

revered, were as enamoured of the virtues of compound interest as everyone else.

Obviously, compound interest had never operated over long periods of time, as the story of the Emperor of China and the chessboard shows. The Emperor asked a man to teach him to play chess and then to name his reward. The man asked for one grain of wheat for the first square, two for the second, four for the third and so on. One pound sterling at 5.5 percent rate of compound interest would double in 12.5 years and in 250 years would pass the million pound mark. An economic system which allowed at least a substantial part of the debt to grow at compound interest would have to be extremely prolific in scientific discoveries, as the nineteenth century had been, and even so, there was not way of escaping from the true economic principles of physics. Economics should not be mistaken for chrematistics, the art of making money, as Aristotle had explained. Perhaps Soddy had read Aristotle's Politics, or perhaps he had got Aristotle's distinction from Marx (Capital, vol.I, chap.4). In any case, he believed in a science of economics which would not study the economy as regulated by the price system (this study could be called chrematistics), but rather would be an analysis of how to provision the commonwealth with the means of life which modern science made possible. One first step towards such a "scientific utopia" would be to limit the rights of creditors.

Ruskin was Soddy's favourite economist, as he defiantly told his audience of economists in 1921. Ruskin had rightly said that in exchange there was no profit. A trader who sold hams with a mark up of ten per cent could buy eleven hams for the sum he would receive from selling ten, and could imagine that he had earned one ham. However, no ham has been produced in such a transaction. If there were ten hams to begin with, there will be

ten by the end, and they are the profit of the entire lives of a certain number of pigs (two and a half, to be precise), which have been fed, according to nursery tradition, on potato skins, whose nutritive value is derived from radiation from the sun. Wealth is always some form of useful energy embodied in an object. The law of conservation of energy says that for each "plus" there will be a "minus"; in this case, however, the "plus" is fortunately credited to the account of our planet while the "minus" is debited to the account of the sun. From the terrestrial point of view, this is equivalent to a creation of wealth. This was the only possible way of looking at things which the laws of energy and matter would allow.

Of course, the contrary proposition (for each "minus" there is a "plus") does not apply to wealth: saving does not mean "investment" in the sense of increase in productive capacity. We know that there is a law that all useful energy -which constitutes wealth- is eventually dumped in the universal heat sink at uniform temperature. Conventional economics could be criticised because it mistook the shadow for the substance, and was guilty of the same misapprehension as the old lady who, when her banker complained that her account was overdrawn, sent a cheque to him on the same account. This confusion arose from the very beginning of economic science, defined as the study of the "Wealth of Nations".

The most frequent form of debt, of course, was money, whose nature could be easily understood because of the war: the amount of money should maintain the same relation to the revenue of wealth as a ration coupon to the supply of food or a theatre ticket to the capacity of the theatre. In fact, there was as little relation between money supply and revenue as between the barometer and the birth rate. For a chemist, it was hard to believe in the almost mystical virtues of

gold which would account for the waves of economic expansion following each new discovery of a mine in California, South Africa or Australia. Of course, chemists are not versed in economic science, and hesitate to pronounce on such subjects, but it would seem that what really happened over the last century was that science increased the revenue of the world by leaps and bounds by the consumption of the store of energy preserved in coal.

Now, if there were more food available while the number of ration coupons remained the same, coupon holders would get more food, but it the supply of coupons increased pari passu with the food supply, previous holders of coupons would get the same as before and new holders would receive the surplus of food. In that era of prosperity, the money supply increased, not because of the discovery of gold but also because of the introduction of cheques, and other forms of payment, and thus the new prosperity was made in part available not only to the old creditors but also to new people.

Money was supposed to be a measure of value, a medium of exchange and a store of wealth. Wealth is, however, a flow, not a store. Humanity was crying for the moon when proposals were made to stabilise the value of the currency without regard to the physical realities behind real wealth. Soddy explained inflation correctly as a means of making the payment of excessive debts bearable: an increase in the money supply, without an increase in real physical wealth, diminishes the creditors' share and therefore is blamed as inflation (he wrote), while a lower money supply increases their share and therefore receives the name of sound finance. We could identify a short-run and a long-run Soddy. What has been said applies in the short

term: inflation favours debtors. In the long term, however, Soddy would have found the notion that increasing nominal GNP has any relation to increasing real GNP highly amusing. Financial expansion had no relation to the real problems of the economy, linked to the availability of energy (and, perhaps, he could have said, to the increasing energy cost of the new sources of energy). He was a true and realistic supply-sider.

Thus, Soddy would have not agreed (we guess) with proposals (Meade et al., 1983) to set objectives for the growth of nominal GNP, preventing this growth from manifesting itself merely as an increase in prices by means of a social pact to keep down wages. Continuous growth might be achieved if the share of investment in production is adequate and if external payments do not become unbalanced. The task of the government is to facilitate and control the money supply. This current mixture of monetarist and Keynesian-corporatist prescriptions would not have convinced Soddy, since they contain no consideration of the real flow of wealth.

"Cartesian economics" had to be scientific economics, far from the "speculative philosophy taught in our schools". In a homelier language than that of Descartes, the subject could be introduced through the following anecdote. A virtuoso organist, enjoying rapturous applause from his audience, was very annoyed to see the blower appearing from behind the screen and saying, "we have indeed played well". The organist ordered him brusquely to disappear from public view. As the next piece was approaching its climax, the music suddenly petered out, and the blower appeared again to say, "we both play, don't we?". The point of the anecdote was that in modern times the human energy of the blower had been replaced by electrical energy: and energy, in any of its forms, should

be the starting point of economics. In the eighteenth century, the French school of philosophers known as the Physiocrats did attempt to base economics in physical reality. They traced the origin of all wealth to the land, and came as near as the science of their time allowed. Karl Marx, contrary to common belief, did not attempt to show that the origin of wealth was only human labour, but rather that the origin of exchange-value (or the money price of wealth) was human labour. Concerning wealth, Marx was perfectly correct (wrote Soddy) when he asserted "that labour is not the only source of material wealth, of the use-values produced by labour. As William Petty said, labour is its father and the earth its mother" (Capital, vol.I, chap. 1). Soddy thought in 1933 that "it was rather the disciples of the prophet who forgot all about the mother, until their memories were jogged by the recalcitrance of the Russian peasant" (1933,p.73-74).

Soddy wavered in his appreciation of marxist economics, which he sometimes considered as metaphysical as orthodox economics, tough, now and then, his left-wing views on distribution led him to praise Marx, even to the point of writing that "had Karl Marx lived after, instead of before, the establishment of the modern doctrine of energy, there can be little doubt that his acute and erudite mind would easily have grasped its significance in the social sciences" (1922, p.13), when we know that Marx (1818-1883) and Engels (1820-1895) were contemporaries of J.R.Mayer (1814-1878), Joule (1818-1889), Clausius (1822-1888), William Thomson (Kelvin) (1824-1907), Helmholtz (1821-1894), and that the establishment of the laws of energetics took place in the 1840s and 1850s, while the first volume of Capital appeared in 1867. We now know, precisely, that Marx and Engels failed to grasp the significance of Podolinsky's work.

Neither the Physiocrats nor orthodox economics nor marxist economics had developed a relevant answer to the basic question: how does mankind live? The answer was, "by sunshine". Without the sun the world would be lifeless, not only because there would be no plants and animals, but also because even inanimate nature would stand still. The volcanoes would still erupt, the tides would ebb and flow in dead oceans, the newly discovered phenomena of radioactivity would persist, but there would be no rain and no wind. The starting point of economics should be the first and second laws of thermodynamics. Although Soddy did not pay attention to exhaustible resources other than fossil fuels and radioactive materials, he was not a partisan of an energy theory of values, being extremely conscious of the difficulties in defining the objectives of human life. He stated explicitly that he did not understand the proposals of those who wanted to substitute a system of "energy certificates" for the prices system (1933, p.iv,cf.Chapman,1980). In the unlikely even that he had been surrounded by economists converted to ecological reductionism, he would certainly have quoted Ruskin at them with his eulogy of the aesthetic objectives of economic activity.

Although life followed the principles of the steam engine for its physical preservation, it was also "the expression of the interaction of two totally distinct things represented by probability and free-will" (1922,p.6). The natural sciences dealt with the phenomena of probability; there was room for sciences of intelligence and free will. Economists needed to understand the laws of physics, but they also had to grasp the effect that the intelligent behaviour of humanity could have on the physical world. The biological and the human sciences had to study the equivalent of Maxwell's demons.

The vital and the laboral use of energy

It was precisely the capacity of using energy externally, and not only internally, like any other plant or animal, which made necessary a specific economic science, which could not be reduced to natural sciences. Soddy's distinction between the vital and the laboral use of energy was introduced in his 1921 lectures, and it is similar to that of Lotka, so often quoted, between the endosomatic and the exosomatic use of energy.

Vital use refers to photosynthesis in plants and to carbon oxidation in the nutrition of animals and human beings. Animals and humans cannot use solar energy directly (except to warm themselves), i.e. they have no chlorophyll. The laboral use of energy refers to the use by humankind of instruments which are moved by the wind, by waterfalls, by steam or internal combustion engines, etc. Such external uses of energy can also have recreative purposes, and this is why Lotka's distinction between "endosomatic" and "exosomatic" uses of energy is more comprehensive than Soddy's.

Soddy pointed out that, although the vital use of energy could not vary much from person to person, the laboral use varied enormously from one person, one country and one historical period to another. This is something which had been noticed from the very beginning of ecological economics by Podolinsky, Sacher and Geddes, and which is a specific characteristic of humankind. There was a discontinuity in the nineteenth century, because before that period the flow of solar energy had been exploited for vital and laboral uses, whilst now use was being made, for laboral purposes, of a stock. "Wind power, water power and wood fuel are parts of the year to year revenue of sunshine no less than cereals and other animals foods. But when coal became king,

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the sunlight of a hundred million years added itself to that of today and by it was built a civilisation such as the world had never seen" (1922, p.20). The fundamental feature of this civilisation, however, was that the "internal combustion" of the human body could not directly be fed by fossil fuels, but only by vegetables, either directly or indirectly in the form of animal products. One could certainly use water power or fossil fuels to make electricity and to manufacture nitrogenous fertiliser, which would increase crops, but the penultimate step must always be the storage of energy by plants. Photosynthesis marked the true limits of human welfare on Earth.

Britain had been able to exchange commodities made with the energy stored in fossil fuels for food from other territories: by this process "the whole world gradually drew more and more for its labour-use on the capital energy of fuel, and used it to widen the area under cultivation and to transport the harvests from the most distant regions of the world and so indirectly augmented the revenue of sunshine upon which it is still entirely dependent for its life-use" (1922,p.11). This short-lived phase could be prolonged by imperialism, but nothing could change the fundamental fact: use of coal (or oil) meant using capital instead of revenue, and coal (or oil) could only be used indirectly for life. Thus there arose the paradox that capitalism was not "capitalist" as regards the means of livelihood. It was, to coin a word, "revenual" -which of course helped to explain the resilience of peasant farming, which was able to retreat into subsistence by giving up the use of "capital"/which could be appropriated by capitalists.

/(i.e. non-solar forms of energy)

It was absurd, however, to talk of an "accumulation of capital". The capital stored in coal was spent, not accumulated. The flow of energy from the sun "may be embodied in some

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concrete commodity, in food which rots, in houses which fall into desuetude if not kept permanently under repair, and in all the tangible assests of our civilisation, in railroads, roads and public works, factories, wharves, shipping and the like. All alike are subject to a process of compound decrement ... The wealth is the revenue and it cannot be saved (1922, p.14). The individual, however, although he will rarely have enough real wealth to keep alive for a single week, can store, not wealth, but currency, "whether a cowrie stone or a mental counter, but now, more and more, a simple paper note", and the community acknowledges the right that the holders of such tokens, who do not create real wealth, have to indent upon the revenue of wealth flowing through the markets at any given moment of time. The more wealth is spent, the greater the total amount of indebtedness, which becomes, as Ruskin said, "power over the lives and labours of others" (1922,p.15).

It could be said, in answer to Soddy, that in economic accounting that part of capital goods which is considered to depreciate yearly is substracted from production. Thus, the GNP includes all investment and only a part of it will be counted as net investment, the rest being counted as amortisation to be substracted from GNP if we wish to get a measure of "net production". Therefore Soddy's strictures seem out of place, unless one recalls that the national accounts do not include any provision (or only a minimal one) for the depletion of natural resources, on the accounting convention that the discovery of new reserves compensates for the expenditure of that "capital", which is therefore not amortised. The point is of such importance that it deserves a brief excursus. Let us see how a modern, influential keynesian macroeconomist (Okun, 1981) deals with this question, which symptomatically receives cursory treatment.

Okun started from the premiss that the economy, by itself, has an underlying "prosperity trend line", and that we can cost crises by comparing actual production with the trend. This is the type of analysis which came into fashion in the first Economic Reports to president Kennedy. Okun would then like to establish whether there is a discrepancy between the cost of a crisis, as measured by the actual loss in production compared to that of the trend line, and the "social cost" of a crisis: perhaps there are some hidden benefits in a crisis, not captured by normal economic accounting. Okun would consider, in principle among such benefits a lower degree of wear and tear of the capital goods (which because of the crisis work under full capacity utilization) and also the fact that the extraction of non-renewable resources will be lower than if the economy were to follow its prosperity trend line.

Let us imagine a farmer who buys a tractor, which he thinks will last for five years. Part of his income will be set aside every year, in order to be able to buy a new tractor; otherwise, he would be losing capital. At the end of the period, models will quite possibly have changed, and perhaps he will be able not only to maintain his productive capacity (which is the objective of amortization) but even to expand it a little bit, making an involuntary net investment, if the new models are more effective. Let us now assume that there is a crisis, and that the farmer leaves some land idle because he anticipates difficulties in selling the produce. The tractor will work a lower number of hours per year. It could seem that if the farmer goes on with his amortization plan (for instance, one fifth of the cost of the tractor every year), then he would be amortizing too much, since the tractor is subject to less wear and tear. But although there will be less physical wear and tear, on the other hand economic "wear and tear" will proceed just the same: the tractor will become obsolete, and the farmer would have higher production costs than farmers using new tractor models. One part of amortization corresponds to physical wear and tear, and another part to technological obsolescence. In a period of economic crisis, physical wear and tear will be lower, a hidden benefit. Okun reaches the following estimates: one third of the total funds for amortization could be assigned to such "user costs"; since the amortization of fixed capital (excluding housing) is approximately 7 per cent of Gross Domestic Product in the U.S., this implies that a fall of one per cent in GDP means a non-registered reduction in user costs of only 0.02 per cent of GDP (Okun, 1981, p.274).

This is clear enough, and it serves us as an introduction to the computation of the "social benefit" which will accrue from the lower extraction of exhaustible resources, as a consequence of a crisis. It would seem that in principle the loss of capital by forgetting to amortize a tractor is quite similar to the loss of "capital" by forgetting to amortize the oil taken from an oil well. However, Okun did not make any correction at all to the costs of the crisis on account of the lower extraction of exhaustible resources, on the grounds that the national accounts do not register any deduction for the depletion of exhaustible resources, since neither is the value of new discoveries of exhaustible resources included (before extraction) in the national accounts (1981,p.275). This is an extraordinary convention.

We could imagine the national accounts of a pastoral economy. The cattle or sheep produce every year a certain number of youngsters, part of which we eat, and part of which remain in the herd to substitute for the old cattle and sheep which die a natural death. The accounting practice with exhaustible resources would be equivalent to consider as net production all the young sheep and cattle (eating them all up), without making

any provision for "amortization" (i.e. for maintaining the productive capacity of the herd). In the case of oil or any other exhaustible resources, such accounting practices assume, in fact, that they are not exhaustible, i.e. that new discoveries will keep up with current use. It might be argued, however, that a hidden social benefit of a crisis in the developed countries is that the destruction of oil and other resources is slowed down somewhat.

A symptom that new discoveries are not keeping up was the battle for the control of Gulf Oil in 1983 and early 1984. The Texan oil-financier T.Boone Pickens was offering to buy shares and, once in control, to change the company's policy, not expending so much money in new prospections for oil which (in the U.S. territory) have not been successful, and investing instead the revenue from selling the considerable oil reserves of that company in activities more lucrative than looking for oil. Many shareholders were convinced. This policy, however, would not make sense for the economy as a whole, which still relies on oil as one of the cheapest sources of energy (in terms of energy costs, cf. Slesser, 1979) for laboral or exosomatic use. In any case, though, new discoveries do not seem to keep pace with current use, and in the past five years the production life of the U.S. oil reserve base had dropped from 11.1 to 9.4 years. Mr Pickens' point was simple: since the big oil companies are "producing" (in the U.S.) much more oil than they are finding, the shareholders should be allowed to reap maximum benefit of this process of liquidation (Financial Times, 7 and 9 March 1984).

Thus, it would seem that the lower rate of depletion of exhaustible resources because of a crisis, should be given some credit in national economic accounting, as a "social benefit" not captured by market values. How it should be counted depends on how the present value of the demand of future generations is counted, a question which will be the subject of another chapter.

The first illusions and doubts about nuclear energy

Our chapter on Soddy's economic thoughts would be however most incomplete if we did not deal with his view that the distinction between the vital and the laboral use of energy would lose importance if enough energy were available to produce synthetic food. What were the prospects for a great increase in the availability of energy? A characteristic statement of his runs like this: "The extraordinary developments since the beginning of the century in the study of radioactivity and of the internal structure of the atom have proved that there is resident in ordinary materials amounts of energy of the order of one million times that which can be obtained from fuel during combustion, but to liberate this store the transmutation of the elements one into another must be first made possible" (1922, p.22). The decisive factor was knowledge, since humanity has shivered with cold for thousands of years on top of coal mines, and nearly died of hunger next to the Niagara that now worked to produce more food through the manufacture of fertilisers. It was quite true that the future of civilisation depended on the summer holidays of university teachers, who then had a few weeks for uninterrupted research. Soddy, it must be said, spent his time for research on economics instead of in trying to split the atom, and his role in atomic physics, comparable in importance to that of Rutherford in the period up to 1920 (cf. Trenn, 1977), was negligible afterwards. It would be quite false, however, to say that his interest in the economy arose only in going back to Oxford: in fact, he had from the very beginning of his career noticed the connexion between the economy and the availability of energy.

Soddy believed in scientific progress, but he did not believe that it was synonymous with technical progress. He realised at the turn of the century how the newly discovered source of energy could change the history of humankind, but he thought all his life that warlike applications were more likely than peaceful ones. He asked himself what would be "the effect of the discovery that, so far, we have been subsisting on the mere by-products of natural energy, and have remained ignorant even of the existence of the primary supplies in the atoms of matter" (1912, p.240). The effect was likely to be destructive. H.G. Wells in The World Set Free (1914), used Soddy's warnings to anticipate not only the industrial employment of atomic energy but also a universal atomic war. In 1917 Soddy wrote that if humanity succeeded in controlling this aspect of nature, war would probably cease to be an interminable agony because a suitable section of the world, or the whole world if necessary, could be swiftly and effectively stripped of its population (Freedman, 1979, p.259; Trenn, 1979, p.267). His early alarm at the destructive possibilities of nuclear energy was not shared by many other scientists. Millikan, for example, himself a Nobel Prize winner and head of Caltech, openly ridiculed it (Sinsheimer, 1978).

Years later, in 1947, when Soddy was seventy years old, he gave a lecture in which he provided a detailed account of the discoveries of atomic theory, from Becquerel, Röntgen and J.J.Thomson between 1895 and 1897 to Otto Hahn in 1939 and the process of accelerated nuclear fission in the atomic bomb. There was a double achievement, "both the sudden liberation of a sensible part of the atomic energy of uranium by the atomic bomb, and the controlled release by the uranium pile", i.e. the graphite-moderated reactor. "Of the effectiveness of the former

for destruction the facts speak for themselves": more deaths from a single atomic bomb than from all the air-raids in England during the war. On the other hand, he was far from hopeful "so far as this one particular method of releasing atomic energy yet known is concerned, that it has any real technological application as a source of power for normal peacetime applications", and this for two reasons: the "poisoning" of the reactor, which shortened its life, and "the virtual impossibility of preventing the use of the non-fission products of the pile, such as plutonium, for war purposes" (1947, p.10-12).

He had long wanted to discover why science had proved at least as much a curse as a blessing to mankind, in view of the contingency, which had seemed remote but now was immediate, that the powers of destruction might suddenly be increased a million-fold. This line of enquiry had brought him to the idea that "all history could be strung on the one thread, the growing power of men to control and use the energy of nature in supplement to their own relatively puny strength" (1947,p.12). Soddy was not in the habit, in his economic writings, of observing scholarly conventions, and he did not quote either Podolinsky or Sacher (whom he did not know), or Patrick Geddes; or indeed Ostwald, whom he certainly knew. It is quite likely that Soddy independently made the connection between energy availability and the course of human history, more or less at the same time as Ostwald but stimulated by his work on radioactivity (which was quite alien to Ostwald's outlook in chemistry and physics).

Be that as it may, by 1947 Soddy could complain of a double frustration of science: the technological benefits to be reaped from scientific work were not made available to humankind at large because of the economic system which made for unequal

distribution, and, moreover, some of the technological developments from scientific discoveries could not be more appalling. The destructive power of atomic energy was already here: "we (should) wait for the natural orderly growth of technology to harness in due course the new source of power, rather than as now feverishly attempting to cook the hare before catching it", and "rather than starting our engineers on a wild-goose chase elaborately cracking peanuts with steam-hammers, for purely political window-dressing as yet another carrot to keep the masses hopefully jogging along, it would be better to concentrate for a while on the purely research side" (1947,p.12).

In politics he apparently had no friends, and although he sometimes praised Marx, he was opposed to Soviet communism. In his lecture in 1947, he supported Bertrand Russell's conjuctural proposal for the U.S. to prevent, by force if need be, the atomic armament of the Soviet Union. He died in 1956, before the CND was founded. Sometimes he had embellished his writings - on the capitalist monetary and banking system with unnecessary comments on Jewish bankers; he also occasionally wrote of the so-called "white race" having to fight over sources of energy. We do not believe that these comments show other than run-of-the-mill Eurocentrism and anti-semitism, and Bernal and his friends thought well enough of him to ask for a preface to a collective work on the "frustration of science" (Hall et al. 1935). He had at least one German "disciple" (Brüggen, 1934) and he was mentioned by Zmavc (1926,p.6), but his impact in Britain and outside was very limited. He joined the Union of Scientific Workers, which was an unlikely step for an Oxford professor to take; he refused to pay the fee due to receive his M.A., which meant that he was barred from attending the general meetings of the University; he was widely considered to be a strange character.

who "as regards real economics, as distinct from chrematistics... wittingly suppress rather than propagate the truth",

No doubt he was "strange", as well as self-confident. He asked publicly how such people as economists could "be tolerated in Universities, the sole raison d'être of which is to seek out Truth and proclaim it though the heavens fall - for which service the students and teachers are relieved of the necessity of contributing a hand's turn of what they consume" (1947,p.12). Despite such views, he did not pass totally unnoticed among economists (cf.Daly, 1980), and Hayek (1941-44, 1952) included him in his list of "social energeticists", "neo-Saintsimonians", together with Geddes, Hogben, Neurath and the so-called "technocrats" of the 1920s and 1930s.

As we said before, Soddy did not emphasise, unlike the "technocrats" (Henderson, 1931; Arkwright, 1933) lack of effective demand, but rather the long-term question of whether the increase in productive capacity which the economists attributed to investment was not a mirage: "Technocracy claims that by the use of the inanimate energy of Nature and by means of machines and mass production, man had become independent of his own physical exertions for his maintenance... that poverty and unemployment at one and the same time is now a horrible anachronism, that the average income and expenditure of the whole American nation could easily be multiplied many times with less hours of labour...In this it is similar to the thesis developed in the present book save, possibly, that I was and am more conservative, both with regard to the extent and rapidity with which the average scale of living can be augmented" (1933, preface).

Wealth depended upon physical laws: "Because formerly ownership of the land -which, with the sunshine that falls on it, provides a revenue of wealth- secured, in the form of rent,

a share in the annual harvest without labour or service, upon which a cultured and leisured class could permanently establish itself, the age seems to have conceived the preposterous notion that money, which can buy land, must therefore itself have the same revenue-producing power" (1933, p.106). A favourite comparison of his was between the payment of interest and perpetual motion: "a man with, say, £ 20 000 invested at 5 percent is in perpetual enjoyment without work of an income of £ 1000 a year, and his heirs and successors after him. Consuming wealth everyday of their lives, they always have the same amount as at first. This is not physics and it is not economics. Like all alledged examples of perpetual motion, it is a trick". It was not, in any case, Political Economy applicable to the whole nation ; it was perhaps Individual Economics, or "the Art of acquiring a Livelihood as professed by Tutors and Mentors of Property Owners": "so used are they to living on the interest of the debt that they do not realize sufficiently the absurdity of everyone trying to do so. Whereas when we deal with the Wealth of Nations rather than Individuals -that is, with political economy in any real sense- ... the views of the manual worker...are in strict accord with the facts of life and the physical laws which regulate the production of wealth" (1933, p. 86-87).

Soddy, then, did put forward the alternative (based on a rational critique of theories of economic growth) of either more economic growth (and therefore new sources of energy, a question on which he really was an expert and on which he held strong and varying opinions throughout his life), or the radical questioning of distribution (to which he contributed a critique of the appropriation by capitalists and rentiers of part of production).

The destiny of ideas often depends upon the social position of those who propose them. Soddy was prima facie in a favourable position: a Nobel Prize winner, a professor at Oxford, publishing in English. One reason for the lack of academic response, both from economists and fellow scientists, was perhaps that economics was already strongly professionalized. This would not explain, however, the lack of political impact. The marxists (in all relevant varieties) may have believed too strongly in economic growth (and in the marxist theory of economic growth) to pay any attention. Soddy's "ecologism" in the modern sense was shown for instance in his remarks on agriculture, emphasising that it remained, as regards "the internal energy of life", "the key industry"; that all science could do was of indirect assistance; and that fundamentally it all remained unchanged, "the collection of sunlight by the agency of chlorophyll and its transformation into the chemical energy of foodstuffs, either directly or through the intermediate transforming agency of animals" (1933, p.38). This could have made him attractive to pro-peasant populists, who were, however, by the 1920s and certainly by the 1930s a practically extinct species. The anarchists, in their few remaining strongholds, did not read books, or at least did not read Soddy, and believed fervently in technical progress.

Digging up such precursors of contemporary "ecologism" as Soddy (much quoted by Foley, 1976, from whom we learnt of him), has the virtue not so much of presenting arguments which by now might be familiar as of asking the question: why the silence, then and for so long after? Why the lack of reception in academic circles and why the lack of ideological consumption of such ideas?

VS. HAYEK

LANCELOT HOGBEN AND ECOLOGICS

J. Martinez-Alier

In his articles in Economica (the review of the London School of Economics) of the early 1940s, Hayek wrote that the scientific advance of economics depended on the consistant application of subjectivism, and that neither commodities, nor money nor food should be defined in physical terms but rather in terms of the opinions held by people (1952,p.31). Against whom was he especifically inveighing? One of Hayek's adversaries clearly was Lancelot Hogben (1895-1975), who held a professorship of Biology and Society at the L.S.E. in the 1930s. Certainly biologists would find it perplexing that food should not be defined in physical terms.

Hogben did not believe that the depletion of natural resources posed any threat to economic development, and in this sense one cannot classify him as an "ecologist" in the present sense though he was one of the most coherent ecological critics of economics that there has ever been. In Science for the Citizen (1938,ed.1946,p.621) he had disparaging words for authors who wanted to derive social consequences from the second law of thermodynamics, although he certainly realised that the introduction of coal had produced a profound change in what the biologist would call "the ecological relations of mankind" (op.cit.,p.496). In common with the rest of socialist scientists grouped in the visible college (Werskey, 1978), i.e. Bernal, Needham, Haldane, Hyman Levy, he did not believe only in the progress of scientific knowledge but also in the concomitant progress of technology. He did not doubt the possibility of an "age of plenty", since modern science could find substitutes for all those resources which Nature had located in some areas only (1936, p.40, 66-67). His quarrel with the economists was not on the prospects for economic growth. It was based rather on the view that the economists did not really study the relation between human needs and resources, since they lacked both a theory of needs and scientific-technical knowledge.

He sometimes criticised his fellow scientists when they sang the praises of Soviet industrialisation, which resurrected the discredited ideology of the first industrial capitalism (Werskey, 1978,p.202). Hogben shared William Morris's opinion that capitalism not only led to injustice in the distribution of production and to periodic crises, but also that it produced goods which it was undesirable for people to want. This is a type of language which will make economists prick up their ears, since they believe that nobody but the economic agents themselves should judge what is good and what is bad. We shall come back to this point.

Hogben wrote that Morris had not been hypnotised by the liberal delusion that the things that people have been taught to desire by capitalist propaganda are the things that they need most. In the 1930s there were few people ready to criticise capitalism not for producing less than possible but for producing the wrong things. Neoclassical economics refuses to consider this question. So does the Keynesian tradition, which argues in terms of aggregated effective demand, not considering therefore the origin of the preferences revealed in the market.

Hogben's liking for William Morris matched his doubts about strict "Bernalism", although he shared its technological optimism. Bernalism could be described as the belief that the economic and social structure of the capitalist world prevented people from taking full advantage of the technical progress that

the existing state of science had already made possible. This could be expressed in Marxist terminology: science was a productive force whose application was slowed down by the existing relations of production. It was typical of Bernal to declare prematurely that the problem of production of energy had been solved and to propose a pattern of urbanisation wholly divorced from agriculture (Hall et al., 1935, p.57, 61). Hogben thought that scale was a decisive consideration, overriding the difference between socialism and capitalism (1949,p.14-15). Both a system of transcontinental free enterprise and a system of socialism which planned for a whole continent (like the USSR) should be rejected. Even in the field of scientific "production" Hogben reacted against the new centralism and the power of the great foundations, speaking openly against the transference of political authority to a scientific elite (1949,p.40-41).

Advanced technology did not imply an urbanised society, either capitalist or socialist. There existed the possibility of a decentralised, ruralised economy the basis for which would be provided by hydroelectric energy, biochemistry and genetics. Libarals shared with socialists the Ricardian superstition that economists could pronounce on agricultural yields, with no help from the biochemists (1936,p.43). Contemporary discussion on agriculture follows a different path, as we have seen; the so-called Green Revolution, we have said, was politically not green at all, either in the old pro-populist sense or in the new ecologist sense. Nevertheless, despite Hogben's technological optimism, there are clear differences between his views and "Bernalism" which make him a more relevant author after 1973. The reader can refer to Werskey's excellent book for an account of the Bernalists' grandiose scale of thinking, which was very much the fashion in the 1930s on the Left. There are even

stronger examples, and therefore Hogben's position is all the more remarkable. Thus, the biologist H.J.Muller wrote (1936) that if food scarcity was not solved through synthetic chemistry, it would be solved by genetic engineering, with new types of plants. Some of his other prophecies (in electronic communications and automation, and in space travel) have already come true, but the increase in the productivity of agriculture is, at least up to now, most doubtful: it all depends on how we measure it, and this would depend on how we see the future availability of energy and other scarce resources and on how we value,now, future demands.

Muller (who later won a Nobel Prize for discovering the effects of radiation on genetic mutations) served in the International Brigades in the Spanish War, and was certainly left-wing. At the same time he was a eugenicist, believing in selection not only for intelligence, but also for mutual help traits which he thought were more widespread in the working class, while intelligence was not adequately measured by tests. Such a peculiar constellation of beliefs, not untypical of the 1930s, went together with great hopes based on the piece of knowledge that Soddy had pointed out for the first time: the inconceivably great founts of energy which "lie in the hidden recesses of the atom" (1936,p.76), and which would be available if the atom were "unlocked". The conquest of the forces in the interior of the atom nucleus was one of the most alluring fields of future endeavour; the preoccupation with fossil fuels was misplaced because of the "practically inexhaustible physical sources of power (which) surround us", as yet undeveloped (1936,p.73). Moreover Muller resurrected the old speculations about the recycling of energy that Rankine and Helmholtz had presented (and that Jevons, as we shall see, had mentioned): "Astronomy also hints to us not only that the energy of the worlds may become scattered, as was formerly thought, but that there are places and occasions where it <u>may</u> gather together. If so, the second law of

thermodynamics, with its pessimistic dictum that all energy must finally be dissipated until the universe attains a dead level of stillness, fails to have universal application. And so it may be that we shall yet find that fantasy of physics called "Maxwell demon" which can recollect for us in usable form the dissipated entropy of the cosmos" (1936,p.79).

In contrast, Hogben was a socialist scientist who was keener on "soft" technologies than many other socialist scientists of the 1930s. He was not a eugenicist, either -almost the only one not to be so. Moreoever, he had an interest in the social sciences, mainly in demography, which he introduced into the L.S.E. He called Malthus "the phlogistonist of demography", because his law of population was not based on empirical study. His complaints against the economists were twofold. They proposed a theory of production without even a rudimentary knowledge of science and technology, which made them ridiculous. They talked about a theory of consumption without a study of the origins of human needs, and this made them noxious, because although they were supposed to study human needs, they did not do so, and nor did anyone else. The fact that people have common needs was forgotten because there was a unilateral insistence on their having individual preferences (1936,p.18-19), which broke one of the points of contact between economics and the sciences, since biology could partially (but only partially) explain human needs. Why renounce this possibility of knowledge, hiding needs behind inscrutable individual preferences which would be revealed only in the market?

Economists left aside the reality of biological needs, which (reduced to absolute basics) could be measured by the caloric requirements in nutrition: since a large part of the British

population did not reach the minimum calorie intake established by the British Medical Council (1936,p.71; cf.Webster,1982), it was convenient to hide this reality under an avalanche of Austrian sophistication. Hogben tried to set up a Department of Population and Resources at the L.S.E., arguing that "vital statistics" (a name taken from Petty, his favourite economist) and dietetics were not only medical disciplines but also parts of the science of the wealth of nations.

One cannot speak of the "physiological needs of human nutrition" without going into the history of physiology. The allocation of resources to human nutrition could not be explained in the way that it is (partly) explained now, before the study of the cycles of materials and of the applications of the laws of energetics to the human body. William Petty, the Physiocrats, Adam Smith, Malthus and Ricardo were unable to discuss the energy needs of the human body. Marx, Jevons and Walras, with books published in the 1860s and 1870s, could have included a discussion of calorie intake.

The science of nutrition as it is now provides an explanation for the type and uniformity of the diet of the greater part of mankind. We know why poor Mexicans eat maize and beans and why poor Brazilians eat rice and beans. Whatever their subjective preferences, we can exclude a decision on their part to dedicate their income (or hours of work) to obtaining a diet of meat, fruit and vegetables instead of cereals, pulses and root crops. However, orthodox economic theory would be reluctant to distinguish between physiological needs (expressable in calories, grams of protein) and other types of needs. This distinction certainly smacks of "objectivism".

The science of nutrition does not explain the alimentary prescriptions of Leviticus. Reductionist explanations of the Hindu avoidance of beef or the Moslem tabu on pork, or indeed of Aztec cannibalism are not necessary in order to establish the simple point that food consumption by human beings is partly explained by physiology. The history of the physiology of nutrition does not stand still. Some years ago there was emphasis on lack of protein, though nowadays it is often said that undernourishment and malnutrition go together, in the sense that if there is lack of calories, protein will be used for energy and not for building up tissue. Few scientists have been as aware as Hogben himself of the history of science: he was one of the organisers of the congress in London in 1931, where the Soviet delegation, with Hessen and Bukharin, made such an impression.

Hogben did not think in the least that human needs could be reduced to calories, or, in general, that biology sufficed to explain them. His emphasis on energy accounting was made as a polemical point against the economists, who did not study the availability of resources and were not even aware of John Boyd Orr's research into calorie deficiencies in Britain. Thus, he wrote: "The word "plenty" defined with reference to man's species has therefore a perfectly clear social meaning which remains in spite of the continued existence of Austrian economists. Plenty is the excess of free energy over the collective calorie debt of human effort applied to securing the needs which all human beings share" (1936,p.71; 1939,p.99). This definition was quoted by Hayek (leaving aside the reference to himself), in his articles against "scientism" and "neosaintsimonism" in Economica in the early 1940s and in his book of 1952, allowing him to place Hogben in the list of "social energeticists", would-be dictators (1943,p.40), a doubtful point to make against Hogben whom Werskey calls an "Orwell of the scientific left".

Hogben's definition of plenty is identical to that proposed sixty years earlier, without his knowledge, by Podolinsky and Sacher. He must have been aware of Soddy's writings, and possibly of Patrick Geddes', but he did not quote them. He also came to know Otto Neurath. He clearly belongs to this group of writers. In common with them, he believed that a study of the energy flow in human society would cast doubts on conventional measures of value. In common with them, he did not believe that economics should be reduced to human ecology, i.e. to the study of how the flow of energy and materials is used to satisfy biological needs. What was needed was knowledge of the biological base of human nature and <u>also</u> knowledge of the laws that condition social habits and preferences. The study of human preferences could advance by turning its attention to the materials offered not so much by biology as by social anthropology and history (1939,p.101).

The economists claimed to study the allocation of scarce resources to different human needs, but thermodynamics was not an educational requirement in the social sciences curriculum. How then could they know about "scarcity" of resources? On the other hand, how could needs be analysed if the attempts to educate the human race so that ostentation should no longer be a distinctive trait of the social behaviour of mankind were condemned as an infraction of personal freedom?

Economists such as Hayek and Robbins made economics a deductive science, based on arbitrary hypotheses, something like a game of chess (1936,p.6-7). They did not study the availability of resources. Robbins had declared, with the coy disdain of a débutante, that economics did not study the uses of dung (cf. Ashok Desai, 1978). Nor did they study human needs, refusing to classify them into physiological and ostentatious. Perhaps

other economists, reluctant to descend into such obscurantist libertarian mysticism, would accept this classification of needs, but would point out that ostentation was characteristic of human nature. Here again social history and anthropology could be of more help than biology. Nature did not condemn to failure the "attempts to eradicate this unconscionable nuisance and discord which arise from hypertrophied craving for personal distinction artificially fostered by advertising propaganda and good breeding" (1936,p.75; 1939,p.101).

Hogben, then, was well aware of the fact that economics, based on methodological individualism, does not aim at explaining human preferences and valuations, but rather merely accepts them as revealed in market transactions. He was opposed to this methodology.

Now, if we preserve the definition of economics as the study of the allocation of scarce resources to alternative ends, and if we say that this study cannot be separated from either the study of the history of science and technology or the study of the establishment of socio-historical rules of consumption, we are not proposing anything new. Hogben is only one of a list of authors who argued along these lines. What we have done in this book, however, is to extend the discussion on the methodology of economics to the question of the intergenerational allocation of exhaustible resources.