

Economics:
‘The Dismal Science’
or
‘The Never-ending
Frontier of Knowledge’?

On Technology, Energy, and Economic Welfare



Christian Wolff's works were enormously influential in Scandinavia, and furthered the thought that it was Man's pleasurable duty continuously to create new knowledge.

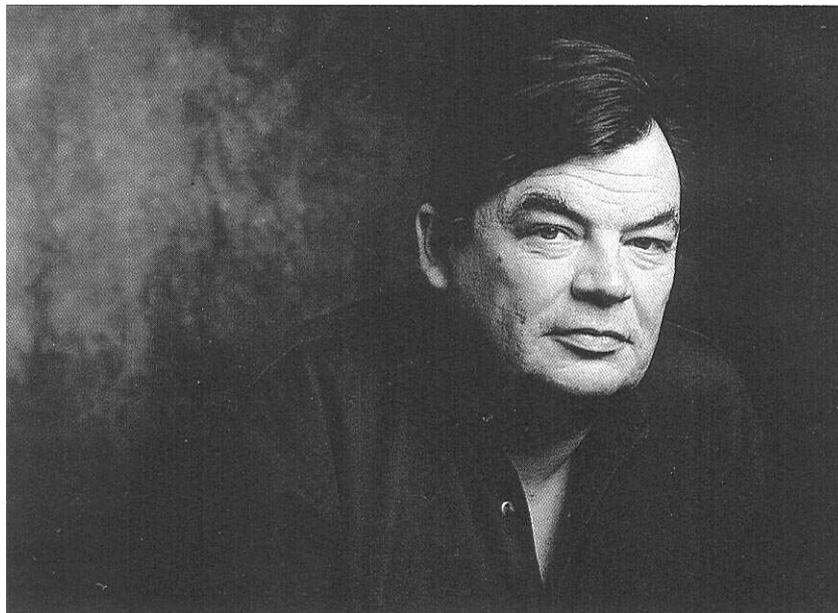
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«The 'Green Movement' has done us all a great favour by pointing to the severity of the problems of environment and sustainability. But, although they are not aware of it, their solutions to these problems are framed in the static and barter-centred theories of Smith, Malthus and Ricardo.»

«All levels of knowledge carry with them their own limits to ecological sustainability. For this reason, the habit of making predictions holding the level of knowledge constant produces curious and overly pessimistic results.»

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In the spring of 1997 another National Long Term Plan will be presented by the Norwegian Government. It has been announced that *the international competitiveness of Norwegian industry* will be a central feature of the next Long Term Plan. In order to establish a theoretical foundation for this work, a commission of experts was created – the ‘Bergo Commission’ (after its Chairman, Vice President Jarle Bergo of Norges Bank) – which presented its findings on July 1st.

By Erik S. Reinert, Head of Research, Norwegian Investor Forum.

The work of this commission is based on today’s standard economic theory – the economics of Adam **Smith** and David **Ricardo**. The theories of Smith and Ricardo were our best allies in the cold war against central planning – but that battle is over and won, and we are now facing other challenges in areas which these authors ignored. We shall argue in this article that today’s mainstream economic theory – because of its basic structure – contains important ‘blind spots’ when it comes to the role of knowledge, technology and energy for the welfare of nations. We further argue that the monopoly of this type of economic theory, based on the ‘dismal science’ of Adam Smith, Thomas **Malthus** and David Ricardo, is a fundamental source of inspiration for the techno- and pessimism which dominates

the *Zeitgeist* of the late 1990’s. The same production functions predicting diminishing returns which gave birth to Malthus’ dismal predictions of disaster, are still at the very core of the tool-box of today’s standard economic theory.

We here suggest an alternative tradition in economic theory which can help us find our place in the knowledge-based society of the future. Where Smith and Ricardo focused on *barter and exchange*, other economists have focused on *knowledge, production and on the harnessing of energy*, and produced theories which in our opinion will better serve us as guides for today’s challenges. In this alternative body of theories, the underlying production function is characterised by the *increasing* returns which is the fundamental property of human knowledge: The more it is used, the more it grows.

‘Adam Smith’s Enemies’.

In most academic disciplines the canonical texts – the ‘true’ texts – are periodically revised. Traditional historiography which centred on ‘the achievements of great men’ has given way to a richer and more varied perspective. Physics has been through several scientific revolutions, and even in literary sciences the authority of the great ‘classics’ has been challenged. Economics, however, is almost totally unaffected by such revisionism, and the fall of the centrally planned economies has even reinforced the canonical sequence: Adam Smith, who was inspired by the French physiocrats, found the promised land and wrote the ‘Bible’ – *The Wealth of Nations* – in 1776, the start of the new era. David Ricardo wrote a more accurate map (1817). Then, in 1890, Alfred **Marshall** started the job of translating the Bible from the clumsy and inaccurate English language into the much

more accurate mathematical language. In the opinion of many economists, the crowning achievement of the profession is **Paul Samuelson's** work on perfecting Ricardo's trade theory in 1949/50. Samuelson proved that if only all nations would open up to free trade, the invisible hand would provide 'factor price equalisation' – all wage earners of the world would become equally rich. This theorem is also the starting point for the Bergo Commission when discussing the effects of internationalisation on the Norwegian economy.

The adherence of virtually the whole profession to the same canonical texts greatly simplifies the debates on economic policy. The picture of who constitutes a hero and who constitutes a villain is shared by everyone. The report of the Bergo Commission is efficiently defended by one of its members (*Dagens Næringsliv*, July 6th) by conjuring up pictures of such heroes and enemies: The heading of the article reads: 'The Enemies of Adam Smith', accompanied by a picture of the cover of a recent edition of *The Wealth of Nations*. A subheading gives the picture of the enemy: 'Mercantilist special treatment of

single industries is not the way to go'. This is effective rhetoric: No economist in his right mind would dream of *criticising* Adam Smith or *defend* the mercantilists.

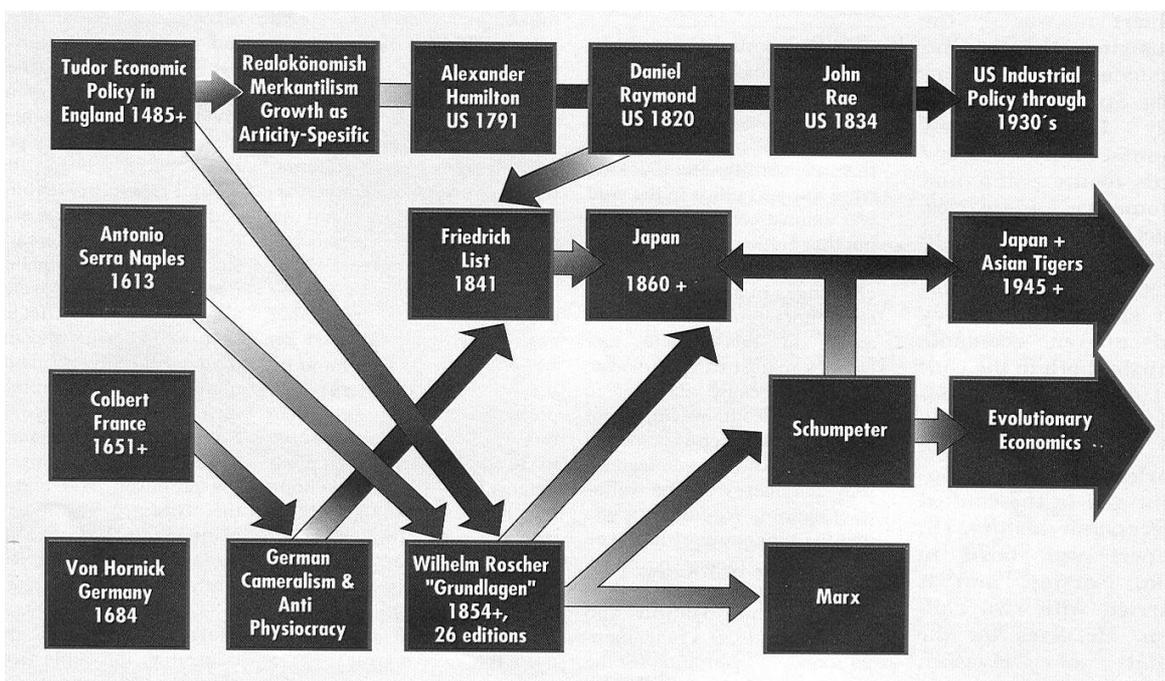
We find ourselves in the world of the novels written for the youngsters of yesteryears – already on the cover it is evident to the reader who is to be the crook and who the hero. In this writer's opinion this state of affairs subsists because economics still suffers from an overdose of 'Cold War Economics' – the ideological battle between two Utopias, the friends and the enemies of the market: The Communist Utopia which promised to pay everyone according to need, and the neo-classical Utopia which promised even more that that: The market would make all wage earners of the world *equally rich* if only barriers to trade were removed – i.e. Samuelson's and the Bergo Commission's factor-price equalization. This result, however, was achieved at the expense of removing from economic theory the very mechanisms which create economic wealth. At a closer look, the mathematical rigor of the analysis proves to be a *rigor mortis* – the fundamental driving forces of society have

been lost.

The Untapped Potentials of Factor-price Equalization?

We are tempted to put some irreverent questions to the honourable commission. If factor-price equalisation will take place in international trade, it is tempting to ask why the Bergo Commission has not used this knowledge to solve other important problems of Norwegian society. A perennial problem is that some economic groups – e.g. farmers and people washing dishes in restaurants – consistently have a much lower income than other groups, e.g. lawyers and stockbrokers. International trade theory makes it clear that these problems of inequitable distribution can be solved elegantly in a relatively simple way. To illustrate the logic of this theory: If we just put the farmers in one separate nation, and the stockbrokers in another nation, and then open up for free international trade between the two nations, *the invisible hand will make farmers and stockbrokers equally rich* – it will produce *factor price equalisation!*

FIGURE 1. GENEALOGY OF THEORIES OF TECHNOLOGY, KNOWLEDGE AND ECONOMICS



International trade theory cannot tell us what the new equilibrium wage, common to farmers and stockbrokers, will be. But, whatever it will be, we will have solved forever the problem of inequalities in national income distribution. Why did we not think of this before: If we just put people of different professions in different countries, they will all be equally rich. After all, Samuelson got a Nobel price in economics for this discovery, and this theory is the very foundation – not only of the Bergo Commission – but of our present world economic order. Although resulting from the commonly accepted assumptions of economic theory, *factor price equalisation* is clearly a case where economic theory consciously walks away from the facts. For this reason some economists take only limited pride in this particular theoretical achievement, and do not push this theory for use in the «real world».

It is therefore all the more remarkable that the Bergo Commission confidently uses *factor price equalisation* and its underlying assumptions as the starting point for their recommendations for Norwegian economic policy: «Assume that all knowledge is commonly known and that everybody has the same productivity» (page 29-30). The problem of the economics profession is that *factor price equalisation* represents the only theory of worldwide income distribution which is available to us – there are no alternatives except in the despised «mercantilist» tradition. In this alternative tradition *relative levels of knowledge and skill*, in a framework of dynamic imperfect competition, determine world income distribution, and – at any point in time – different economic activities present widely different *windows of opportunity* for introducing such skills. For this reason economic growth is *activity specific* – it is available in some economic activities rather than in others. (We intuitively know that the Japanese could not have achieved their welfare by supplying the world with inexpensive shirts, rather than with inexpensive cars

and electronics. This intuitive knowledge cannot, however, be captured in today's economic theory.)

However, we do suspect that the members of the Bergo Commission secretly practice 'mercantilism' in the sphere of their own domestic economy. We find it unlikely that they recommend their children to choose a profession which does not require a degree of formal education. Contrary to their teachings, neo-classical economists do not tell their children that it's just as well to take a job washing dishes in a restaurant, because factor-price equalization is



At the time Adam Smith created his economic theory based on barter, German economists, like Prof. Johann Beckmann of Göttingen, were writing about the importance of technology for national welfare. The first academic chair in economics was established in Germany 100 years earlier than in England, and 19th century US economics was to find its inspiration in Germany rather than in England.

just around the corner anyway. In this way they exhibit 'a mercantilist preference for one economic activity above others' which, according to professor Victor Norman of the Bergo Commission, is a main characteristic of Adam Smith's enemies. Why is it that what is common sense in a family economy automatically becomes despicable mercantilism when brought to the national level? This is because the incomplete notions of production in today's economic theory assume that the same amount of human capital can be profitably added I to a person washing dishes as to a lawyer – that all economic activities are 'alike' in the sense that they present the same windows of opportunity for expanding

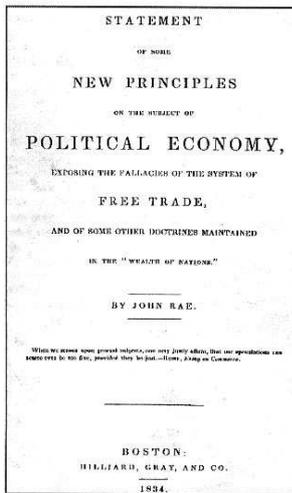
welfare.

'Powerful assumptions produce powerful conclusions' says US economist Robert Solow. In order to achieve factor-price equalization, economic trade theory assumes that all persons on the planet possess exactly the same knowledge and skills, i.e. that we are all clones, and that there are no economies of scale, i.e. no fixed costs. But, if we all know the same and there are no fixed costs, this describes the complete do-it-yourself society. We would all build our own Mercedes in the back yard from iron ore as cheaply as the Stuttgart factory! The curious effect of the assumptions of today's theory of international trade is that it takes away the existence of that most important insight of Adam Smith: The Division of Labour.

This example uncovers one of the important blind spots of neo-classical economic theory: The theory only produces *even* economic growth – it gives no clues whatsoever as to what causes wealth to be unevenly distributed. This makes this theory singularly unsuited as a basis for national economic policies. A common theme of 'Adam Smith's enemies' – listed in the alternative genealogy in Figure 1 – is the relatively simple proposition that income distribution *between* nations is caused by the same factors which cause income distribution *within* nations, i.e. that farmers and stockbrokers will not get the same salary even if they are put in different nations. With today's free trade and full mobility of resources, there is no reason why a theory of international trade should differ from a theory of *national* trade. This point – which I refer to as pre-Ricardian common sense – has, since Adam Smith's Bible, been referred to as 'mercantilism'. The alternative family tree consists of economists who are not opposed to the market – although Marxism after Marx developed into such a position – they just disagree with Adam Smith that there is any automatism either in economic growth as such or in any 'natural' equitable income distribution. The disagreement is founded in different conceptions of what creates economic growth.

Exploring the Causes of Economic Growth and Forever Finding New Ones.

Underlying the disagreement between Adam Smith and the alternative school chartered in Figure 1 are fundamental philosophical reasons as to what causes economic growth and welfare. In other words, what brought mankind – and not the other species – out of the cold and draughty caves into modern society? Adam Smith's theory focuses on the role of *barter*, whereas the alternative tradition focuses on *production*. It is only by focusing on *barter and exchange*, with an insufficient theory of *production*, that Adam Smith's friends today produce the counter-intuitive mathematical 'proof' that farmers and stockbrokers will be equally rich if we just put them in two different nations.



John Rae introduces the role of technology in English-speaking economics. To Rae, both capital accumulation ('savings') and economic progress are fundamentally caused and driven by imperfect competition created by new technologies. The US would therefore stay poor if it kept to its comparative advantage of picking cotton by hand, a process then not yet mechanised.

Should the reader be interested in seeing what 'Adam Smith's enemies' looked like, a good way to start is by looking at the gallery of portraits on US dollar bills. Here is an unusual collection of persons from Franklin through Washington, Hamilton, Jefferson, Jackson and Lincoln who – although acutely aware of the importance of markets and competition – all fundamentally

disagreed with Adam Smith's theories and their policy implications. We therefore let Abraham Lincoln represent 'Adam Smith's enemies' as the contrasting view on what brought mankind out of the caves:

The barter-centred theory of development:

«The division of labour arises from a propensity in human nature to.. truck, barter and exchange one thing for another.. It is common to all men, and to be found in no other race of animals, which seem to know neither this nor any other species of contracts... Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog.»

(Adam Smith, *Wealth of Nations* (1776), Chicago Edition, p. 17.)

The reply from the production-centred theory of development:

«..Beavers build houses; but they build them nowise differently, or better, now than they did five thousand years ago.. Man is not the only animal who labours; but he is the only one who improves his workmanship. These improvements he effects by Discoveries and Inventions....»

(Abraham Lincoln, *Speech of the 1860 Presidential Campaign*.)

The roots of the problems of today's mainstream economics can be traced back to these conflicting views on Man. Neo-classical economics fundamentally lacks a theory of economic development beyond seeing it as a process of adding capital to labour. In 1956 Stanford economist Moses Abramowitz showed that capital accumulation only accounted for 10–20 per cent of US economic growth – which he then referred to as 'a measure of our ignorance about the causes of economic growth'. Adam Smith's 19th Century enemies in the United States would ask how Adam Smith's theory explains economic growth. How, would his 'enemies' ask, do you get more bones into the economy by teaching dogs to barter and to make contracts? And, how do you explain with Adam Smith's theory why dogs today eat canned dog food and not bones? Although Adam Smith sees a

'general tendency of things to improve' in the background, these improvements descend on mankind as 'manna from heaven' – not as a result of organised conscious effort – and hit everybody at the same time.

What are the forces creating welfare? It seems that search process for the approximate causes of growth follows the path of Ibsen's Peer Gynt, to whom the onion – and his inner self – only revealed layer after layer, but no core. Modern economics has been uncovering layers

1. **Markets**
2. **Capital**
3. **Technology (the *techno* part: new hardware/tools)**
4. **Technology (the *-logy* part: new human skills and new knowledge)**
5. **The attitude to new knowledge (persons' and nations').**
6. **Man's rational will ('wit and will')**

this way:

The causes of increased economic welfare:

The problem with today's mainstream economic theory – and the Bergo Commission – is that they limit themselves to *the first two factors only*. Mankind did not get out of their caves only by starting to barter and by 'getting the prices right'. These are clearly necessary, but far from sufficient, building blocks for a theory of economic growth. New research, sponsored by the OECD under the title TEP – Technology and Economy Programme – also includes factor 3, and increasingly factor 4. Through the TEP programme the Schumpeterian message is slowly sinking in: The driving forces of the economic system are innovations created by new knowledge. Nations who stop innovating do not keep their standard of living, they lose their standard of living even though they keep the same efficiency. This research – most relevant for economic policy – is seemingly completely unknown to the Bergo Commission.

What Brought Mankind Out of the Caves?

Modern society starts with the Renaissance, when neo-Platonist ideas from the Byzantine Empire reached the Academy of Florence in the early 15th Century. Before this time, Man saw himself as the caretaker of God's creation – a creation which was finished by the Lord on the 6th day. To Mediaeval Man all knowledge worth knowing – and all knowledge allowed for him to seek – was contained in the Holy Scriptures and in the writings of **Aristotle**. During the Renaissance, Man came to see himself in a different light. In the Mediaeval world view, new thinking and 'innovations' were considered heresies. In fact, Roger **Bacon** was jailed in Oxford in 1271 for 'suspicious innovations'. The basis for our modern society lies in a new interpretation of the Holy Scriptures. The new argument went like this: Man was created in the image of God. But, what characterises God above anything else? It has to be his enormous creativity. Then – if Man was created in the image of God – then Man should also be creative.

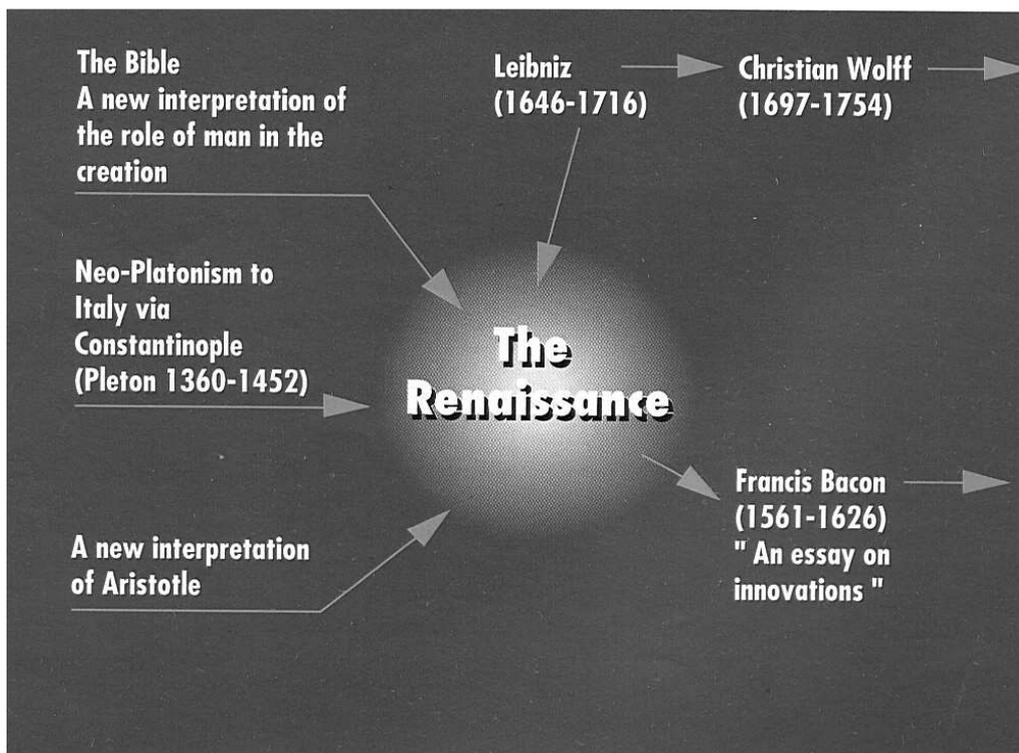
In the time following the Renaissance 'explosion', bartering raw ma-

terials increasingly gave way to the production of manufactured goods. In the process, the value added to the raw materials of nature was seen as imputable to human knowledge – to 'the Soul of Man' – which distinguished him from beasts. Importantly – to the observers of the day – *these new and knowledge-based economic activities were seen as bringing more wealth, as being more profitable, than the old resource-based activities*. Therefore Renaissance economic policy supported the manufacturing industries at the expense of resource-based industries – *encouraging and protecting new knowledge, e.g. through the establishment of a patent system*. A list of economic policies of the Renaissance is found on the next page.

Out of this line of reasoning *Man's duty to invent* and to *create new knowledge* are born. But, this duty was a pleasurable one. The argument seems to have gone like this: It is Man's duty to people the Earth, therefore God made the duty of procreating a joyous one. Similarly, because it was Man's duty to create, to invent and to discover was also a joyous duty. In England Francis **Bacon** – statesman under Elizabeth I –

was the carrier of these ideas, and wrote *An Essay on Innovations* around 1605. In Germany the philosophers **Leibniz** and **Wolff** later represented the same philosophical tradition. 'Some people collect knowledge like other people collect money', says Christian Wolff. Economic growth is achieved by putting the two types together.

In Adam Smith's work there is an automatic 'general tendency for things to improve', but in a sense his causal arrows are reversed. The economists focusing on invention would see the division of labour as a result of new inventions; Adam Smith took the view that *trade alone* would have this effect. That this is more than a chicken-and-egg problem is evident when the policy recommendations are studied. In the alternative tradition, exemplified by **Lincoln**, the fundamental cause of economic growth is 'Man's Rational Will' – his ability to make hypothesis and to generate new knowledge. With this knowledge Man develops a never ending chain of new knowledge, which manifests itself in new processes, products and tools.



Economics and Sustainability: 'The Dismal Science' vs. 'The Never-Ending Frontier of Knowl- edge'.

The focus of neo-classical theory on the barter aspects of economic life, rather than on production, is the single most important underlying factor of the technology-pessimism which is an important feature of the *Zeitgeist* towards the end of the Century. The mood of the day is a curious mixture of two sets of credos which at first sight seem to be extremely contradictory: Economic theory predicts that if we just keep our hands off, things will go fine and we will all be equally rich. On the other hand, since we see that this is not happening, then this must be due to 'faith' and 'destiny'. The recommended economic strategy in both cases is 'passivity' – just 'get the prices right', do nothing and leave things to the invisible hand/destiny. However, the apparently contradictory beliefs originate from the same philosophy, shared with neo-classical economic theory: Man's creative powers are assumed away, in a static model of a world of barter, not production.

In contrast, the message of the Renaissance philosophers and economists was an extremely optimistic one. But the men of the Renaissance were acutely aware that their optimistic visions could only be carried out by wise and active economic policies and through the conscious will of man. Francis Bacon – the statesman under Elizabeth I – foresaw a never ending frontier of knowledge in Man's future. As Leonardo da Vinci described aeroplanes and helicopters, Bacon describes and initiates inventions and reforms of society leading to economic welfare.

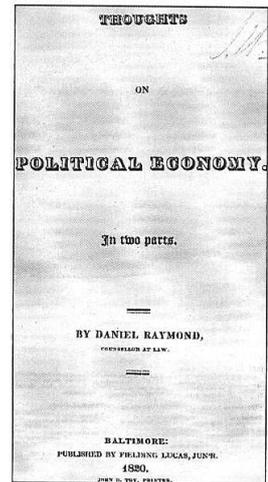
His inventions include the telescope, microphone, explosive material, flying machines, engines with air and water power, chemical discoveries, better culture of plants and animals, telephones and cars. But, whereas Leonardo and the other artists of the Renaissance are considered heroes today, Bacon and other economist-statesmen of his time –

due to the influence of Adam Smith – today fall into the despicable category of 'mercantilists'.

The Renaissance pulled Mankind out of a miserable life tilled with ignorance and superstition. This was not a product of Adam Smith's invisible hand of natural harmony, but because of Man's rational will and strong economic policies. As 17th Century Italian philosopher Giambattista Vico put it, 'Human history differs from natural history in this, that we have made the former, but not the latter.' History is produced by Man's 'wit and will'.

Today's production functions in economic theory are still those produced by David Ricardo for his 'com economy' – reflecting the diminishing returns which will occur with static knowledge in agriculture, rather than the increasing returns found in industry. Over time, with new knowledge, also farming is subject to increasing returns. After David Ricardo, economics rightly came to be called 'the dismal science'. The 'Green Movement' has done us all a great favour by pointing to the severity of the problems of environment and sustainability. But, although they are not aware of it, their *solutions* to these problems are framed in the static and barter-centred theories of Smith, Malthus and Ricardo. In our opinion, this heritage is the reason why environmentalism is so often synonymous with techno-pessimism. There is no invisible hand which will get us out of these problems. Technological development is shaped by society – by Man's knowledge and attitudes – not by the invisible hand of 'Destiny'.

One important inheritance from Adam Smith and neo-classical economics is the tradition of evaluating problems of population independent of the level of knowledge. For the same reason, the standard reply to problems of ecology and technology is 'freeze society as it is' – or even 'reverse it' – rather than 'apply more knowledge to solve our present problems'. The lack of dynamics in economic theory seems to carry over



Daniel Raymond, a lawyer and economist from Baltimore, provided perhaps the most important basis for economic policy in 19th century US – the 'American System of Manufactures' and 'the High Wage Strategy', His is the simple and intuitive notion that the standard of living of a nation – just like the standard of living of a person – will above all be determined by its choice of profession and the skill level required by this profession. Therefore there is no tendency towards equalisation of wages between nations engaged in professions requiring very different skill levels.

to the *zeitgeist*. Optimisation in neo-classical theory is a static concept. Optimisation in the alternative tradition includes cumulative increases in the stock of knowledge, and is therefore only an ever-moving target on the horizon.

All levels of knowledge carry with them their own limits to ecological sustainability. For this reason, predictions holding the level of knowledge constant produces curious results. The sustainability of stone age society was limited by the supply of flintstone. Extrapolating the population assuming static stock of knowledge was a sure prediction of disaster. Extrapolating the traffic increase in the cities of the late 19th Century, one could predict the year when the city would drown in horse manure. This dire prediction, we have to add, was made by Stanley Jevons, one of the founding fathers of today's neo-classical economic

theory. The same economist, true to his Physiocratic legacy, attributed the fluctuation in human economic activities – the business cycles – to fluctuations in sun-spot activities.

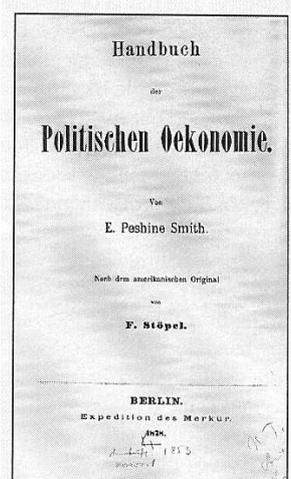
However, the most serious results of today's barter-based economic theory appear in our relationship to the Third World, as was evident in the conclusion of last year's population conference in Cairo: A virtually unanimous industrialised world agreed that the main development problem is the population explosion. No one asks the question why we are convinced that the poverty problem of Bolivia – with 5 persons per square km – or Peru – with 15 persons per square km – has its roots in overpopulation. Why are their levels of population not 'sustainable', whereas a population density of 350 persons per square km in Holland is 'sustainable'? In effect many poor nations today are underpopulated, like Norway after the black death. In effect, the 19th Century US economists, here exemplified by Henry Carey (1851), firmly rejected this sort of economic theory: 'Overpopulation is the ready excuse for all the evils of a vicious system, and so it will continue to be until that system shall see its end.'

E. Peshine Smith – Energy as the Fundamental Driving Force of Economics.

As already mentioned, 19th Century German and American economists claimed that the fallacies of the English classical economics were rooted in the fact that English theory formed their theories 'upon the supposition that men are merely vendors and purchasers, and not producers'. This criticism could be voiced equally well against today's neo-classical theory, whose 'production functions' – where technological change appears like 'manna from heaven' – utterly fail to grasp the realities behind technological change.

Consequently these alternative economists developed theories of 'productive powers'. Whereas Eng-

lish classical economics, after Ricardo, deservedly earned its name 'the dismal science', American economics, in particular, developed into a very optimistic science. American economics was to be a science based on facts, not on assumptions. As in the German philosophical tradition of **Leibniz and Wolff**, the driving force of the economy was seen as the domination of Man's mind over physical matter. The two fundamental driving forces of history were Man's 'wit and will' – the *wit* to extend the frontiers of technological ability, and the *will* of society to provide adequate inducements anti incentives to invest in this technological potential. This 'American System' of political economy can be traced back to the thoughts of Benjamin **Franklin**, it dominated US economics well into this Century – being the doctrine of the North against the English doctrines of the South during the Civil War. This tra-

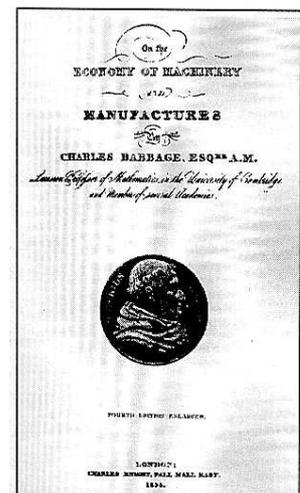


E. Pershine Smith is unique in the history of economic thought in having produced a theory of economic growth entirely on energy - on Man's ability to harness the forces of nature. Just like Raymond and Rae, Peshine Smith was of the opinion that the United States, until it had reached the level of knowledge of England, should protect the activities which used new knowledge and machinery.

dition completely died out after World War II – under the crossfire of mathematisation and the cold war demand for 'perfect markets'.

American economists who deserve to be resurrected due to their

relevance for economic policy include Daniel **Raymond**, whose reply to English trade theory (1820) was the proposition that the forces which determined the income distribution *between* nations are caused by the same factors which cause income distribution *within* nations, i.e. that farmers and stockbrokers will *not* get the same salary even if they are put in different nations. To Raymond, skills and knowledge were the most important factors determining the wealth of a nation. These factors were excluded by Adam Smith in his trade theory – in fact Adam Smith goes out of his way to prove that education is of no value to the individual or to society, because the



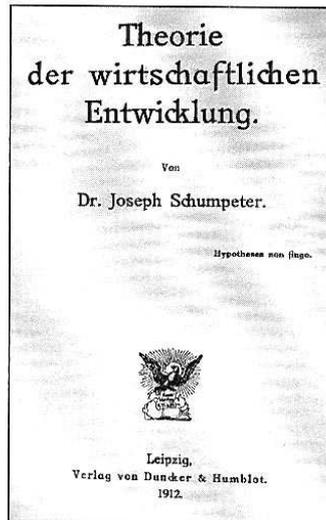
Whereas the English exported the theories of Adam Smith and David Ricardo, their own industrial policy was led by the theories of Charles Babbage, the inventor of the theory of the computer. Babbage emphasised the role of knowledge embedded both in machinery and in new scientific discoveries.

higher gains from more knowledgeable persons are 'no greater than what is sufficient to compensate the superior expense of their education,' Another American, John Rae introduced the role of technology into English-speaking economic theory (1834). Friedrich **List** – a German political refugee in the United States – carried these ideas to the European Continent, where they merged into the German historical tradition in economics.

Erasmus Peshine **Smith** (1814-82) was the economist who above anyone else placed *Man's harnessing of Nature's energy* as the main moving force of the economy. To Peshine Smith, Nature's resources, especially her energy resources, have an infinite potential, in sharp contrast to the pessimistic 'scarcity' economics of British Ricardian orthodoxy. Whereas the theories of Adam Smith developed into pessimistic Malthusianism, Peshine Smith's theories kept alive the spirit of the Renaissance and of Man's undeveloped potentials.

Peshine Smith sought to develop economics into a quantitative engineering science: 'to construct a skeleton of political economy upon the basis of purely physical laws'. He believed all economic laws to have their counterparts in those of the natural sciences, and proceeded to characterise the reproduction of wealth as a vast energy-transfer system within Nature's overall equilibrium, the basic question being the extent to which Man would proceed to exploit Nature's latent wealth. He wrote to Henry **Carey**, a fellow economist: 'The entire universe then is motion, and the only point is how much of the universal and ceaseless motion we shall utilise, and how much we shall permit to be working against us'. His holistic view of the planet as described in the 'Law of Endless Circulation in Matter and Forces' is decidedly both 'modern' and 'ecological.'

The increased wealth produced by increased productivity was to Peshine Smith a product of the forces of nature – harnessed by Man – substituting for manual labour. 'Twenty years ago', says Smith, 'a paper box of matches sold for a shilling. Now as many matches, of superior quality, are sold for a half-penny' – i.e. the price had been reduced to 1/24. '...in the meantime, by improved chemical and mechanical combinations, twenty-five boxes had come to be made by the same expenditure of human labour as one match required in its day.' In a box with twenty-five matches, says Peshine Smith. *twenty-four* may be regarded as the contribution from



Austrian-born Harvard economist Joseph Alois Schumpeter shared Marx' view that inventions and innovations were the main forces 'propelling the capitalist engine.' He spent his life trying to integrate this vision into the body of neo-classical economics – and failed. Schumpeter is the starting point for today's 'evolutionary economics' which is very influential in the OECD, but is not considered at all by the Bergo Commission on Norwegian industrial policy.

Man's harnessing of Nature – a Nature who gives her aid, and asks no recompense – and *one*, as the result of muscular action.

The policy implications of the 19th Century US economists differed from that of Adam Smith. Because they saw knowledge in harnessing nature and technology as the main moving force of welfare, it was crucial to Peshine Smith and his colleagues to move the US economy into the limited number of economic activities where mechanisation took place at the time. For 300 years English commercial policy had favoured manufacturing exports – goods made with new technology and new knowledge. Now English economists recommended the United States to stick to its comparative advantage in picking cotton, an activity where no technical change took place. 'The English have found national wealth'. US economists said, and they are now 'trying to pull up the ladder' –

using the theories of Smith and Ricardo in order to convince the rest of the world to stick to our comparative advantage of being poor and ignorant. To 19th Century US economists, every nation tended to keep its productivity advances in the form of higher wages. Knowledge – assumed away in English theory – was the most important factor of production. Therefore, for a period, until they had reached the level of technical knowledge of the English, the US had to protect their knowledge and industries from the more advanced English industries. This conclusion was evident from theory based on production, but not from a theory based only on barter.

Early in his career as a lawyer, Peshine Smith joined the law firm of William Henry **Seward** in Rochester, N.Y. Seward later became Governor of the State of New York, a US Senator, the leader of the Republican Party in its early years, and Lincoln's Secretary of State, Peshine Smith's *Manual* appeared in 1853, one year before the Republican Party was founded, and came to provide the ideological basis for that party and for the Civil War reconstruction effort. The US economists of the period, who saw knowledge as the moving factor of welfare, observed with horror the fact that the slave-owners took great care in preventing their slaves from learning how to read and write – 'knowledge unfits a person to be a slave'. They found a parallel to this way of thinking in the suffering of the United States 'from the policy of Great Britain in checking our industrial and mechanical aspirations, and keeping us a buying instead of a making people.'

In 1871 – four years after the Meiji Restoration – the Japanese government requested from the government of the United States an advisor in international law. The Secretary of State recommended Peshine Smith, who was to spend eight years in Japan as the first US citizen to serve the Japanese government in an official capacity. When he left, he proudly commented that the 'American System' of economic theory – as opposed to English theory – had become 'common thinking among

Japanese statesmen, government officials and philosophers.’

Nine editions of Peshine Smith’s *Manual of Political Economy* appearing in the United States between 1853 and 1897 testify to his influence, and his book was translated into both French, German and Italian. In spite of this, and in spite of his strong influence on American

economic policy, Erasmus Peshine Smith remains virtually unrecognised in the history of economic thought, not being mentioned in any of the standard histories of the subject. The 19th Century evolutionary and history-based branches of economics died out with the formalisation of classical economics into neo-classical economics. The history of

economic thought has, since then, been monopolised into a history of the predecessors of neo-classical theory. The alternative production-based theories and the theories which were important for economic policy, all have virtually disappeared.

The Historical Techno-Economic Paradigms.

PERIOD FROM-TO	NAME OF PERIOD	IMPORTANT INDUSTRIES	INEXPENSIVE RESOURCE	INFRA-STRUCTURE
1. 1770–1840	<i>Early mechanisation</i>	<i>Textiles Wool</i>	<i>Water power Cotton</i>	<i>Canals Roads</i>
2. 1830–1890	<i>Steam and railway</i>	<i>Iron Transportation</i>	<i>Steam Coal</i>	<i>Railroad Steam ships</i>
3. 1880–1940	<i>Electricity and heavy industry</i>	<i>Electr. machinery Chemical ind.</i>	<i>Electricity Steel</i>	<i>Ships Roads</i>
4. 1930–1990	<i>Mass production (Fordism)</i>	<i>Cars Synthetic water.</i>	<i>Oil</i>	<i>Roads, Planes Cables</i>
5. 1990–?	<i>Information and communication</i>	<i>Data/Software Bio-technology</i>	<i>Micro-electronics</i>	<i>Digital telecom Satellites</i>

Energy and the Techno-Economic Paradigms.

Erasmus Peshine Smith clearly shows how the different sources of energy carry the various industrial periods. These are the periods which we today call *techno-economic paradigms*.

Traditionally we divide the history of Mankind into historical periods named after the technologies which dominated the period: e.g. stone cutting technology in the stone age and iron technology in the iron age. The gradual shift from one period to the next radically changes Man’s way of life. These historical periods may be looked upon as different modes – different methods – of increasing Man’s material standard of living. Towards the end of each period it becomes increasingly clear that the previous technology is ‘used up’, its potentials are exhausted. There is no more room for improvements along the previous technological path – the world does not change anymore without fundamental changes to the technological base. Such periods are closely re-

lated to the long waves in economic history.

In modern history, we distinguish between five such different ways of increasing the standard of living, all of which dominated a long historical period. Above we show, after Carlota **Perez** and Christopher **Freeman**, an overview of these periods, and the various sources of energy which fed each technological development: Perez and Freeman have shown that techno-economic paradigm shifts not only lie in a cluster of new and radical innovations, but also in the universal and low cost availability, in large quantities, of a key factor or a combination of factors. The source of energy is here such a key factor distinguishing each techno-economic paradigm. We are now moving into a paradigm which solves some of our past problems, but which, no doubt, also produces new and different challenges.

The fundamental driving force behind the world economy is the changing level of Man’s knowledge. Only by assuming away this factor, neo-classical economics produces

factor price equalisation. Part of an alternative theory based on this vision is also the fact that nations exporting products based on old and commonplace knowledge will have a lower standard of living than nations exporting products containing advanced, new and scarce knowledge – regardless of their relative efficiency. The world’s most efficient producers of baseballs for the American sport, who are in Haiti, make 30 US cent per hour. They are the world’s most efficient producers in an industry which all the capital of the United States has not managed to mechanise. Baseballs are sown by hand everywhere. The world’s most efficient producers of golf balls – made by machines – have a nominal wage which is about 30 times higher. The uneven advances of mechanisation produce huge inequities in world income, and lock many poor nations into a comparative advantage of being poor and ignorant. This fact was not lost on US economists and politicians of the 19th Century, but today its absence forms the most important blind spot on the cornea of mainstream economic theory. Until

we include knowledge – Man’s ‘wit and will’ – as a factor into economic theory, we shall continue, in vain, to throw money at the *symptoms* of poverty, rather than address its *causes*.

Today mainstream economic theory continues to play Hamlet without the Prince – theorising about economic welfare without considering the huge, but uneven, advances of human knowledge which – through

innovations, new technologies and new products – provide the real engine fuelling human welfare. Today’s limited understanding of how the market system creates and so unevenly distributes the fruits of these processes, would be enormously helped by researching the insights of 19th Century production-based economics. These theories, or their modern versions sponsored by the OECD, are not taught anywhere in

the Norwegian university system. We are, in terms of economic theory, stuck in the paradigm of ‘Cold War Economies’. A better understanding of the mechanisms at work would not only improve the debate on Norwegian economic policy – it would above all benefit the Third World which is trapped in its Ricardian comparative advantage of being poor and ignorant.

