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COMMENTARIES ON PAPERS PRESENTED IN COMMITTEE V, SESSION II*

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The papers by Professor Ervin Laszlo and Dr Daniel Spreng are very different. Together they cover the wide stretch of the contemporary natural philosophy of time; from the engineer's and economist's concept of measured clock-time to the cosmologist's and modern Western mystic's vision of finite, peridically recurrent, unindirectional time.

Beginning with Dr Spreng's paper, which touches on many facets of the elusive concept I must, in this by necessity brief commentary, focus on what I take to be the central points raised by the authors. These are neatly summarized at the very end of the paper. I consider all four points relevant and basically correct. The suggestion that time, energy and information can be considered as production factors is an intriguing idea, that deserves further consideration.

One way the persue this hyperthesis is perhaps to make a direct comparison with the production factors used in conventional economics, namely

capital
labor
raw materials and
technology

Productivity may be defined as the economic impact of an incremental increase in either of these production factors: capital productivity is the increased value of production caused by added capital, labor productivity the corresponding result due to more intensive use of labor and so on.

It is also well known that these production factors to some extent can substitute for one another: capital can often substitute for labor, technology for raw materials etc. In econometries the ability to substitute is expressed by cross-elasticities. These, however, may not necessarily be negative. Increased use of capital (machinery) may lead to increased use of energy (fuel) an increased use of technology may increase rather than reduce employment.

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* At the time of this writing (July 10 1991) I have only received two of the three papers to be presented in this session. I will supplement these commentaries when I get the remaining contribution.

At first the conventional production factors listed above appear to be very different from those proposed by Dr Spreng. However there are close similarities. Labor, for instance, is measured in the amount of working hours per unit of production. Increased labor productivity may be understood as more labor per unit time or, as Dr Spreng suggests, as less time per unit of labor. The latter alternative is probably more akin to the mind of industrialized man. As such it contributes to further the common understanding of the operators of the economy.

The suggestion that information should be considered a production factor was a similar virtue. The technology factor of conventional economics is of course closely related to information, but the two concepts are not quite the same. In conventional economics the hardware of NIT (new information technology) is generally included in capital and the software development in labor. The technology factor is primarily used for innovations leading to new products and production methods.

In view of the ever increasing importance of software development and the often drastic improvement obtained in productivity it seems appropriate to single out this ithem and put it under a separate heading - information - which also naturally incorporates the results of general R D now considered as "technology".

However, it seems as the concept of energy is too narrow to qualify as the sole remaining production factor. Raw materials - including energy raw materials (fuel, uranium) - is a much broader term which probably cannot be disposed of. In many industrial activities the raw material base is of decisive importance for the economy. Exploration, production, refining storage, transportation and marketing of metals and industrial minerals and of agricultural products is an essential part of the industrial economy.

More important, however, is the fact that capital is not included among Dr Spreng's production factors. This appears to me as a major limitation. Shortage of capital is generally the major limitation in economic development. Incentives to saving and to capital formation is probably an indispensible part of any successful development strategy.

As an aside I would like to challenge the commonly held notion, alluded to in the introduction to Dr Spreng's paper, that more efficient use of energy reduces energy demand.

It seems selfevident that this must be the case. But upon further reflection it appears that this is not necessarily true.

Energy is but one of several production factors. To a certain extent energy can be used to replace the other. If it can be used more efficiently it becomes more competitive. Hence energy will substitute for other relatively more expensive production factors. As a consequence energy demand will increase when it becomes more effectively used.

This counterintuitive point was made over 100 years ago by the British economist Stanley Jevons in his book **The Coal Question** (1865). Jevons said: " it is wholly a confusion of ideas to suppose that the economical use of fuel is equivalent to diminished consumption. The

very contrary is the truth.... It is the very economy of its use, which leads to its extensive consumption. It has been so in the past and it will be so in the future."

Jevons pointed out that in the first steam engines the fuel was so inefficiently utilized that the machines could not compete with animal power. But thanks to innovators such as James Watt the competiveness of the steam engines was much improved and as a consequence they replaced animal power in particular in the mining industry. This in turn led not only to increased demand for coal but also to increased coal production and to a lowering of the price for coal. Soon coal was used for domestic heating and found new markets in the railroads as well as in due time in the thermoelectric power plants.

In 1824 a given amount of mechanical work required 1200 kg of coal to perform. Hundred years later it took only 800 kg to do the same job, thanks to efficiency improvements. In 1925 the required amount was only 300 kg and now the efficiency is so high that the work can be done with hardly more than 1/10 of what it took in 1824. Yet, in spite of these spectacular efficiency improvements, or rather because of them, the demand for coal has continued to increase during the last 150 years.

Dr Spreng's point that the time saved (by increased productivity) can be used to produce and consume more or set aside for recreation and cultural activities is well taken. There are reasons to believe that economic development naturally leads to the second alternative. As a consequence energy demand tends to saturate in the most advanced industrialized nations.

Professor Ervin Laszlo's paper deals with a very different concept of time: cosmological time. In an elegant presentation Professor Laszlo takes us from the dawn of Western philosophy to the most burning issues in modern cosmology.

At the very end of this paper he arrives at what I consider the most interesting and thought provoking part of this presentation. He calls our attention to the observed fine-tuning of the universal constants providing a "noted fitness of the physical universe to life" and continues to hit the most important of these puzzling facts. All in all these coincidences end up to an incredibly unlikely combination of critical conditions required for emergence of life and the evolution of man. "The very special systems and structures we observe amount to a miracle" as Paul Davies puts it.

Unwilling to accept as scientific the grand design of a devine creation physicists have speculated about a large number of universies co-exciting with ours in space-time. Of these our own just happens to be conducive to the emergence of life. The other universes are, in the words of Professor Laszlo, "stillborn".

However, the author offers an alternative explanation: "it appears more logical to conceive of a universe undergoing succesive cycles and perfecting the tuning of the constants across the cycles. A learning curve across multiple cycles could explain the fine-tuning of the constants in our particular universe (more exactly, in our particular cycle of a pulsating universe) provided only that some "memory" of the proceeding cycles is conserved in the succeeding ones. In that case the observed fitness of the physical universe to the higher reaches of evolution would not be the result of a happy accident setting the constants in

favor of life at the instant of a single Big Bang 20 billion years ago, but would have evolved gradually over succesive cycles.

Professor Laszlo proceeds speculating about future progressively finer turning of the physical constants "more and more favorable to life" leading the evolutionary process towards ever increasing complexity and higher and higher levels of fulfilment and concludes with a grandiose vision of a finite omega cycle where time comes to a stop: "a Nirvanic State of ultimate timelessness."

The tast of providing in credible physical terms, a memory mechanism and a learning curve that will survive during the succesive periods of universal implosion appears formidable. But since the technical details will be given in a forthcomming publication of Professor Laszlo they will not be dealt with here.

My difficulty with this cosmology is more of conceptional nature. If time, as is suggested, eventually comes to an end it must by logical necessity also have a beginning. But then we are faced with the task of accounting for the very first primordial cycle of the universe with its memory mechanism, learning curve and with a purpose guiding the cosmic development the "Nirvanic State" of perfect fine-turning and timelessness. Are we then not faced with more problems rather than less?

Moreover, since all finite unidirectional time cosmologies $t=0$ represents a singular point scientific cosmology ultimately transcends into a cosmogony of meta-scientific nature. To me it seems just as legitimate to accept the derive wonders of universal fine-turning as it presents it self to us here and now, as it is to place the miracles of creation before the beginning of time.

But do we really have to evoce a devine creator to counter the difficulties modern cosmology is up against? Does it not seem more reasonable and accordance with established modes of scientific thinking to assume that these incrediable coincidences will find their natural explanations within the framework of a future more comprehensive cosmology? Or will have to unless we must confine ourselves to facts for which we have not yet and perhaps never will find, proper scientific explanations.

My final remark concerns Professor Laszlo's ontology i.e. his realistic conception of time. Time, whether finite or infinite, unidirectional or recurrent is taken to exist by itself and by its own nature regardless of whether we observers have knowledge of it or not. Time is considered autonomous.

This notion of time (in physics) is challenged by Dr Spreng who says in his paper (and I agree with him) that "time exists only in as far as it can be measured." To speculate about time beyond observation is to speculate about nothing.

If time is conceived of in a newtonian sense as something void of all physical properties it has no place in (modern) physics, Einsteinian spacetime, however, is obviously a part of physics (since it is observable). But since the physical existence of a time-like component presupposes an observer the phenomenological objection to absolute time carries over to all comceptions of absolute space-time.

The same, by the way, applies to the direction of time which contrary to common belief cannot be determined by the second law of thermodynamics in the way Boltzmann proposed. However, with Claude Shannon's reinterpretation of entropy in terms of information it finally seems possible - and indeed necessary - to put an arrow on time. But only if there is a subject - an observer - that receives information. In other words: the direction of time has not, and cannot have, an absolute meaning, at least not in physics.