With the appropriations process completed, the Energy Department had no choice but to begin the process of determining what programs to terminate or reduce and to begin notifying the unfortunates of their prospective fates. It is worth noting that, although the discussions in committee markup sessions specified in detail what Congress regarded as approved and disapproved programs, the bill itself gives no such guidance, only an overall spending limit. It is fair to say that the choices made by the Energy Department therefore reflect some combination of the priorities of the two organizations. Moreover, as James Decker, Director of the Applied Plasma Physics division emphasizes, only $2.2 million of the total reduction was suffered by the university groups, whereas the remainder was felt by Energy Department laboratories, other federal laboratories and industry. The $2.2 million represents, says Decker, a 14 percent decrease in funding for universities as compared to the previous year.

At this point, a frantic round of letter writing, personal visits, and telephone calls to the Energy Department, to Congress, to influential colleagues, and even to the National Academy of Sciences began. The campaign has been so effective that it now seems that no one any longer believes the university fusion programs should be cut. As it was, about ten would have been terminated.

What seems to have happened, all agree, is that Applied Plasma Physics has certain large blocks of funding, such as that for a nationwide fusion computer network, that are fixed or otherwise protected. As a result, the reductions that amounted to only a small proportion of the overall division budget fell disproportionately heavily on small programs in the universities. The Energy Department laboratories that also lost some support were much better able to absorb them. Such an outcome presumably should have been foreseeable, but the energy subcommittee staff had no fusion experts at the time, and also, as some observers have commented, "did not do their homework." Since then, McCormack has added Allan Mense, a former Oak Ridge National Laboratory fusion researcher, to his staff.

From the university researchers' viewpoint, the episode seems as if it will end on a happy note, says a staffer, since both the Energy Department and Congress are in agreement that the universities' loss of support was a mistake. The solution to rectifying the error identified by the Energy Department involves shifting $2.6 million of the money specified in the appropriations bill for construction of the next Elmo Bumpy Torus to Applied Plasma Physics for research. However, the details of the plan will not be made public until congressional approval is granted.

In the meantime, wary academic fusion scientists have formed an association to look after their interests in Washington. Although a long-discussed move, according to George Vlases of the University of Washington, this summer's brouhaha did much to accelerate its implementation. Last month at a meeting of the Plasma Physics division of the American Physical Society in Boston, the association began activities in earnest. A group of five physicists, headed by R. N. Sudan of Cornell University, was chosen to formulate a constitution for the group.—ARTHUR L. ROBINSON

The 1979 Nobel Prize in Economics

The Nobel Prize in Economics for 1979 was shared by Professor W. Arthur Lewis of Princeton University and Professor Emeritus Theodore W. Schultz of the University of Chicago for their work on problems of development in the Third World. In a field that is not very well defined these two men have focused on the same two dimensions of a complicated problem: the importance of the quality of a system's agricultural sector and the importance of its human resources. Although there are substantial differences between the two prize winners in terms of the scope of their work, the specific methodology they bring to bear, and perhaps most marked, their style, they both were pioneers in pricking the conventional wisdom of the 1950's and early 1960's concerning the central issues of development economics; and both were successful in helping to transform this wisdom.

The full significance of the work of Lewis and Schultz can be seen only in historical context. The renewal of concern with economic development in modern times can be dated to the post-World War II period when many of the excolonial overseas territories were gaining political independence and were anxious to move quickly in an effort to "catch up" with the already advanced countries. Impressed by the quick successes of Western Europe's postwar reconstruction with the help of Marshall Plan aid, virtually all planners and politicians, as well as most academic economists concerned with the Third World, tended to emphasize the importance of savings and capital transfers from abroad to achieve a similar quick burst of growth. It was generally assumed that a Third World country should use its traditional, colonial export earnings, be they from sugar, copper, or jute, to import producer goods for a new, favored industrial sector; should accept any available foreign aid or private foreign capital to supplement domestically earned resources; and, using these means, should quickly erect a well-protected industrial structure and thus arrive at the promised land of economic maturity. This "forced march" or "big push" approach to development clearly identified success with industrialization; the brute forces of capital accumulation together with foreign capital and, increasingly, the reinvestment of domestic industrial profits, would provide most of the fuel.

Among the early dissenters from this prevailing view of the world were Lewis and Schultz. Long before the failure to achieve a quick transformation in Asia, Africa, and Latin America began to shake the conventional wisdom, Schultz contributed a path-breaking article emphasizing the importance of human capital in the development of underdeveloped countries, and Lewis was emphasizing the importance of education both in his writings and in his advice to the prime ministers of Ghana and his native West Indies.

Similarly, long before world food shortages drew attention to the neglect of agricultural production in most developing countries, Schultz had contributed a book on *Transforming Traditional Agriculture* (*1*), which laid out in detail both the costs of neglecting the agricultural sector and what it would take to set things right. And long before the importance of the special commodity content of the agricultural sector was recognized, Lewis published his seminal work (*2*) emphasizing the organizational differences between the major sectors of a developing economy with a labor sur-

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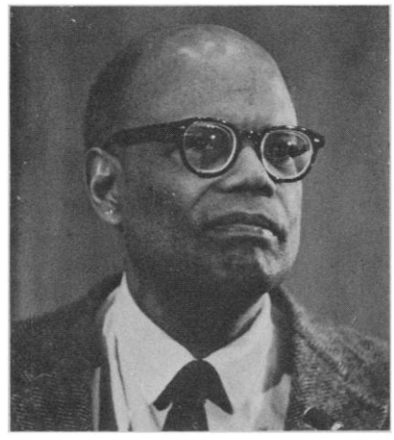
plus. What both men were saying in the 1950's and early 1960's, and what now has become part of the conventional wisdom, is that successful development is likely to depend more heavily on the quality of the human resources available than on the simple accumulation of the more traditional physical inputs; and that a lack of understanding of the role of the agricultural sector (Schultz) or of the noncapitalist sector (Lewis) is likely to adversely affect the success of development efforts.

The rationale for awarding the 1979 Nobel Prize to these two men, of course, extends beyond their early identification of critical deficiencies in the development paradigm; it can also be found in their specific scientific contributions which, in fact, helped to modify that paradigm. Lewis, who has written 10 books and more than 100 articles, is undoubtedly best known for his 1954 Manchester School piece on "Development with unlimited supplies of labour" (*2*). In this fundamental contribution he presented a simple two-sector model in which a large noncapitalist sector gradually gives way to a growing capitalist sector. The noncapitalist sector contains a reservoir of underemployed labor that could be mobilized for the expansion of the capitalist sector. The maintenance of this inefficient surplus labor is part of the multipurpose, sharing ethos of the family or community that characterizes the organizational choice in that sector. The capitalist sector, in contrast, is dominated by profit maximizing, which does not tolerate the maintenance of inefficient surplus labor by the organizing units.

In this early work Lewis was concerned with the "hidden rural savings" that could be mobilized when low productivity workers in the noncapitalist sector are reallocated to higher productivity jobs in the capitalist sector. This emphasis on an initial organizational dualism, which in the course of its dissolution can contribute to the successful transition of the system as a whole, encompasses the basic message of the Lewis model. It has been followed by a veritable explosion of literature, extensions, interpretations, and, of course, misinterpretations.

By his own admission (*3*), however, Lewis did not focus on product dualism—for example, on the peculiar characteristics of food, a necessity that happens to be produced mainly in the noncapitalist (read agricultural) sector—nor on that sector's potential additional, and much more active, role in contributing not-so-hidden savings to the total development effort through substantially enhanced levels of productivity.



W. Arthur Lewis

Others have since pointed to the importance of this special product dualism superimposed on organizational dualism, identifying the noncapitalist sector as largely food-producing agriculture whose failure to increase its productivity could, especially in a large country, be expected to drive up industrial real wages long before labor abundance is eliminated through reallocation and growth. But it was Schultz, dean of American agricultural economists, who emphasized the large potential role of agriculture and offered specific advice on how to harness its contribution to the total development effort. At a time when agriculture's reputation was that of an inherently unproductive activity characterized by unresponsive and obstreperous (if not downright "stupid") peasants, Schultz's *Transforming Traditional Agriculture* (*1*) pointed to the bargains to be had by introducing modern inputs and offering higher returns to farm families. His basic twin propositions were: (i) that the policies generally followed were heavily biased in favor of industry and against food-producing agriculture, both via a neglect of resource allocation to rural areas and via market interventions to maintain artificially cheaper prices for the wage goods facing urban consumers; and (ii) that farmers, given proper price signals and access to modern inputs, including the technology of the then new Green Revolution, could be expected to respond in their own self-interest and, in so doing, permit the sector to make a major contribution to the prospects for overall development.

It might be noted that while both Lewis, implicitly, and Schultz, explicitly, directed the attention of analysts and policy-makers to the behavior of the agricultural sector, they differed rather sharply on the question of the existence of surplus labor. Schultz does not accept Lewis's notion of organizational dualism with its income-sharing arrangements in the subsistence or noncapitalist sector; for him, agricultural wages or incomes are determined competitively, at equality with (possibly low) levels of marginal productivity. He cites the reduction of India's agricultural acreage and output during the 1918 to 1919 influenza epidemic, which substantially reduced the agricultural population, as proof that there was no surplus labor. Lewis's rebuttal focuses on the twin facts that population pressure on the land was much less severe then than now and that the deaths did not necessarily occur on the small family farms and other pockets of rural underemployment. But this is in large part a sham dispute conducted with inadequate statistics; the withdrawal of surplus labor, if it does exist, for example, in Bangladesh or Indonesia, is likely to be accompanied by minor organizational reforms that raise the productivity of those who remain behind. But the essentially empirical question of whether or not peasant agriculture is better modeled along the lines of the normal "neoclassical" profit-maximizing firm or by institutional "classical" income-sharing rules remains essentially unresolved. Both men, if Schultz somewhat earlier and more fervently, believe in the responsiveness of farmers to economic opportunity; thus, ending the agricultural neglect and urban bias of development policy is their common message, and this message is increasingly being listened to in the Third World.

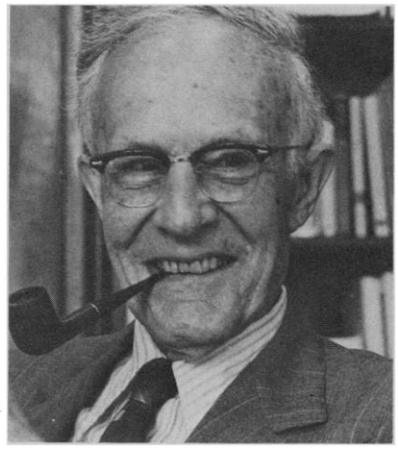
One can trace the origins of other contributions by Lewis and Schultz, in the realms of both theory and policy, to this early work on organizational and product dualism. Schultz, for example, analyzed the negative impact of food imports on agricultural productivity and became an early enemy of P.L. 480 food aid programs by which the United States and other donors still try to augment their foreign assistance budgets. His view, once heretical and largely ignored but now generally accepted, is that, aside from relief shipments in case of natural disaster, tying aid to a particular commodity may well turn out to be counterproductive. The transfer of resources in the form of surplus or, in recent years, not-so-surplus food—though often more popular with the agricultural lobbies and congressional committees of rich countries—is likely to constitute a Trojan horse for the recipient underdeveloped country, in which it is almost bound to depress agriculture's terms of trade and serve as a disincentive to farmers.

Schultz's powerful message here is that if farmers could only be protected from well-intentioned governments anxious to help the poor via market interventions of one kind or another they could be counted on to "roll up their sleeves" and go to work. This is a position, incidentally, quite consistent with his well-known earlier (1943) work on *Redirecting Farm Policy* (*4*), in which he saw the market as the most effective way of mobilizing the talents of the agricultural population in a relatively rich country facing cyclical problems.

Similarly, Lewis more recently (*5*) explained the terms of trade between countries of the North and South, a subject of interest in the context of the New International Economic Order, by extending his domestic two-sector model to the international scene. He thus responded to "dependency" theorists who claim that the developing countries suffer from deteriorating relative prices of their exports because of international demand conditions and an unequal division of labor that preassigns benefits away from the weak "periphery" and toward the strong "center." Lewis claims that, since wages outside of food-producing agriculture, whether for raw material production or industry, are tied to agricultural wages (or incomes) which are in turn tied to productivity levels in food, it is the unsatisfactory progress of the latter that may cause deterioration of the terms of trade. Although this extension of Lewis's domestic model appears to ignore nonlabor inputs as well as demand factors, it has attracted much attention, both for its simplicity and its effort to marry aspects of development and of trade theory—never an easy union.

Lewis has, in fact, been paying increasing attention to the international aspects of development in recent years, emphasizing that maximum growth in the North is likely to be in the South's best interests in the future. As a native West Indian he has been particularly sensitive to the cause of the South, and hard on the North for its protectionism, its unwillingness to maintain even meager foreign aid levels, and its often automatic support of multinational corporations abroad. He has served for years as vice-chancellor of the University of the West Indies, for which he was knighted by Queen Elizabeth, and as first president of the Caribbean Development Bank. But he has steadfastly refused to play to the galleries and to endorse popular positions on North-South issues taken by the developing countries unless his own logic could take him there.

Had his prolific writings contained nothing else, Schultz would be cited and remembered for his analysis of the importance of investment in human beings, whether in agriculture or elsewhere, as a generator of technology change and as a major factor in determining growth. His message is simple: It must be recognized that education and research represent important, if nontraditional, types of investment; and that their rates of return must be estimated and compared with the more conventional type of investment as a basis for rational overall resource allocation. Thus the convenient, simplifying notion that labor represents a more or less homogeneous entity entering our production functions must be abandoned. Both formal education and the less formal improvement of human beings through learning by doing constitute vitally important and undervalued resources for development, and computing the rates of return from different types and levels of schooling will reveal the extent of prior neglect or underinvestment—here as in the case of agriculture. In education as in research, especially agricultural research, Schultz recognized the importance of public sector actions to improve the environment for individual private actions. Schultz's faith in the ability of the individual to make the appropriate rational choice, given the information and the opportunity, really represents the cornerstone of his emphasis on human capital and of his early support of the "new household economics," which places family decision-making in a broader, multi-choice context at center stage.



Theodore W. Schultz

Lewis's emphasis on education represents less of a clarion call and is more tinged with caution. He agrees that new knowledge and training can make important contributions to growth, but places more emphasis on the likely distortion of signals in the markets for different qualities of labor; such distortion leads to the possibility of misallocations in the level and quality of the educational investment effort, and to the phenomenon of the educated unemployed.

Neither Lewis nor Schultz are ivory-tower iconoclasts; they have both spent much of their adult energies in public service, giving policy advice to governments, sitting on international commissions, or taking on full-time assignments. Both are motivated by the desire to throw light on the question that also occupied Adam Smith at the beginning of economic science, namely, on the elusive relationship between growth and distribution in human affairs, within as well as between nations. Schultz, the tall lean midwesterner, was by his own admission always "trying to provide a small room for poverty in the house that economists have built." And Lewis, the British-educated don from the West Indies, saw the problems of the underprivileged as the world's most important economic and political problem. Both men specialize in ideas rather than in mathematical niceties; both tend to rely on somewhat old-fashioned empirical proofs rather than modern econometric methods. Yet, while they are likely to agree on most issues of substance and of methodology, their personal styles remain very different. Schultz is a free-swinging, idealistic, and gregarious enthusiast who never tires of "teaching," whether the listener is one of his many students around the world or some recalcitrant Washington bureaucrat. Lewis is more the taciturn, caustic, sometimes even cynical, individualist, who insists on emphasizing the realism of given political or institutional pitfalls along the road of beautiful models and perfect policies. But Schultz does not suffer fools any more gladly, and Lewis is basically sentimental about the culture of poverty he is trying to affect. Both men are essentially driven by the same concerns and by the same realization that careful, dispassionate analysis is the best way to be of help.

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