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WHAT IS INTERMEDIATE TECHNOLOGY?

THE question is not so easy to answer as might appear. This phrase—coined or adopted by E. F. Schumacher to describe the industrial and agricultural requirements of the so-called "underdeveloped" countries—has become something of a byword, as indeed it should. It means the kind of tools and simple machines that poor farmers and other rural people can afford to buy, or can learn to make, to become better able to support themselves and be self-sufficient. But if you trace the development of Dr. Schumacher's thinking, as found in the scores of articles he has written during the past ten years, you find that this idea opens up into a wide and comprehensive attitude toward all practical human activity, based upon a hurnanistic and transcendental philosophy of life. You can see the sense of what he proposes without adopting the philosophy, but the moral ideas this outlook rests upon are shared intuitively by countless individuals who will be grateful indeed to see them developed and applied in so many deeply intelligent ways.

Judging from what he says, Dr. Schumacher began thinking along the lines of intermediate technology back in 1955 when he became economic adviser to the government of Burma. "I felt," he said, "that I must do three things: I must study poverty and the boundaries and disabilities of poverty; I must identify myself with poverty; and then I must try and discover how to help the poor to help themselves." He has some things to say in one of his papers about his experience with the Burmese, but that is another subject. A few years later, back in England, he formulated the concept of intermediate technology in a report for the Indian Planning Commission, and in 1964 he presented the idea to the Cambridge Conference on Rural Industrialization. In summary, he maintained—

> *first,* that the source and center of world poverty lies primarily in the rural areas of poor countries, which are largely by-passed by aid and development as currently practiced;
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> *second,* that the rural areas will continue to be by-passed and unemployment will continue to grow unless self-help technologies are made available to the poor countries with assistance in their use; and
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> *third,* that the donor countries and agencies do not possess at present the necessary organized knowledge of adapted, appropriate technologies to be able to assist effectively in rural development.

In the summer of 1965 Dr. Schumacher and a small group of friends and associates brought into being the Intermediate Technology Development Group, Ltd., a non-profit company designed to fill the knowledge-gap in relation to self-help technologies. ITDG set out to gather information about tools and methods suitable for rural and small town areas in the developing countries, and to undertake the invention or adaptation of tools when this was necessary. The Group also evolved communication methods to spread this information around where it is needed, and also the fact of its availability. Finally, it undertook to develop research resources for application of the best modern knowledge to the problems of the developing countries, and to serve as consultant and collaborator in numerous projects.

Well, what sort of things result from this work? One good example of intermediate technology is a cassava grinder developed by the Intermediate Technology Workshop in Zaria, Nigeria. (ITDG helps local workshops to start up wherever possible.) Cassava is a principal food in Nigeria, which has to be ground and dried before it is cooked. The cassava root is spongy and grating it with a tin can with holes punched in the bottom leads to lots of hand injuries. The Nigeria workshop devised an efficient cassava grinder made out of old bicycle parts and hacksaw blades.

It grinds sixteen pounds of cassava in about five minutes. Another product of this shop is a guinea corn threshing machine which also uses bicycle parts—crank, chain, and a pedal. Still another development is a "bush ambulance" that can be towed by a bicycle. Plans for low-cost housing suited to the region were supplied to a town in Ghana. In this case local customs had consideration as well as regional building materials, and erection is by local labor with hardware made by town blacksmiths.

A dramatic example of the need for—and development of—intermediate technology came when the ITDG industrial panel went to work to design an efficient, inexpensive pack for eggs for the Zambians. The Zambians needed about a million egg trays a year and were importing them, and: when trays were in short supply the eggs went bad all over. To make a long and interesting story short, the large firm that had a monopoly on making egg trays was not interested in supplying Zambia with a small machine for making trays. The machine devised by the industrial designers who worked with the ITDG panel was exactly suited to Zambian needs—it produced egg trays in the right volume and they were a better pack in a variety of ways. Most important of all, the Zambians could afford to buy or build this machine—it is in scale with their needs and capacities. (The machine, with a change of moulds, can make a lot of other packaging items, too.)

The Intermediate Technology Group is both long and short on theory. It is long on thinking about the basic role of technology in the service of actual human need, and short on assumptions about the specific requirements of people in underdeveloped countries—or anywhere else. Information about actual needs develops through requests for help. Sometimes study of a request results in recognition of a need behind the need. For example, in a country lacking local buildings for schools, clinics, government offices, and farm structures, it became evident that the need lay more in general know-how than in building materials or on-the-job skills. The kind of organizational ability practiced by the small contractor was missing. This led to development of simple educational materials for use with local people who could learn to put together construction projects and deal with the building trades.

What is the broad, theoretical approach of ITDG? The following are general ideas:

> Basically, there are three possible ways of arriving at the simple, low cost techniques needed by the peoples of the underdeveloped areas of the world: the first is to upgrade to make more productive, traditional ways of doing things. The second is to strip down, simplify and reduce the cost of sophisticated machinery and equipment—retaining the "tool" element but eliminating the expensive labor-saving accretions which are a feature of Western technology. The third is by new invention. The expertise—and much of the information required—to do this kind of work certainly exists in the West, but it needs to be mobilized, systematized, and presented in a useful form.

What should intermediate technology accomplish?

> In the first place, technical innovation should stimulate economic progress by making better use of available natural resources and labor power.
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> Secondly, it should promote social progress by enabling the mass of the population to share in the benefits and participate in new activities.
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> Thirdly, it should set in motion widespread technical improvement compared with what now exists in the country concerned. External standards, especially those current in the West, are likely to be irrelevant.
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> Fourthly, the technologies should be progressive over time—that is, they will change in response to the society's ability to pay for them and use them effectively.

What, the ITDG people ask themselves, causes poverty? The answer, if you look around the world, is not so much lack of natural wealth or resources as it is lack of education, organization, and discipline. "Miracles" of economic development have been performed by countries with very sparse resources when these qualities are present—as for example Switzerland, England, and Japan. Dr. Schumacher says:

> Here, then, lies the central problem of development. If the causes of poverty are deficiencies in these three respects then the alleviation of poverty depends upon the removal of these deficiencies. Here is the reason why one cannot "jump" in development, because education does not jump; education is a gradual process. Organization does not jump; it must evolve to fit changing circumstances; and the same goes for discipline. All three cannot be ordered or simply planned; they must evolve step by step, and the foremost task of policy must be to speed this evolution. And all three must become the property of the whole people, not merely of a small minority.
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> How can the West best help to foster the development and widespread adoption of such technologies? Not, we suggest, by continuing to promote the purchase by poor countries of expensive hardware which requires not only large sums of capital and heavy imports but *special* forms of education—special forms of organization and discipline which are not inherent in the societies concerned. I am not advocating a complete reversal or transformation of aid policies and approaches to development. What is needed is to start a shift in emphasis, towards aid for self-help; and to *marshal the scientific and technical knowledge of the West to that end.*

This was the sort of thinking which led to the formation of Intermediate Technology Development Group. Its aim was to help in "the creation of a kind of social infrastructure of education, organization and discipline which enables people to work themselves out of poverty." An ITDG leaflet gives this comparison of the difference between appropriate and inappropriate technology:

> For example, in one poor country, 5,000 shoemakers were kept very busy by their customers. Many other people earned their living by supplying materials for shoemakers; leather, hand tools, cotton laces, wooden lasts and cartons. The country then imported two plastic injection moulding machines, costing close to a hundred thousand dollars. All the PVC for making the shoes was also imported, which meant more spending outside the country. These plastic shoes were cheaper than the leather ones, and lasted longer. The 5,000 shoemakers soon found themselves out of a job. So did all the others who had been supplying the shoemakers. The plastic shoe factory employs only 40 people. The effect was a loss of real income in the country.
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> An "intermediate technology" for this shoe industry could have been simple sewing machines. This makes for quicker stitching of the sole to the upper and insole than hand-stitching, but does not require large spending outside the country (and does not put people out of work).

There is also this comment:

> While intermediate technology can be the right technology for most situations in poorer countries—there are some cases when an advanced capital-intensive technology may be useful. For example, a fibre board plant in an African country costs well over two million dollars and employs only 120 workers to run the heavy machinery. However, the plant has been processing sugar-cane and maize stalks which would otherwise have gone to waste. This also means added income for the farmers. The finished product is a good cheap material for furniture and housing. The wood which has been used for housing had needed to be imported. Using the new fibre board means less spending outside the country. The plant has been useful to the country in several ways. However, it is likely that a plant using lighter machinery and more workers would have been even better. Intermediate technology research is looking for ways to scale down large plants. This could meet the employment and other needs of poorer countries more precisely.

Great stress is laid by ITDG on the fact that intermediate technology calls for the *best* that scientific knowledge can devise—intermediate technology should never be thought of as involving only second-best solutions for economic problems. The best use of scientific knowledge and technical skill lies in applying it in the way that serves human need, and this varies greatly around the world. "Any intelligent fool," Dr. Schumacher has remarked, "can make things bigger, more complex, and more violent." It takes sensibility, inventiveness—even a "touch of genius"—to move in the opposite direction.

Again, what is "intermediate technology"? It is, for the farmer, say, something between the hoe and the tractor, or between the machete and the combine harvester. Where, in this broad range of possibilities, should a contribution be made? Finding out is the work of ITDG. As Dr. Schumacher says:

> Know-how at this "intermediate" level—and relevant equipment—obviously existed in many places, but no one could say what *gaps* there were, and there was no point anywhere in the world where this know-how could be obtained as and when the people most in need of it required it. Intermediate technology *development* therefore means the work of bringing this knowledge to light, to systematize and, where necessary, complete it, and to organize a worldwide system of "knowledge centers" where it can be readily found.
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> Years of work in this field have supplied the Group with plentiful evidence that the "knowledge gap" which it set out to fill is indeed very wide. The labor-saving, capital-intensive, highly sophisticated technologies, suitable for large-scale production in rich markets, which are commonly used in rich countries, are extremely well documented and easily accessible; but technologies applicable on a small scale by, or in, communities with plenty of labor and little capital, lacking technical and organizational sophistication are on the whole poorly documented, difficult to get hold of, and in many cases even non-existent. There are numerous instances where the relevant knowledge and equipment used to exist but has virtually disappeared, in accordance with the well-known tendency of the "better" to be the enemy of the "good." This tendency is of course progressive and therefore to be welcomed, unless it deprives large numbers of people who cannot afford the "better," of the "good" they could afford.

At this point, the whole question of what is indeed *better* needs attention. There may be many cases in which, from the viewpoint of a country as a whole, of the planet as a whole, and of both workmen and consumers, the way things used to be done was far better than the way they are done now. At an ITDG seminar this point was effectively made by George Tyler:

> I worked in the State of Kuwait where costs are not a main problem, but nevertheless there is a need to develop appropriate technologies. We found that many of the people we worked with were convinced of the superiority of European-designed buildings with very large areas of glass on the exterior, and constructed of steel and concrete. It was very difficult to convince Kuwait clients that, on the basis of sophisticated thermodynamic analysis of the performance of a building, their old pre-oil age structures were in many ways much more efficient. We had to use not advanced technology but advanced science to demonstrate that their old technology, or an advanced version of it, was in fact superior. It was a long process to persuade architects who had been thoroughly indoctrinated by Western architectural schools.

The broadening out of the thinking about intermediate technology to include not only the needs of "developing countries," but of all countries, and especially industrially advanced countries beset by serious unemployment problems, has become evident in recent years. In an address last year George McRobie, Director of ITDG, spoke in these terms:

> To give more concreteness to the work program indicated by the words "intermediate technology," we may emphasize four criteria: (*a*) smallness, (*b*) simplicity, (*c*) capital~cheapness, and (*d*) non-violence. It is by no means certain that all four criteria can be satisfied in every case; but any one of them, or a combination of them, is of value for our purposes.
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> The established trend of technological development is towards ever larger scale, towards giantism. This is considered to be justified by the "economies of scale." But large-scale production units can be economical only when certain conditions are satisfied: a high market "density," for instance, or a highly efficient low-cost transport system. When these conditions (and others, such as skill in large-scale organization, management, buying, and selling) are not satisfied, the so-called economies of scale become illusory. In fact, large-scale then tends to act as a principle of exclusion: only people already rich and powerful can embark on new productive enterprises; the small man is excluded, reduced to the position of a job-seeker—and when there are not enough jobs provided by the rich and powerful, he has no possibility of becoming productive. The importance of the criterion of smallness hardly needs to be argued, and experience shows that whenever efficient, small-scale equipment *is* made available the demand for it does not come merely from the Third World, but even more insistently from the affluent societies as well. Smallness is a *conditio sine qua non* for rural development, but it is also highly

relevant from many other points of view—ecological, resource-wise, and social.

Much the same applies to simplicity and capital cheapness. It does not take great scientific or technological creativity to take a further step in the direction of complexity, and capital intensity. This means nothing more than following the established trend. But when the demand is made to search for smallness, simplicity, and capital saving, the normal first answer is that "it cannot be done." Experience shows that—not everywhere, but over a wide range of application—this answer is simply wrong. It can be done but it requires a more original Research-and-Development effort than is normally forthcoming.

Readers should by now have a general idea of the scope and possibilities of future development of the Intermediate Technology movement. When E. F. Schumacher, who is an economist with many years of varied experience, gathered together some associates and formed ITDG, he and they resolved to keep the organization small and to draw in the abilities of already existing research facilities. Presently they have some ten panels in essential areas needing development, such as agriculture, building, food (storage and preparation), health, industry, power, water (supply and sanitation, and irrigation), co-op organization, simple accounting procedures, etc. A main objective is to produce "daughter cells" of intermediate technology developers around the world. The Group first published a catalog of agricultural tools representing intermediate technology, and the quarterly journal, *Appropriate Technology*, is now in its second year. This magazine is filled with examples of intermediate technology successfully applied.

Since the work of ITDG is essentially educational, Dr. Schumacher and his staff spend much time traveling to consult and lecture in other countries, and in organizing and distributing needed information. It has become plainly evident that the practical demand for this sort of assistance can do nothing but grow. ITDG functions as catalyst and guide for this growth. The address of ITDG is 9 King Street (Covent Garden), London W.C.2, U.K. A good introduction to work in this area would be Dr. Schumacher's book, *Small Is Beautiful* (Harper paperback), which appeared in December, 1973. A general statement which captures the underlying spirit of the undertaking appeared in *Resurgence*:

What is the meaning of democracy, freedom, human dignity, standard of living, self-realization, fulfilment? Is it a matter of goods, or of people? Of course it is a matter of people. But people can be themselves only in small comprehensible groups. Therefore we must learn to think in terms of an articulated structure that can cope with a multiplicity of small-scale units. If economic thinking cannot grasp this it is useless. If it cannot get beyond its vast abstractions, the national income, the rate of growth, capital/output ratio, input-output analysis, labor mobility, capital accumulation—if it cannot get beyond all this and make contact with the human realities of poverty, frustration, alienation, despair, breakdown, crime, escapism, stress, congestion, ugliness and spiritual death, then let us scrap economics and start afresh.

Are there not indeed enough "signs of the times" to indicate that a new start is needed?

REVIEW
A CONCEPTION OF PUBLIC SERVICE

NOT many men have a natural inclination to work for the general welfare, and fewer still develop the competence and background in this area required as the foundation of social vision. To serve the general welfare, one needs strong devotion to ideals—a commitment to human good that is not weakened by frequent disappointments—and wide and tested knowledge of practical affairs, along with unusual sagacity concerning the tricks and dodges of human nature. Even when all these requirements are substantially fulfilled, complete successes in the service of the common good may still be few.

Arthur Morgan's latest book, *The Making of TVA* (Prometheus Books, $10.95), is a report on a great and impressive effort in behalf of the general welfare. For those old enough to remember the controversies which attended the planning and progress of this vast engineering project affecting the destinies of several states, Dr. Morgan's book, completed by him in his ninety-seventh year, will be clarifying and informing. Other readers may be more impressed by the book as a general study of the frustrations and difficulties which arise out of the conventional political process to harass and sometimes defeat the most needed and desirable undertakings. In the case of TVA—the Tennessee Valley Authority—however, the project was so well conceived, and its foundations so well laid, that eventually it fulfilled many of the original objectives.

Another value of this book lies in the portrait of its author which slowly emerges from the tangle of political shenanigans, mixed motivations, and varying conceptions of purpose and goal in an enterprise that represented a new level of thinking about the role of government. Dr. Morgan combined in his personal and professional background exactly the qualities such a project was in need of, and he also embodied an ethical spirit so rare in its integrities as to be virtually alien to familiar modes of behavior in public service. That he was unable to remain with the TVA to its final completion, and thereafter, becomes a fact of diagnostic significance when we consider the low moral tone of national affairs, these days, pointing to qualities of character that need to be restored to American life.

This, surely, is the long-term significance of Dr. Morgan's book. The experience he went through during the five years as Chairman of TVA apparently brought him to a similar evaluation of what had happened. Toward the end of his connection with the project he set down his testament of what he had learned in a small book, *The Long Road*, which is a reflective study of the formation of human character. In a foreword Dorothy Canfield Fisher said:

> To read this reminder that character, human character, is a vitamin as indispensable to the health of society in the new mechanized high-speed modern world as it has always been in every other version of human society, is to see as by the focussing of the lenses of the binoculars, firm and familiar reality emerge clear and true from a wild whirling confusion, the proportions what they have always been—though on another scale. By putting upon us, on every one of us, his fair share of responsibility for the common good, he [Arthur Morgan] frees us from the fatalism of the multitude and the mechanical, gives us back our human dignity, and with dignity, strength, courage, faith in living.

A quotation from President Franklin D. Roosevelt, outlining (in 1933) his conception of TVA, conveys the framework of ideas and activities out of which the themes of *The Long Road* were developed. In his message to Congress requesting legislation to create the Tennessee Valley Authority, the President said:

> It is clear that the Muscle Shoals development is but a small part of the potential usefulness of the entire Tennessee River. Such use, if envisioned in its entirety transcends mere power development: it enters the wide fields of flood control, soil erosion, afforestation, elimination from agricultural use of marginal lands, and distribution and diversification of industry. In short, this power development of war days leads logically to national planning for a

complete river watershed involving many States and the future lives and welfare of millions. It touches and gives life to all forms of human concerns.

I, therefore, suggest to the Congress, legislation to create a Tennessee Valley Authority—a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise. It should be charged with the broadest duty of planning for the proper use, conservation, and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the Nation. . . .

Many hard lessons have taught us the human waste that results from lack of planning. Here and there a few wise cities and counties have looked ahead and planned. But our Nation has "just grown." It is time to extend planning to a wider field, in this instance comprehending in one great project many States directly concerned with the basin of one of our greatest rivers.

This in a true sense is a return to the spirit and vision of the pioneer. If we are successful here we can march on, step by step, in a like development of other great natural territorial units within our borders.

Dr. Morgan was surprised when the President proposed that he head the TVA as chairman. Morgan was a flood control engineer and he supposed that Mr. Roosevelt was interested in an Ohio water management project. When he found that he was being considered as Chairman of TVA, he exclaimed, "But Mr. President, you do not know me." The President replied: "Haven't I been reading *Antioch Notes* all these years? I like your vision." This vision, it might be said, was the link between the two men. Morgan saw in Roosevelt's conception of what the TVA might become an extension on a larger scale of what he had himself been working at for a number of years. In 1920-21 he had renewed the life of Antioch College, founded in the mid-nineteenth century by Horace Mann, and given much effort to the regeneration and fostering of the socio-economic life of Yellow Springs, Ohio, where the college was located. Morgan's idea of what might be accomplished in the Tennessee River Valley is shown in the following:

As I discussed the TVA with President Roosevelt, it seemed to me that for twelve years in Yellow Springs I had been actively engaged in an undertaking that was almost identical in spirit to the one he outlined. The TVA seemed to offer a chance to create a new cultural environment, where almost no field would be closed to a competent, able person. I was surprised and pleased to find that Roosevelt had much the same outlook: he wanted the country to loosen up and become conscious of a wide variety of economic and cultural interests. He wanted a new breath of life.

It was common for public works to be undertaken on limited projects of definite scope, such as highways, water control, electric power, and building construction, and the TVA legislation included such programs. However, the President had a more inclusive vision in mind for the Tennessee Valley. To his mind it should be concerned with every aspect of the region's well-being. There were few areas in America with such a poor and narrowly based agriculture and economy as the mountainous parts of the Tennessee Valley but he believed in the possibility of its rebirth and larger life. . . . He told of his long-standing hope that he might help to give a new life and culture to the long-neglected descendants of those indentured servants who had, before the days of slavery, largely made up the working class of southern agriculture. The principle of the all-round development of life is only gradually emerging into consciousness. Because of FDR's vision it became a major consideration in the TVA.

My primary hope for the TVA when it was set up in 1933 was that it might create a new spirit and attitude in a public service. I believed that fresh ideas and undertakings in better living might be as important a service as the control of rivers and the production of power, and I felt free to explore them in any way that seemed to carry out the spirit of the TVA and the President's objectives.

Unfortunately, the other two directors of TVA did not share these broad and innovating views, nor was the President constant in his support of the original ideal. Morgan's devotion to the vision of human reconstruction became one of the major grounds of attack upon him by David Lillienthal (one of the directors), while the President failed to stick by his original commitment to Morgan that there would be "no politics" in the decisions affecting TVA. The book tells the story of what was in effect a betrayal of the original vision and inspiration of the project, but more important is the account of what Morgan set out to do, and of the actual programs of social reconstruction he initiated. It should be noted that a number of these programs still continue, and that the vision has at least partially been realized.

In a comment on this book, Griscom Morgan, Arthur Morgan's son, remarks that the tragedy of the conflict in TVA did not seriously affect his father's life, since he soon found other outlets for his creative energy. The tragedy was rather "in the resultant failure of the New Deal to create a national system of TVAs which might have transformed large areas of the country." Griscom Morgan's concluding comment is this:

> Valuable as Arthur Morgan's book is for the history it gives us, a far greater value is in the philosophy and method of public administration it sets forth, pivoting on the total rejection of political patronage and an all-pervasive respect for human personality and concern with the quality of human life.

COMMENTARY
GOOD TEACHING

THE assessment of the role of "critical thinking" by the teachers at "Little College" (see "Children") claims this week's editorial space. "Must we," the teachers asked themselves, "try to maintain a detachment, a sort of universal skepticism about the worth of any and all positions and try to teach this universal detachment to our students?"

> The answer to these fears is no, we need not try to adopt or teach such detachment. To recognize that critical thinking includes fundamental questioning does not imply that one can never accept any answer. In fact to take that position makes nonsense of the meaning of the word "question," which clearly demands that somehow one get an answer. The difference between critical thinking and dogmatism is not that dogmatism allows you to get an answer and critical thinking never allows an answer. *The difference lies rather in the states of the answer.* The dogmatist moves from his question to whatever answer he comes to and then quits. The critical thinker does not refuse to move from question to answer, but he understands the intimate tension between questioning and answering and so accepts answers with the awareness that future possibilities may modify and change those answers. He accepts answers but never fully stops the questioning. The critical thinker is not like the person who, seeing that because the answers are not absolute, falls into despair and says therefore these answers are only "provisional" and therefore of no worth. Critical thinking says that answers are of great worth, but that this great worth need not blind us to what future questioning may reveal if and when such future questioning develops. Critical questioning includes a questioning, but it does not exclude an answering. . . .
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> The open-ended questioning, a questioning which does not deny the worth of answers but does not absolutize them either, does have to face another, though related concern. . . . it also allows for a conflict between different "answers," that is, between different disciplines and their logic. . . . The confrontation between the logic of the sciences and that of religion or art is one such conflict. How do we choose between these competing logics? . . . My answer to this concern is to call for a rigorous candor and honesty about what we can and cannot say about such conflicts. My own understanding of them is simply this: *some* such conflicts are not really conflicts at all, but grow out of a misunderstanding of the limits of the different "competing" logics; but other conflicts *are* genuine conflicts. . . . Who knows which of our students will provide a breakthrough even here, but clearly he will never do so if we hide from him (or ourselves) such unfinished problem areas. . . .

The world and ourselves being unfinished things, our knowledge and understanding are also unfinished. Good teaching faces these realities openly.

CHILDREN
. . . and Ourselves
STUDENT AND TEACHER PROBLEMS

WRITING about good teaching is never easy, and the occasional successes seem to come about more by accident than design. There is an "alchemical" element in teaching which rejects formula or definition, so that examples, casually related, often have much greater value than formal discussions. Sometimes the entire body of a person's work, when regarded reflectively, may suddenly take on the character of a magnificent example of good teaching. Ortega y Gasset certainly qualifies in this respect, and so does Harold Goddard. Both these men left behind them innumerable grateful students.

Many publications dealing with education—books and journals and papers—find their way to our desk, but of all those which have become familiar through regular appearance, we pick up *New Directions in Teaching* with the most anticipation. Labeled "A non-journal committed to the improvement of undergraduate teaching," *NDT* is issued by the Office of Experimental Studies, Bowling Green State University, Bowling Green, Ohio 43403. It comes out three times a year. Subscription for four issues is $4.00 ($2.50 for students), and single issues are $1.25.

The Summer-Fall *NDT* for 1974 has an article by Peter H. Spader, "The Freshman Experience," which describes the self-reform undertaken by the ten teachers in an experiment called "the Little College" within the College of Arts and Sciences of Bowling Green University. There were two hundred students. It became apparent to the teachers that their basic problem lay in the fact that conventionally, during the freshman year, students are "enrolled in a variety of introductory courses which neither recognized what they had already learned nor engaged them in much more than rote memory." In short, the students found themselves being processed by specialists in various fields—professors who had clear ideas about the importance of their specialties, and who took it for granted that the students shared their assumptions.

But the students *didn't* share those assumptions. They had come to college or university feeling that now they would have opportunity to get some orientation for their lives—a sense of meaning, perhaps, or a feeling that going to school was not only the conventional but the right thing for them to do. And when they got there, they couldn't help but be confused by what was happening to them. Mr. Spader begins:

> Why are students frustrated, and what can we, or ought we, to do about it? Now students tell us that they have upon entering a college or university, a sense of being in a machine. They don't quite know what is going on, and what they can figure out doesn't seem to be very much focused on them or designed to help them. It seems, indeed, to be done mostly for the sake of the organization, the teachers or the administration. For example, most freshmen are faced immediately with a group of courses which are "required" courses. Yet no one tells them much of why they have to take these courses except for a more subtle version of "do it, it's good for you." . . .
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> Much can be done to overcome the feeling of impersonality and regimentation that is part of what these students are telling us. One can keep the Introductory level class small, and choose for these classes those teachers who have the kinds of interpersonal skills no one can fully measure, skills which nevertheless exist and which help to put students at ease. The difficulty is that as important as these things are, they are not enough.

Still to be answered is the fundamental question in the student's mind: Why should he be taking that particular course, or even going to school at all? The student is not just "lonely," but likely to be alienated as well. As Mr. Spader says:

> The alienated student is the student who has a personal sense of integrity high enough so that he is not going to just take things on faith. He wants to understand what he is doing and why, what we are proposing to help him learn and why he should bother to learn it.

In short, the deep questioning going on in modern society is inevitably present—as it should be—in places of higher learning, and most colleges and universities, being institutions and having their own momentum and private forms of enterprise, are not drawn into the questioning spirit as much as they should be in response to student wonderings and doubts. Moreover, it is difficult for any institution to accept and cope with a challenge to its own existence. There is also a practical problem for teachers:

> It is in a sense, hard for teachers to recognize this as a problem. We are dedicated to some academic discipline, which we teach, and the worth of that discipline is, if not a settled issue in our minds, at least one which we have had to wrestle with and settle enough to stay within the discipline and continue to teach it. It is thus clear to us that what we do is worthwhile, and it is something of a shock to find that students cannot see this value. It seems somehow demeaning to have to "sell" what we are teaching to students. Couple with this the feeling that one *cannot* explain what you are doing and its worth "in twenty-five words or less" and you are in a very depressing situation indeed. One is tempted to say that the student very well better be able to take some things on faith, because that is the only thing we can offer at the initial stage.

Well, the ten teachers of the Little College at Bowling Green were not satisfied with this status-quo solution, and the rest of Mr. Spader's article is an account of their reflections and debate concerning what they ought to do to meet the student on his own ground. It does not belabor the obvious to say that they were determined to teach students, not subjects, since this is a characteristic problem of a specializing culture, found in other areas. Doctors, for example, are slowly recognizing their obligation to treat patients, not diseases, and quite recently a planner and designer of hospitals declared the need to revise the whole conception of these institutions—which now conform mainly to the imperatives of medical technology instead of the human requirements of the sick.

Up for discussion, then, is the basic question of the pluralist theory of knowledge. It hardly seems likely that teachers who remain secure in the expertise of their specialty, indifferent to the philosophical trends and questionings of the time, can be of much value to coming generations of students. Needless to say, the teachers whose deliberations Mr. Spader reports—in some sixteen pages—are of a different sort. They recognize that students have lives to live and a world to understand, and that their feelings and state of mind in relation to themselves and the world must be the starting-point for education.

So the Little College teachers discussed the question of how to begin. The course of their debates seems to touch on most of the crucial issues in modern thought. First, for example, was the apparent opposition between "cognitive" learning and its "affective" side—put in far better language by Mr. Spader:

> One side (the "thinkers") gloomily prophesied that the "barbarians were at the gates" and that anti-intellectualism was about to breach the walls. The other side (the "feelers") returned the compliments and sketched a vision of bloodless computers fearlessly forcing students through the latest and most "logical" do-loops.

Another central issue was how to meet the dogmatic relativist contention: All knowledge is relative; nobody knows anything with certainty, so why should we bother to study at all?

A focus of argument grew out of the question of whether or not, if the goal of schooling is to learn how to think critically, the scientific method should be made the model of critical thinking. Science, after all, leaves out so much of human reality.

None of these questions was finally resolved, but refining the questions produced comparatively successful solutions in teaching practice. In any event, many of the freshman students found themselves at least "engaged" by the kind of introduction the teachers worked out, which means that they began to be "on their own" in getting an education—which is, after all, the most decisive step any student can take. We strongly recommend a reading of this article.

FRONTIERS

For "Urban Barbarians"

THAT specialized knowledge and its innumerable applications in technology outrun the understanding of the ordinary person is a common and continuing problem in our society. There are two possible remedies. One is the conscious development of a "philosophy" of technology, devoted, for obvious reasons, to what simplification may be possible in the future, along the lines of E. F. Schumacher's "Intermediate Technology." The other remedy lies in educational activity designed to bring basic knowledge of how technology works to the people at large, so that they will become able to enter more fully into policy decisions concerning its use. Obviously, both remedies are urgently needed.

An "Urban Physics Course" taught at Ramapo College, Mahwah, New Jersey, for the past five years by Edwin H. Marston seems an especially good example of an educational program. Its value, not just to students, but to practically everyone, will be easily apparent. In an introduction to a paper describing this course, Prof. Marston says:

> Technology—whether it is autos, massive dams or spaceships—is one of the ways by which our society expresses itself. But it is a means of expression many can only be in awe of or be hostile to—not understand. And without understanding we become urban barbarians—camping in rather than living and participating in our cities. At best the work of experts and the distribution of resources by the economic system may allow such a society to survive. But as we are gradually learning, this is not a very satisfactory solution.

The approach of this course is in terms of the working of technological systems which support and affect the lives of city dwellers—urban water supply, transportation, and energy production and use are examples. These are considered in relation to environmental problems and related areas such as agriculture and communications. "It would be interesting," says Prof. Marston, "to discuss such things as laser communication, computers and space travel, but most students come into the course ignorant of how and where their food is grown or even how a toilet works." So, he says, "we eschew lasers and computers in favor of freight trains and sewers."

Applications of physics are numerous in all these areas. The uses of measurement are demonstrated in the course with emphasis on "being exact enough rather than exact." A basic study is water supply, which involves water-flow in rivers and pipes, watershed size, reservoirs, aqueducts, and flow calculations. A grounding in these considerations prepares the students to consider both the problems of protecting people against drought and the effect of technology on urban development or growth. Technical advance in the supply of water, for example, made possible much greater population density in cities, since with more water for drinking and putting out fires the checks to urban growth were removed. Other effects of delivering more water to cities are not so obvious:

> The evolution of urban water systems illustrates how one technological step—an improvement at the time—can create new problems which require new technology. Construction of urban water systems permitted cities to seal the land with asphalt and buildings and to become more densely populated. The sealing led to urban floods since the ground no longer absorbed or braked flowing rain water. In response, another improvement—storm sewers—was introduced to remove the water from the streets. But the sewers dumped that water all at once in the now inadequate local streams and rivers. To handle these newly created flows (the peak-hour problem) required that the local waterways be straightened, deepened, and lined with concrete to increase flow and prevent flooding. Many waterways were eventually encased in pipes, in effect becoming sewer mains. So when urban areas reached out to distant watersheds, they doomed their own local streams and rivers.
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> Drainage of urban lakes and ponds, the sealing of the land, and the heat-holding ability of concrete, asphalt and steel leads to high summer temperatures. This helps create a need for air-conditioning and totally sealed, high-rise office and apartment buildings, with their extravagant energy needs. One

> result of the sealing of water in pipes and people in buildings, then, is increased energy use.
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> The short-term nature of many technological fixes can be seen by examining sewage systems. Sewers were built to drain household waste water off water-logged streets. But untreated sewage pollutes local streams, so in recent years most areas have built treatment plants. In the intensely developed New York-New Jersey metropolitan area, the ocean dumping of sludge creates air pollution; using it as a landfill consumes scarce land.
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> These cycles are not presented to convince the students that the problems cannot be solved, but to demonstrate that technology is not magic: any technological fix can be negated by rapid population growth, or increasing consumption. If large segments of the population are ignorant of the networks that lie behind water faucets and electric outlets, these systems will be abused.

From these generalizations Prof. Marston turns to dramatic examples, using the water systems of Denver, Los Angeles, and New York—cities which have "stunted the economic growth of the areas they draw water from." And now, in Colorado, Denver is tunnelling through the Continental Divide to divert water from the rural Western Slope of the Rockies. "The Western Slope farmers, who depend totally on irrigation, fear that they will meet the same fate of those who once farmed the Owens Valley in California." (The Owens Valley is now unfarmed and uninhabited, since the water which once gave it fertility flows to Los Angeles.)

The comment on BART—the Bay Area Rapid Transport of San Francisco—shows what may be the unpredictable effects of large-scale rapid transportation:

> BART's small land needs and large passenger-carrying ability has threatened low-rise, comparatively low-density San Francisco with high-rise, high-density development. The irony is that Bay Area residents voted for BART back in 1962 to eliminate the need for additional highways and bridges, which they felt would alter the character of their region for the worse. BART's operating and safety problems are mentioned only in passing. It is felt that making the system work is a problem best left to specialists, but that the land development implications of the properly working system is a matter for public discussion and decision.

The importance of this sort of education as the basis for social intelligence hardly needs pointing out.