5/Case Studies in Technology Transfer

The present chapter illustrates, with case studies drawn from my recent field research, how and why priorities of suppliers and utilizers of technology diverge. At times, differences cannot be reconciled. Even when full harmony is unattainable, however, valuable lessons can be learned regarding transfer negotiations. One key to success is engaging, in early stages of negotiations, in critical discussion of the value assumptions of partners to transfer contracts. Although debate at this level is full of friction, it reduces misunderstanding at later stages.

The cases described here are neither necessarily typical nor representative of any statistical class of phenomena. They do, nonetheless, illustrate the dynamics of international technology transfers and negotiation strategies. In most instances here presented, all partners to the transfers were reasonably satisfied, but none of the cases is an "unqualified success story" which can serve as a paradigm for other efforts. What emerges more clearly from these studies is that, even in achieving a relative "success," certain values must be sacrificed.

Various institutional actors are included in the cases chosen: universities, government agencies, consultant firms, manufacturing firms, and peasant villagers in a mountainous country. The roster of cases includes a university project for water-basin development in Argentina, a consultant study on cold-food systems in Brazil, licensing arrangements in an Argentine shipyard, overall operations of a US precision-instrument firm in Latin America, general remarks on value conflicts in tourism, and miscellaneous short cases.

These exhibits reveal how technology is both a destroyer and a promoter of values and an instrument for creating new bonds of dependency even as it removes old constraints. The link between technology transfers and market competition is likewise brought to light. Finally, the cases show concretely how transfer mechanisms operate and what roles transnational corporations play in moving technology from one society to another.[1]

Case 1: Water-Basin Development in Argentina

The Massachusetts Institute of Technology (MIT) has conducted a "technology transfer" to the Sub-Secretariat of Water Resources, an agency of the Argentine government, with a view to achieving three objectives:

- to construct a framework of comprehensive planning suitable for use in future water-basin development in Argentina and elsewhere
- to train a group of Argentine professionals in the theory and practice of multipurpose water-basin planning
- to prepare an integral development for the river Rio Colorado using these methods

The original two-year contract expired on 30 September 1972 but was renewed for two more years. There is no need here to relate contractual details or specifics of the MIT action plan.[2] What is important, however, is to review briefly the rationale for what MIT Professor David Major has termed "a successful transfer of systems technology from one country to another."[3]

One important element consisted of conducting "trial runs" of multi-objective or multifunctional water-resource planning. Investment *criteria* were drawn up *to optimize* a combination of objectives—net contribution to national and regional incomes and harmonization of social, environmental, defense, and economic goals—sought in the specific programs. MIT designed its approach to be even broader than so-called multipurpose planning in water-resource management, a term which evokes multiple benefits expected from such projects—irrigation, hydroelectric power, and water control. The multifaceted approach was thought vital to the Rio Colorado basin selected by Argentines in joint negotiations with MIT in part because the river flows through five provinces with different needs: Mendoza, Rio Negro, Neuquén, La Pampa, and Buenos Aires provinces. As Major explains:

> Each of the five riverine provinces has interests somewhat different from those of the others, and from those of the national government. Since some of the riverine provinces or some areas within them have few resources aside from the river; given the historic importance of irrigation to many areas in Argentina; and given the plans that the separate provinces have for development that would if all brought to fruition require water in excess of the capacity of the river, the decision problem is of great practical as well as theoretical interest.[4]

Needs of the sparsely populated provinces for water-control and irrigation projects conflicted with the preference of more populous ones for industrial electricity. Similarly, priority sites for certain irrigation installations implied depriving others of sufficient volumes of water for irrigation elsewhere in the river system. The MIT Argentine

team sought to join multiple optimality (the combination of economic, jurisdictional, political, and social benefits) to hydrologic feasibility. All officials interviewed, as well as written documents bearing on the project, emphasized the role of Argentine officials in the project's design. The training component of the project was meant to give Argentina a team of six young professionals committed to working for Argentina's water resources agency for three years after returning home from MIT. This team would, ideally, not only utilize the new methodology to make practical decisions about the Rio Colorado but would also adapt it to water-basin development throughout Argentina. My interviews unearthed no fundamental or basic disagreements among interested parties.[5] All agreed that the three objectives of the project had been met. Criticism, freely expressed, focused on procedural difficulties encountered in carrying out joint actions. Nevertheless, clear divergences existed among the parties in terms of the relative priorities they assigned to the three common goals. Moreover, in discussions with MIT project officials, questions of value conflict were not answered directly or convincingly.

Tensions and Procedural Defects

Initial expectations diverged. Because the river is not navigable, Argentina's national government has no jurisdiction over the Rio Colorado (except in the case of navigable waterways, Argentine law assigns jurisdiction to individual provinces). One government official explained that investment decisions for the Rio Colorado had been pending for more than twenty years; no effective solution to conflicting claims on investment, placement of dams, and arbitration among parties desiring irreconcilable water uses could be found. Another official, himself the son of a former governor of Mendoza Province, was eager to remove any hint of political favoritism from his proposed solution to the impasse. Thus he decided to call in a prestigious US university to achieve his aims, while declaring that the "technical advisability" of MIT's final recommendation would reduce the danger of adopting a purely "political" solution. For public-relations reasons the project was "sold" to the Commission of the Provinces as the way to solve the Rio Colorado's practical difficulties, although within national government agencies it was asserted that the main benefit from the contemplated "technology transfer" would be the training of a sophisticated Argentine team. A loan of $380,000 from the Inter-American Development Bank to the Argentine National Fund for Pre-Investment Studies provided funds for the initial phase of the contract with MIT. An important personal element intervened: the cabinet-level officer entrusted with the decision was himself a water expert and had worked at the United Nations with one of the MIT engineers. The original contract stipulated that the sum of $380,000 was to be paid to MIT for the first two years' work.

The hierarchy of relative priorities among the main actors in the project varied. For the Sub-Secretariat of Water Resources, the first priority was the training of an Argentine multidisciplinary team able to handle overall water-resource-planning issues; its second priority was the improvement of a methodology for engaging in such activities; and its third priority, obtaining practical investment recommendations for the Rio Colorado. MIT, however, had a different ranking of priorities: first came improvement of methodology; next, training an Argentine team; and a distant third, providing practical investment recommendations. For the governments of the five interested provinces, the order was: practical investment recommendations, training, and methodology. Most conflicts arose when one party judged the other to be ignoring, or giving insufficient attention to, its own first priority.

The general lesson is that although identical priority rankings are not essential to success, the degree of procedural friction is closely correlated to the degree of consonance in goal-priority rankings. This theory finds concrete expression in tensions between MIT and the water agency over the training and methodology goals. MIT attached great importance to perfecting its methodological instrument, mainly because it was vigorously seeking contracts in other countries. This led one senior Argentine official to complain that "MIT did not transfer the technology: it formed it and perfected it in Argentina, thanks to our laboratory." Given MIT's priority scale, Argentines felt at times that insufficient attention was being given to their training needs at several levels. Although several Argentines suggested that it would have been better to bring MIT trainers to teach the team locally, trainees themselves disagreed with this opinion. At the same time, however, Argentine students at MIT complained of not being treated as regular master's degree candidates and of not receiving training that was specifically related to their future needs. Worse still, seminars staged by MIT at Neuquén and other Argentine sites produced disappointing results because MIT cast its teaching in purely hypothetical terms (around a fictitious Rio Tinto case) and refused to answer questions posed by provincial personnel about the real Rio Colorado. More than twenty-five MIT personnel were shuttled to Argentina, many of them professors or graduate students floating within what one Argentine called a "cultural vacuum; they knew nothing of local history, culture, psychology, institutions, or constraints." Perhaps because of this failing, MIT "experts," in their training efforts, repeatedly shied away from addressing the difficult *political* elements which, by definition, should have been included in multidimensional planning of river systems, because it was precisely such political elements which had proved so difficult for Argentines to handle and had moved them to summon MIT for help. Other failings are traceable to changes in top personnel, both at MIT and at Argentine host institutions.

On balance, the agreement reached by the five provinces (in December 1974) to a "certain configuration" (that is, location and nature of dam sites) of the Rio Colorado investment scheme stands as an undeniable step forward. And upon their return, the trainees were well equipped to handle planning for Argentina's overall water problems. The real long-term difficulty, according to one trainee, is how to raise the general level of expertise of the 6,000 engineers in Argentina. A major obstacle is the lack of solid information. Consequently, the Institute of Applied Science and Hydraulic Technology, whose research program he now directs, plans to create an information bank on natural resources. He explains that the country holds one hundred years' worth of nonprocessed information and that it will take at least five years to process relevant data. The most vital lesson he learned, he adds, is this: Argentina's ability to negotiate sound technology transfer contracts is tightly conditioned by its capacity to analyze relevant data.

MIT's Methodological Claims

Discrepancies arise between claims made by MIT experts and their actual performance in this first test of their methodology. One major problem is the way in which noneconomic factors are handled by MIT in its plural-objective planning model, an issue important to all planners who seek to quantify planning-input factors. MIT's treatment of nontechnical input factors reveals much concerning "trade-offs" among competing objectives of a project. One senior Argentine official declared that "MIT dealt with noneconomic inputs successfully in a qualitative way but did not succeed in treating them successfully quantitatively speaking." That is, although MIT paid great attention to these factors, it proved unable to express them quantitatively or to incorporate them organically into its simulations. When queried on this point, the MIT team leader replied that his experts made no attempt to treat social, political, or value problems (as distinct from technical and economic problems) as *inputs* into simulation or model runs. Instead, MIT tried to measure (quantitatively—but by what criteria?) what impact on the political, social, or value universe different hypothetical *outputs* would have. He confessed ignorance as to whether they had succeeded in doing this. In my judgment, MIT failed at this level, in great measure, because its experts suffered from "cultural vacuity," particularly regarding political culture. Notwithstanding the expressed disappointment of top-level Argentines over MIT's failure to quantify noneconomic variables, the university's scholars insist that the difference between quantitative and qualitative measures is meaningless. In the words of one MIT expert, "Everything can be measured in some way, and everything is quantifiable—some things with greater, some with lesser, precision."

His reply raises the question whether any foreign technical team can deal seriously with values as *inputs* and not merely as hypothetically projected impingement effects or imagined *outputs.* Perhaps value-input can be managed only by an indigenous team enjoying a solid mandate from the local populace which is the intended beneficiary of the technology transfer in question. MIT engineers are predictably skeptical on this point. Nevertheless, it is plausible to think that the ability of technical experts properly to assess value elements in plural-objective planning depends closely upon their degree of dialogue (in reciprocity—hence the need for legitimacy or mandate) with genuine representatives of the local populace. Nothing conclusive can be deduced from the Rio Colorado case, but value conflicts between promises and performance suggest that the hypothesis just outlined merits serious testing by those who profess interest in multi-objective planning.

This view is confirmed obliquely by the opinions of MIT professors who reported on their preferred criteria for site selection for new contracts using the methodology perfected at Rio Colorado. They prefer to work in a country where they are certain to find a high degree of discipline, professionalism, order, and willingness to work. Thus they were enthusiastic about Korea, pessimistic over the Philippines. And why? Because, notwithstanding their declared willingness to work in nonoptimum conditions (in such places, they indicated, as Sahelian Africa) for purely "humanitarian" considerations, they preferred to work most of the time where "results" had an "optimum" chance of occurring. This means places where the "objective conditions" for the applicability of their methods are in place: a unified command in water-agency decision-making within an agency that knows exactly what it wants and is willing to let the foreign consultant firm act according to its technological and professional exigencies. A rather strange requirement for a unit that insists on the ability of its model to incorporate social, political, and psychological factors in its *multi-objective* model. And all of this notwithstanding MIT's claim to have an instrument of transferable technology suited to less-developed countries.

On balance, then, it is clear that one must introduce some qualifications to Professor Major's conclusion that "while it is too early to say definitely, it appears that the MIT-Argentina project may well constitute a successful transfer."[6] One Argentine consultant thinks that one "must wait five years in order to gauge the success of the MIT effort at technology transfer." Perhaps so, but we need not wait that long to discover wherein lie recurring sources of value conflict between providers and users of technology. This case study identifies several such sources, even though the transfer on which it has focused is generally lauded, albeit tentatively, as a "success story."

Case 2: Precision Instruments in Latin America

This case illustrates how one reputable company dedicated exclusively to the manufacture of precision instruments transfers technology to its affiliates and clients. The Foxboro Company employs some 8,000 persons and manufactures approximately 1,000 products. Roughly half of its annual sales of $140 million come from overseas business, with 20% of total sales in the Third World. Foxboro, which specializes in systems and product technologies, makes precision instruments used to measure temperature, pressure, and flows of all types in operations ranging from copper mining to oil refining and food processing. Most of its "technology transfers" take place directly from the central manufacturing plant in Massachusetts to factory and processing sites around the world. For Foxboro, the key to satisfied customers is providing reliable technical services through the ongoing exchange of instructional documents, access to training facilities, and rapid repair and maintenance.

Foxboro is a well-established, traditional, and low-key company whose top managers are mainly engineers by training and managers by experience. The firm takes special pride in its ability to design, manufacture, and service the most complete line of instruments and systems available to the process industries. Products range from simple temperature gauges to sophisticated analog and digital computer-control systems. The approach to technology transfer adopted by the company seems quite congenial to the requirements of Latin American, and other, less-developed countries.

Facts and interpretations presented here are based on numerous visits to the main plant and R&D installations, coupled with frequent interviews with engineers and other officers at the main plant and at Foxboro facilities in Brazil, Argentina, Chile, and Peru.[7] This case study reveals the criteria used by one particularly responsible "seller" of technology.

Foxboro has been forced at times into measures it did not greatly desire, such as buying a manufacturing plant in Argentina instead of Brazil, its first choice in South America (it already has a plant in Mexico) and a more logical site. But, in the words of one senior company official, "One must sometimes do that sort of thing, especially when competition forces you into action." "Competition" is provided by Honeywell, Taylor, Kent, Fisher/Parker, Bristol, Hartmann-Brown, and Siemens. The wholly-owned subsidiary is Foxboro's preferred mode of association, although company policy dictates hiring as many local people as possible. A country's growth potential in large process industries is the key criterion governing entry by Foxboro into a national market. Because the firm sells instruments to producers, and not final goods to customers, it must be constantly alert to any source of demand: large industries with needs

for many instruments, small industries requiring high degrees of precision, and state firms (particularly in mines, oil refineries, and steel mills) requiring specialized control systems. As with most firms with head offices located in the United States, Foxboro carries on the major part of its research and development activity at home, although laboratories are also located in England and Holland. Some pure research is carried out continuously on problems of fluid flows, but major effort centers on perfecting existing products and on anticipating the future needs of process industries. A particularly tight link exists between selling, R&D, and production engineering. Indeed my several visits to the main factory (and to one subsidiary) confirmed the image of the engineer as factory worker. Foxboro designs its own manufacturing equipment and builds most of it itself. It habitually has recourse to international bidding and often wins, even when it is not low bidder, because of its reputation for quality. It also advertises widely in professional journals and takes part in fairs and expositions. Most of its clients, however, are recruited as the result of direct visits by company officials. The firm spends relatively little for commercial advertising, preferring to let its "superior products and unmatchable servicing" do its advertising. In dealing with the Third World, the company declares itself interested above all in hardware.[8] To cite one spokesman, "We're not concerned with patents so much. We patent our instruments only so that no one else can reproduce them, not so that we can license them." Nevertheless, the firm does sell "application patents": these are *ad hoc* sales to customers who buy a patent for some particular application of a precision instrument. Unlike many other TNCs, the Foxboro Company displays no interest in diversification: "We are not interested in owning manufacturing plants of other things."

Through which mechanisms does the company transfer its technology? Except for one licensing contract in Japan, the usual way is the physical shipment to affiliates or clients of microfilm containing technical drawings. In turn, manufacturing subsidiaries in the Third World send reports and samples to the head office as part of an informal routine, not to meet the requirements of any written contract. One experienced engineer in the head office explained that there are two schools of thought within the company as to the merits of inspections for quality control. The first view holds that overseas manufacturers will obey precise quality specifications without any control from the head office; the second view contends that products must be constantly checked, sampled, and controlled. The same person adds that "performance history over the years shows that both systems have worked." Nevertheless, company policy insists on "the same standards of design and quality regardless of the manufacturing sources."[9] Notwithstanding concessions made to local requirements,

"the function, performance, and appearance of the product is not to deviate from the corporate design." So as to ensure conformity to corporate standards, "all designs shall be under the control of the Corporate Development and Engineering Department....[P]arts made by the various manufacturing facilities are to be interchangeable at a modular level to be determined by Corporate Development and Engineering, Corporate Marketing and the appropriate production plants."

Foxboro's Argentine subsidiary pays royalties to the head office on equipment designed by the latter. Yet the plant also uses equipment not designed by Foxboro; on such machinery, obviously, no royalty payments to the head office are made.

Many of the company's dealings in Latin America are not with subsidiaries but with sales and service representatives working on a commission basis. The political context of technology transfers carried out in this mode is illuminated by a brief look at decisions taken during the Allende years in Chile. Although Allende assumed presidential office late in 1970, the Foxboro Company had maintained an ongoing sales and service operation in Chile since 1968. By late 1972, however, the company became convinced that it would have a difficult time making profits in Chile. The office manager of the Santiago operation lamented: "All new projects were wiped out, we lost a big contract, and US banks withdrew credits for Chilean state-owned firms, which were some of our best customers."[10] Nevertheless, the company decided to keep the Santiago office open "in the hope of better days in the future." An indication of advantages accruing even to representatives paid on commission is gleaned from what then ensued. Foxboro offered this Chilean national the choice of a job with the company in Brazil, Argentina, Jamaica, Venezuela, or the United States. Largely for personal reasons, however, the person in question moved to Lima, Peru, where he reactivated a sales-and-service operation which had been defunct since 1967. In view of the Peruvian government's ambitious plans for nationalizing private enterprises and expanding further investments, prospects in Peru seemed encouraging. This spokesman preferred to deal with state-owned enterprises over private firms because the former have a clearer mandate to negotiate with outsiders and can pressure national banks and other government agencies to get the specifics of contracts "moving" (these "specifics" including import licenses, authorizations to transfer foreign currency, and registry of technological contracts).

He recalled a trip that he had once made to the state-owned copper mine in Chiquimata, Chile, for the purpose of convincing the nationalized mine that it should continue to purchase its control instruments from Foxboro. This engineer-manager employed interesting arguments. Under discussion was the cancellation of orders from Foxboro and a contemplated switch to Siemens, a German competi-

tor. The Foxboro representative argued that if it were true that the United States could control Chile through its transnational corporations, what was to stop Germany from doing likewise through its own companies? Moreover, how could Chileans working at nationalized mines be completely sure that ITT did not own stock in Siemens and would not welcome gaining, through that company, a different foothold in Chile once its telephone operations were expropriated? The implicit value revelation here made explicit by my interlocutor is that a country cannot counter dependency just by looking at appearances. To him, it made no difference if a regime was communist, socialist, or capitalist as long as his own, and his company's, liberty to operate were respected. The second ingredient of "harmonious technology transfer," he added, is the existence of unambiguous rules for bargaining and doing business. The precise formulations articulated here by one person reflect the general attitude of TNC personnel working in the Third World. Such people resent insinuations that they are tied to "capitalist" regimes: all they ask is "the freedom to do business according to clearly defined, and observed, rules."

A glimpse into Foxboro's flexibility in technology transfers is gained from a visit to a wholly-owned service-and-sales subsidiary in São Paulo, Brazil. The transfer process (from Foxboro/USA to clients who purchase instruments via the intermediary of Foxboro/Brazil) rests on a constant flow of documented instructions for assembling, operating, maintaining, and repairing precision instruments. Top-level engineers in most Brazilian process firms read English and therefore enjoy direct access to all the technology. For the benefit of technicians and skilled workers at the next lower level, however, Foxboro/Brazil conducts training sessions around four volumes of master instructions, updated constantly with new technical information and supplemented by glossaries of technical terms sent to engineers in relevant industries. Many instruction manuals have been translated into Portuguese. Moreover, the enlightened director of the Brazilian operation sought government approval for his training program as a credit-granting technological unit. He has also urged SENAI (National Industrial Apprenticeship Service) to send its pupils to his own course free of charge. Another modality of "technology transfer" said to benefit not only clients but also "the larger cause of Brazilian development" is the sponsorship by Foxboro of mobile courses, running from a few days to six weeks, for such entities as Petrobrás, the government petroleum monopoly. According to this Brazilian director, a manufacturing plant in Brazil had become (by early 1970) a necessity for Foxboro. The major contribution of a plant is not in manufacturing itself, he explained, but in improving the training of one's own manpower. To him technology transfer is "simply a question of economics. But it takes time and money to train manpower, and it can be done best in your own plant."

Because Foxboro depends on large process-industry investments, the size of its potential markets is severely limited. Its area manager for Latin America estimated in late 1973 that the Latin American market for precision instruments was approximately $35 million annually, of which Brazil would account for $15 million. At one time the company had captured 60% of the Chilean market of some $3 million annually and more than half of the Argentine market, then estimated at approximately $5 million per year. Therefore, in periods of stress or transition, what "carries" the company is often a contract with a single large state-owned enterprise, as was the case with YPF (Yacimientos Petrolíferos Fiscales) in Argentina and CODELCO (Corporación del Cobre) in Chile. One of the company's main selling points is that it provides something more than quality equipment or even servicing of that equipment. Especially in power industries (the firm has "instrumented" more than 500 power installations in the United States, Canada, South America, Europe, Asia, Africa, and Antarctica), Foxboro often assumes contractual responsibility for overall system performance. The company is especially proud of its power-oriented computer system, PEIR (Performance Evaluation and Information Reduction).

Even a summary profile of Foxboro's approach to technology transfer would be incomplete without mentioning the impact of even the slightest research improvements in its instruments. One highlight of my several visits to the home factory came when an engineer dismantled, in my presence, a liquid-pressure gauge. His gesture came in reply to my question, "What makes a technology competitive?" The technological "forward edge" in this instance consists of a metal diaphragm in the center of which a small quantity of liquid silicone has been inserted. The diaphragm and the entire gauge roll even under slight pressure changes. But although this silicone-filled diaphragm is the key to Foxboro's competitive position in this instrument, the firm has no patent on the diaphragm, for Foxboro's real lead is in a highly refined welding process which no competitor could duplicate in less than six months. And by that time Foxboro would already have made further incremental but significant gains in refining its welding process.

This example illustrates the "fluidity" of incremental technological improvements obtained from research. The lesson for Third World negotiators is that what Andean Pact specialists call "modular" technology is something dynamic, not static. Ultimately, only the ongoing capacity to register parallel incremental improvements can enable a "receiver" of technology to implement a policy of disaggregating technology packages into their component elements. This is probably the most significant conclusion to be gained from the Foxboro example which, to all appearances, is a reasonably successful technology transfer.

Case 3: Frozen Foods in Brazil

The present example illustrates the criteria of a well-known US consultant firm in diagnosing one specific set of technological problems at the request of the government of Brazil.[11]

In the case under review a final "operations" contract was never signed. Nevertheless, the preliminary study conducted by Arthur D. Little, Inc. (ADL), under contract to the Ministry of Planning of the Government of Brazil, is instructive on three counts:

(a) It brings to the surface the values of a prestigious international consulting firm.

(b) It explicates several assumptions as to development priorities held by the client, the Brazilian federal government.

(c) It raises broad questions as to the "appropriateness" of decisional technologies habitually favored by international consultant firms.

One reason for the Brazilian government's interest in the project was the desire of the Medici regime to publicize a large and sensational achievement before handing the presidency over to General Ernesto Geisel in early 1974.[12] Contract feelers were first tendered to Brazilian authorities in 1972 by ADL's Rio de Janeiro office. Food experts in the company's Cambridge, Massachusetts, office subsequently refined terms of the project. After the probable impact of a cold-chain food system upon broader socioeconomic activities was explained to them, Brazilian officials began to show interest in the study. These officials stated as their goals for the project: to promote export earnings, to engage in greater regional food distribution, to control inflation by gaining mastery over fluctuations in demand and supply of food, and to achieve greater income equalization (although they never explained how equalization could be achieved). The federal government also expressed an interest in building central installations where refrigerated and frozen foods could be stored, thereby reducing waste and controlling peaks of supply and demand.

The preliminary assessment made by ADL and published in the two-volume report cited in these pages required one month's work by a five-man team in Rio de Janeiro. The follow-up study recommended by ADL would have cost more than $700,000 and required fifteen months' additional work; it was never contracted.

As discussions began, both partners agreed that Brazilian consultants lacked the time, the experience in general-systems approaches, and the objectivity required to plan a comprehensive cold-chain system for the country and to assess its regional impact.

Inasmuch as the larger, second stage of the project was never implemented, I shall confine myself to analyzing elements of the preliminary study germane to the three points mentioned above. Afterwards I shall briefly assess ADL's operational style (transcend-

ing the scope of this single example) in conducting diagnostic activities which bear on technology transfers to the Third World.

ADL's preliminary report assessing Brazil's needs in a cold-chain food system was presented to the Ministry of Planning in August 1972. To date (June 1977) no decision has been taken in proceeding to the next step, a detailed feasibility study prior to implementation.

A cold-chain system (CCFS) is defined as

> that portion of the food-distribution process and infrastructure which reduces and maintains perishable commodities at lower than ambient temperatures from production up to and including storage with the final consumer. A CCFS can theoretically exist for each commodity, and an overall CCFS can theoretically exist for all perishable commodities.[13]

According to the ADL report, the rationale for arguing Brazil's need for a CCFS centers around the following general objectives:

(a) to reduce food loss through spoilage

(b) to encourage food production in areas where facilities to conserve food are presently lacking

(c) to provide greater flexibility in the distribution of perishable foods thanks to refrigeration and frozen-food transport capacity

(d) to create sound storage capacity necessary for storing surpluses so as to control fluctuations in demand and/or prices

(e) to enlarge opportunities for farm people to sell their products in distant markets

(f) to endow the country with the ability to compete in world exports

(g) to reduce public health hazards posed by spoiled or infested foodstuffs

(h) to improve nutrition in the national diet

The Brazilian government concurred in the view that these goals would bring clear benefits. ADL consultants adduced still further advantages to installing a nationwide cold-chain food system, claiming that developing a CCFS would:

(i) increase productivity in agriculture by increasing the demand for goods and services required for building and operating a cold-chain food system

(j) demonstrate to producers the value of improved technology and efficient management of resources

(k) reduce domestic demand for imported food products

(l) lead to long-term price reduction in some foods through more efficient handling

(m) stimulate wide distribution of income by bringing regions of Brazil now virtually outside the market economy directly into that economy

(These objectives are listed in the report under the rubric: "Cold

Chain Food System Would Contribute to Brazil's Development Program.")

Which value assumptions pertinent to development emerge from the report? The arguments used to convince the Brazilian government that it "needs" a CCFS illustrate the "vital nexus" among basic value options, preferred development strategies, and concrete policy (in this case, a policy for food conservation). One way to clarify value assumptions is to pose critical questions about declared goals. Another is to compare expressed objectives (either explicitly declared or revealed in interviews by negotiating parties) with detailed targets presented elsewhere in the report and cognate documents. A third is to evaluate a concrete case in the light of broader criteria, such as those proposed by Ivan Illich in his works on education and health.[14] Illich considers it counterdevelopmental to attempt to satisfy real human needs (like the need for education, health, or food) solely through the provision of specific packages of goods or services which are then symbolically presented to people as "the only way" or "the best way" to meet those needs. His rationale is that these proposed "packages" usually entail high social costs or exclude large numbers of "needy" people from effective access to the very goods which allegedly justify providing the packages in the first place. It is instructive to review briefly some implications of the CCFS project in this light.

No one can quarrel with the objective of reducing waste through spoilage or of introducing rationality in the processing, storage, and transport of foods of animal origin (meats, fish, eggs, milk products) and of perishable fruits and vegetables. Nor can one dispute the assertion that cold-food handling should be initiated at the source of food production or that

> the system should be integrated, with links between ice makers, shippers, truckers, other transporters having equipment for conservation of cold foods, cold storage facilities, processors, distributors and marketers of perishable products requiring cold storage and/or handling.[15]

But the vital question is: Who will benefit from all this infrastructure? We glimpse the answer when we are told by the consultants that "if the system is to be fully successful, single-family units should be equipped with refrigerators and freezers as well."[16] Whatever may be the subjective intentions of the consultants on this point, the design of a system whose full success presupposes the existence of family refrigerators and freezers automatically excludes from the pool of potential beneficiaries the poorest masses who suffer most from food spoilage but are unable to purchase refrigerators or freezers. How, then, can it plausibly be argued that the creation of an adequate cold-food chain will lead to the evening out of income distribution?[17] ADL officials queried on this point replied that the "evening out" of income they had in mind is geographical: agricultural regions would

gain a relatively higher share of national product than before. But they make no attempt to analyze income-distribution effects of the CCFS on segments of the population within agricultural areas. Moreover, it is not evident how the design system would allow Brazil's agricultural poor to improve their diet or gain access to better foods. On the contrary, one can reasonably fear that an increasing proportion of resources available for food-growing, processing, and distribution will be pre-empted by that "modern" sector of the economy—now expanded to include a CCFS—which already places many basic goods and services out of reach of all except the more privileged sectors of the population. A bias in favor of meeting the wants of those with present or future purchasing power is thus implicit in the very technological diagnosis made of the problem. Moreover, incentives to production are weighted in favor of "quality" producers, a euphemism for middle farmers and large agribusiness firms. Thus we read that deficient cold-storage capacity for meats causes farmers and ranchers to suffer, especially "ranchers who work to develop a high-quality hog"; they cannot sell their hogs for a premium "because the distribution system cannot carry the premium quality forward to the consumer with certainty, because of lack of an adequate cold-chain food system."[18]

The language employed in the ADL report illustrates a general principle discussed in a later chapter: namely, that modern technologies have an innate tendency to favor the rich to the detriment of those in greater need. The fault is not traceable to lack of vision or social responsibility in Arthur D. Little's professional staff; it is inherent in the very technologies consultant firms are best trained to manage and transfer. Only the recognition by "technology receivers" in developing countries of the existence of this systemic bias can even lead them to question the social impact of such proposals.

The CCFS under discussion also favors large-scale investment and leaves unexplored the issue of whether smaller, decentralized applications of capital might prove more congenial to the professional goals of the project. After surveying more than 1,000 beef-slaughtering houses, ADL consultants discovered that fewer than 10% of them possessed modern refrigeration facilities, a deficiency directly related to the scale of units. More than 56% of the units slaughtered less than ten head per day, and only 12% had the capacity to slaughter more than 100 animals per day. The food experts concluded:

> Such small businesses cannot readily afford the fixed investment necessary to provide adequate chilling or freezing facilities; in the absence of legal action by the governments, they would seldom consider such an investment.[19]

Once again the assumption is made that large-scale operations are to be preferred over smaller ones. If this is so, it then becomes plausible, perhaps even unavoidable, to channel infrastructure investments in

ways which favor large agribusiness units at the expense of small producers. Inasmuch as the Brazilian government likewise endorses this outlook, ADL judges that, contractually speaking, it is meeting its client's needs.[20] The relevant point is that the choice of diagnostic technology often prejudices outcomes. Throughout its report ADL places exclusive emphasis on high technology, as when we are told that a CCFS "will provide a strong impetus for high technology cattle production in areas more removed from consuming centers."[21]

In their efforts to "sell" the complete cold-chain food system to their client, the ADL consultants paid scant heed to the needs of poor rural masses. They apparently gave no thought to the possibility that partial cold-chain systems adapted to local crops and purchasing power might prove more appropriate. Moreover, the report emphasizes production for world markets, arguing that more meat must be produced in order to meet export demand. Brazil's dearth of international-quality export facilities for frozen foods is cited as proof that the country "needs" a CCFS; nevertheless, elsewhere in the report it is acknowledged that equipment in cold-chain units is "difficult to maintain" when it is of foreign manufacture.[22] The consultants also flatly declare that more meat should be consumed by Brazilians,[23] offering no analysis of relative tradeoffs between acreage planted with grain to be used for animal feed and acreage devoted to crops allowing human consumption of protein lower on the food chain. Still another important value is implicitly endorsed in the statement that the frozen- and refrigerated-food infrastructure is a "subsystem of the larger agribusiness (or agri-industrial) system."[24] The appropriateness of a CCFS is thus justified by virtue of its compatibility as part and parcel of a larger system: it "interfaces with the international market, and with the durable and non-durable service sectors of the general economy."[25]

Notwithstanding the claim, noted earlier, that a CCFS would reduce Brazil's need to import food, the report takes it for granted that "imported refrigerated and frozen foods leave the CCFS from many points in the system."[26] Nowhere is the report more questionable, however, than in its claim that the CCFS will contribute to income equalization, judged desirable because "inflation has a more severe effect on lower income groups."[27] One cannot but be skeptical of this assertion in a document totally oriented toward high purchasing power—as when the client is told that it must prepare for expected demand for "TV dinners or other *important* frozen food items."[28]

What emerges clearly is the conclusion that even responsible consultant firms such as Arthur D. Little—whose top leadership has a genuine social conscience at the international level and whose self-image is that of an enlightened, tolerant company where bright people have great freedom to be creative[29]—do not carefully scrutinize the larger value implications of international consulting. Although they

locate consulting at the "cutting edge" of developmental activities, in practice, according to one ADL official, their predisposition is simply "to see if we can do a job for clients who have money to pay."

Many sensitive consultants are aware of discrepancies between the moralistic rhetoric of "helping" underdeveloped countries achieve their genuine goals and the commercial reductionism of their dealings with government agencies or private business in these countries. But such value tensions as those brought to light in this cold-chain case seem to be a natural outgrowth of the manner in which consultants compete to transfer their diagnostic and prescriptive technologies to the Third World.

Notwithstanding these discrepancies, which ADL openly acknowledges, the firm remains optimistic about the future evolution of relations between consultant firms and less-developed countries. Company leaders favor regulation—largely self-imposed—of transnational corporations to make them more responsive to legitimate social pressures. And ADL is confident in its ability to stay in the forefront and avoid what it calls "pedestrian" technology contracts. One basis for its optimism is the firm's strength in "management technology," the application of which opens "tremendous opportunities in many countries." The real problem here, the company explains, is to shorten the time gap between the discovery of a new technology and its application. So as to reduce this gap, ADL devotes much energy to the marketing of technology. In the race to market, however, consultants testify that they cannot indulge in the luxury of questioning the values of their clients beyond the point of assuring themselves of two conditions: that the work requested serves honest ends and that professionals can engage in it without betraying their code of professional integrity.

This case study of the cold-chain food system suggests, however, that vital systemic value conflicts can easily be overlooked if these two principles are applied in isolation from wider norms of social responsibility. (To restate an earlier point, there are many important social "externalities" that are never "internalized" in the process of transferring technology.) ADL is keenly aware of this danger when it evaluates the behavior of individual enterpreneurs in a client country. While reviewing trends in private enterprise within Brazil, for example, ADL experts detected much dynamism, as many firms were building new cold-chain food units. But although these innovators are to be commended, the ADL report adds, "their prime interest is the financial future of their enterprises; they have limited reason for concern about the technological coherence of the system as a whole."[30] One must turn ADL's evaluation back on ADL itself and ask: Why are you unconcerned with the coherence of Brazil's developmental system as a whole?

My argument, in short, is that even such a laudable goal as "tech-

nological coherence" of the system is too narrow a framework within which to transfer decisional technology. The vital nexus requires that technological coherence be linked to development strategy and the basic value options of the society in question. The cold-chain study suggests how difficult is this task.

Case 4: Tourism, Technology, and Values

Unlike those preceding it, the present case study bears on the impact of technology not in a specific project but in one *sector* of activity. The following pages highlight value dilemmas posed by technology transfers in the tourist industry.

A wide array of technologies is used by promoters of international tourist activities.[31] These include transport technologies, public-relations techniques, image technologies (films on tourist sites; special cable, radio, and mail installations; etcetera), construction technologies (for hotels, restaurants, amusement centers, holiday villages, resort installations of all sorts, recreational infrastructure), management technologies, financing technologies, and recreational technologies (for special facilities like marinas, golf courses, swimming pools and for special functions such as organized visits to archeological sites). Food and cold-chain technologies also figure prominently as adapted to supplying tourists with "international quality" food and refrigeration.

No single technology, however, is so important to tourism as the intangible skills of fantasy creation, a specialization which the French cultural historian André Malraux claims characterizes Western modern civilizations.[32] The public in rich countries is massaged, with the help of multiple technologies, with images designed to induce it to spend money on tourism, preferably in poorer countries. Happiness is surf, sex, and sand. Alternative fantasy-creation takes the form of reducing culture, history, religion, and archeology to bring consumer *objects* rather than internalized *subjective* enrichments. Through the bias of image manipulation, promoters of tourism give a content to the "notion of desirable development" for the populace in host countries. Tourism, more than others, is one investment sector wherein value considerations cannot remain externalized with impunity; they must be internalized. The problem has often been ignored, even by "experts." To illustrate, World Bank specialists, in a 1972 document, defend their policy of employing

> the same criteria in evaluating a tourism project as in evaluating a project in, for example, agriculture, mining or manufacturing. A tourism project is considered appropriate for Bank financing when the economic rate of return is at least equal to the opportunity cost of capital in the country in which the project is located.[33]

This purely economic approach does not lead to the choice of a tourism policy supporting sound development, a fact acknowl-

edged by recent World Bank documents. The report of the Inter-American Development Bank, on the other hand, is sensitive to these problems. We are told therein that tourism brings its own evils and that three special problems concern tourism in South America:

(1) In small island economies in the Caribbean, the net social benefits of present patterns of tourist developments are exceedingly small.

(2) Disruption by large-scale tourism of the economic functions and structures of smaller-scale economies is substantial.

(3) Generally tourism is more capital-intensive and more generative of import demand than has been thought the case in the past.[34]

That all is not well even when tourism is "successful" is also suggested by a study, published by the Organisation for Economic Co-operation and Development, in which governments are urged to diversify the economy of rural areas by promoting "rural tourism"; to imbue tourism policies with a "social content" (protecting consumers, increasing the accessibility of wider sectors of a population to recreational facilities, and conserving natural and cultural beauty); and to grant the public a role in planning tourism so as to protect its interests.[35] No industry caters so blatantly to the wealthy and middle classes as does tourism. Worse still, it strives mightily to induce more modest spenders to convince themselves that they too can afford "luxury" vacations. Most promotional and analytical literature stresses large-scale, mass tourism with little regard for equitable access or larger issues of social justice.[36]

What, then, are the arguments for a country's investment in tourism? First and foremost is the proposition, expounded by lending agencies and consultant firms even in poor countries, that tourism is a beneficial source of foreign currency. Superficially, this may be true, but such income is subject to immediate drainoff through numerous leakages. Among leakages identified in the Inter-American Development Bank study are expenditures for imported goods and services consumed by foreign tourists (most tourist promotion creates or reinforces the "needs" of foreign tourists for imported goods), payments of interest and amortization of foreign capital, payments to expatriate workers, costs for training abroad, and imports of capital goods for the tourism sector.[37] A more intangible cost is the pressure placed on poor local populations to imitate the consumer behavior of tourists, thereby generating new levels of local demand for imported goods. For these reasons, the *net* foreign earnings from international tourism are sometimes less than 45% of *gross* foreign-exchange earnings.[38]

The second argument invoked to justify tourist investment in poor countries is that it creates jobs. But, if we are to believe the World Bank report,

> even for many developing countries where tourism has become a leading foreign exchange earner, the sector's output constitutes a

> relatively small portion of the GNP and employs directly only a small part of the labor force. It is often claimed that tourism is relatively labor-intensive but the available evidence is not conclusive on this point.[39]

Moreover, there is something particularly shocking about luxurious installations in locales of mass misery. Recognition of this scandal has led many governments to seek ways of "integrating" social remedial investments with their "development" of tourist resorts. One proposal describes the imbalance between luxury tourism and generalized squalor in these terms:

> The development of Acapulco as a tourist center and as an urban and regional community has not been balanced. It is estimated that of 175,000 inhabitants of the port, 105,000 live in low-income neighborhoods which are largely without adequate public and municipal services. The contrast between the low-income sections and the milieu in which tourist activities take place has become more striking in recent years, primarily as a result of the rise in the economic status of tourists and of migration to the city from surrounding rural areas. The rapid expansion of the tourism sector and the growth of the low-income population threaten to create a situation of conflict.
>
> The coexistence of tourist zones with depressed areas of the city and the region could give rise to social frictions and even to curtailment of the inflow of tourists, with effects on the regional and national economy.[40]

There is no need here to detail the complex maneuvers which ensued; briefly, the Mexican government agency in question negotiated several alternative contract modalities with US consultants, at first with proposed World Bank financing, later without it. The point is that Mexico's government chose to ignore structural imbalances resulting from a defective tourist policy and to deal merely with symptoms. Tourism revenue in Acapulco had dropped rapidly because the bay was being polluted by open sewage systems. But for political reasons this was not acknowledged publicly because Miguel Alemán, a former president of Mexico and now "tsar" of tourism in his country, owned extensive tourist properties in Acapulco.

This type of conflict between developmental values and tourist technology—at planning and managerial levels—has led some tourist professionals to plead for a "new tourism" designed to promote the development of the populace at tourist sites. This interesting movement has made some inroads in the Caribbean area. Its principal theorist is Herbert Hiller, whose objective is "to resolve the contradictions between tourism and development,...to ask in what way tourism can be supportive of development."[41] Although tourism investment in poor countries is presented as an aid to development, an initial contradiction is apparent in the fact that tourism promotes the

values and technologies of only the industrial rich world and its leisure classes. For Hiller a second value conflict lies in the inability of the general populace at tourist sites to control the tourism flow; for, after all, "progress" now depends on the affluence and leisure of tourists from other lands. A third difficulty arises from the apparatus mounted by the tourism industry in order to "industrialize" the leisure of tourists in marketable ways.

In positive terms, Hiller urges placing the development of the people of host tourist sites at the heart of the tourist equation. How can the people's objectives be met? he asks. By what kind of tourism on what scale, in what patterns? Priority must go to these objectives: optimizing local self-sufficiency, utilizing trade (including tourism) to increase domestic benefits from local resources, and defending local culture as a valid expression of adaptation to natural resources and constraints. In his words,

> The objectives of development will include establishment of institutions and symbols of cultural adaptation to the resource environment, the integrity of local communities, the investment of our lives in purposes locally sanctioned.

Ultimately,

> The success of tourism will be measured by how well these and related objectives are supported through the energies of the local community in organizing for the presence of visitors.

Hiller's specific proposals include: people-to-people programs; the creation of local and national tourism cooperatives; the maximum use of local products in accord with local tastes; the encouragement of locally scaled businesses through direct contact between craftsmen and visitors; the fostering of tourism in rural areas; the provision of tourism-related training programs at community and national levels; measures to exclude tourism from communities not wanting it; the preservation and improvement of historical sites; and the dispersal of visitor activities throughout broad reaches of the community.

"New tourism" calls for marketing strategies which focus on the quality, not merely the quantity, of visitors. To increase the real income of host *populations* (not simply to fill the coffers of host *governments*) becomes a major objective. Hiller encourages hospitality toward certain categories of visitors who would contribute to understanding between their cultures and that of host countries: students, minority groups, emigrants from the host country, persons with occupational or hobby linkages to the receptor countries, and educators. Much of Hiller's work aims at changing images among travel-marketing professionals of "what tourists want" and at supporting efforts by tourist-dependent societies, particularly in the Caribbean, to institute new tourism policies which serve local interests.[42] An eloquent statement of these aspirations comes from the

former premier of the unspoiled Caribbean island of St. Vincent, James F. Mitchell, who wrote in 1973:

> As Premier of my state, you will pardon me, I hope, if I appear not too anxious to grab the easiest dollar. The tourist dollar alone, unrestricted, is not worth the devastation of my people. A country where the people have lost their soul is no longer a country—and not worth visiting.[43]

Nowhere is the "inappropriateness" of mass-scale market technologies more apparent than in tourism. This is why Hiller wants to replace the "high-technology hotel" with other forms of construction and services which support the development of poor lands heavily dependent upon tourism. Little evidence exists, however, either in official publications or in the reports of private consultant firms, that tourist technologies and marketing procedures are being subordinated to the properly *developmental* needs of host countries or even of industrialized nations with "export" tourists. In the hope of introducing correctives to bankrupt philosophies of tourism, the "new tourism" school analyzes the benefits accruing to tourists themselves when they have a more genuine, development-fostering experience with the people whose lands they visit. "New tourism" obviously emphasizes the values of local cultures—viewed not statically but in a self-defined developmental dynamism. Yet the true leisure needs of tourists themselves are seen to depend on respect for the hosts. This emphasis stands in marked contrast to the position of "leisure scientists" like Max Kaplan and their patrons, who concentrate on experimenting with "leisure communities" for the rich in the hope of finding new paradigms of a "humanizing utilization" of leisure time.[44] As Veblen, Pieper, de Grazia and Huizinga long ago pointed out, leisure has been the privilege of the rich.[45] Nevertheless, their consumption and symbolic patterns largely set the style for less opulent classes. Mass tourism, thanks to the technology it employs and the values it channels, is rapidly making all forms other than mass-consumer models of development nonviable in countless small and vulnerable societies. In fact, as presently conducted and financed by most international development agencies, tourism actually institutionalizes several *counter*developmental trends, among them:

- excessive dependence on outside capital
- a division of labor which casts nationals in menial jobs and foreigners in loftier management positions
- an excessive reliance on imported "international quality" goods and services
- the pre-empting of attractive natural resources for aliens, to the frequent exclusion of nationals
- the over-commitment of limited host government funds to providing tourism infrastructure, at the expense of vital services to the needy local population

- legislation favoring foreign ownership of tourist facilities
- the trivialization of cultures and peoples by tourist "images" which, as manipulated by promotional technologies, emphasize superficial delights in ways damaging to local identity and dignity[46]

Increasingly, however, host governments are beginning to alert themselves to the excessive value sacrifices they are making when they accept technology transfers on the terms of the international tourist merchandisers. And some of them are taking steps to devise alternatives. More and more people in the Third World are coming to recognize tourism as "poison in a luxury package."[47] The chief merit of the "new tourism" briefly profiled in these pages resides in its practical efforts to show that tourism need not be thus. The choice for poor countries endowed with tourist attractions is not: Either repudiate tourism or sell out your culture. Instead the lesson is: Promote a new form of tourism which is both locally developmental and humanly enriching for outside tourists.

Miscellaneous Short Cases

Widely differing circumstances, preferred operating styles of individual companies, and technical constraints within each branch or sector of industry all condition modes of technology transfer. In addition, varying degrees of stability in technologies themselves also constitute a major variable in transfers. Although exact coefficients of stability cannot be assigned to specific technologies, practitioners agree that some technologies are relatively stable, others highly volatile. The importance of varying stability in technologies is illustrated in the next two case studies.

Among firms visited by the author, ASTARSA (Astilleros Argentinos Rio de la Plata, S.A.), an Argentine shipbuilder, stands at one end of the scale—that of stable technology—whereas the Cabot Corporation, a US manufacturer of carbon black, deals in unstable technology.

A. Stable Technology: Dredges

ASTARSA, the largest private shipbuilder in Argentina, has, since its inception in 1927, built more than 130 ships, ranging from tankers to auto/passenger ferries and specialized cattle-carriers.[48] Other fabrication lines include pressure vessels for metallurgical industries, heavy machinery of all types, locomotives, earth-moving equipment, and army tanks. The company designs most of its own tooling machinery and remains technologically competitive thanks to a policy of diversified licensing with foreign firms.[49] Most ASTARSA licensing agreements cover just a few years, because the firm's own engineers, technicians, and skilled workers are not experienced enough to benefit fully from their training visits to the plants of their licensing partners.

Consequently, ASTARSA rarely needs to renew licenses once these expire. At present this firm, which employs some 1,500 people, holds licenses with General Motors, Caterpillar, Ellicott Machine Corporation, and M.W. Kellogg in the United States; Usines Schneider, Alsthom, Matériel de Traction Electrique, and Société Alsacienne de Constructions Mécaniques in France; Vickers and John Thompson in England; and Werkspoor in Holland.

Though it is primarily a shipbuilder, ASTARSA has diversified into earth-moving equipment, railroads, petrochemicals, military equipment, and metallurgy in order to offset oscillations in demand for naval construction which could lead to seasonal unemployment. The firm has a well-trained corps of workers and does not wish to see them unemployed during portions of the year. Its technicians have already assimilated most imported technology and are now able to comply with fabrication standards set in codes of the American Society for Mechanical Engineers, British Steel Standard, American Petroleum Institute, Interstate Commerce Commission, and Tubular Exchangers Manufacturers Association.

One of ASTARSA's licensors, the Ellicott Machine Corporation located in Baltimore, specializes in a form of technology which is highly stable, namely, the manufacture of dredges and dredging materials.[50] The selection, design, building, and maintenance of dredges is a highly specialized business requiring wide engineering experience and constantly varying applications in field work, design, production, and servicing. Each dredge must, in a sense, be "tailor-made." Ellicott, a traditional firm created in 1885, has representatives and licensees in seventeen Latin American countries. Its arrangements with ASTARSA incorporate several interesting features.

As background, it should be noted that although Ellicott favors licensing in general, it faces restrictive legislation in Argentina requiring that national products be used when available. Therefore, the company cannot sell its dredges ready-made. Even licensing poses problems because of high duty (100%) and the legal prohibition to import certain dredge parts (e.g., complete engines) normally purchased by Ellicott from General Motors and Caterpillar. Thus constrained, Ellicott in 1964 signed a licensing contract with ASTARSA (for five years and extendible thereafter) to build dredges. ASTARSA needed a license because, notwithstanding its capacity to build hulls and power systems, the company lacks the technology to build satisfactory winches, pumps, cutter assemblies, dustpan heads, and engines. The government prohibition on importing engines fabricated by General Motors and Caterpillar is neutralized by ASTARSA's commitment to the Argentine government that the relevant equipment will be taken out of the country once the dredging job is finished. (It is current practice in large jobs to shift dredges to other sites.) Interesting procedures are observed in bidding for jobs in Argentina: Local

licensees are the prime bidders on government jobs, while outside licensors may contract with licensees to supply specifications and know-how, as well as a set of modules and winches.

Of interest to the present study is the relative ease and speed with which ASTARSA acquired a high degree of technological autonomy. The chief reason is that practically all the technology used is stable, that is, it changes slowly. Shipbuilding employs mainly product technologies embodied in tools and machinery, not in fluid processes. Safety and precision are the key variables, not packaging, consumer attractiveness, or ease of transportation. All these factors make for relative stability. And because all ASTARSA licenses include full visitation privileges to host plants, local capacity to improve upon licensed machinery and finished parts has developed rapidly. ASTARSA now builds all its ships with its own technology, with the sole exception of the know-how, covered by the Ellicott license, for the construction of special dredges. The Argentine shipbuilder's reasons for importing technology are reducible to two: (1) ASTARSA lacks the market volume to warrant developing its own technology (sales volume is especially vital in the production of capital goods), and (2) each of its ships must be especially designed and custom-made. Because specialized dredge technology had to be of the highest quality, recourse was had to Ellicott.

As a matter of general policy, ASTARSA's managers believe that, in cases of joint-equity participation, initial technology provided by foreign partners should be viewed as part of the investment. Consequently, payments should be made only for subsequent improvements. In the case of improvements made by local licensees, compensation should be made to them in the form of royalty payments by the original supplier of the technology. They also judge royalty payments, in general, to serve as counterincentives to inventive adaptations. This conviction explains why, in certain cases, ASTARSA has declined to renew a license; the company would rather stimulate its own personnel to find equivalent technological solutions. Overall, both ASTARSA and Ellicott expressed their satisfaction with the technology-transfer contract just outlined. The general lesson to be drawn is that such compatibility is quite easy to assure when the technologies concerned are relatively stable.

To round out the picture, it should be added that Ellicott conducts about 50% of its total business in underdeveloped countries. The company sells freely in Brazil, where no restrictive duty is in force and where import licenses are easily obtained. Although Brazilian legislation is similar to that in force in Argentina, the interpretation given by officials in Brazil is much looser. Ellicott also does a considerable business in Venezuela and Colombia but very little in other Andean Pact countries—Chile, Peru, Ecuador, and Bolivia. (One company official, while discussing the criteria adopted by the

firm in its technology-transfer policy, explained that Ellicott has built nothing under license in Colombia because the skill level in that country is not yet sufficient for building dredges.) Generally speaking, however, dredging markets are growing rapidly in many parts of the Third World, especially in Latin America, where large projects are in progress in mining, dam construction, port modernization, river-navigation development, beach-resort improvements, and construction of new airports. The technological edge enjoyed by Ellicott resides largely in the quality of its dredge modules and the supporting electronic equipment used to control operations at each step of dredging. The company has pioneered a production meter which offers many benefits not previously available to the industry, such as direct readings of velocity and specific gravity of materials being pumped, instantaneous production in tons per hour, and total tonnage of material pumped. Ellicott has also introduced a new containerized portable dredge which greatly reduces transportation costs and mobilization-demobilization time. At its R&D site in Baltimore, Ellicott has facilities for simulating almost any conceivable problem environment. Notwithstanding the basic strength of its dredging operations, however, the company, like many others operating in stable technological sectors, has diversified. It presently has holdings in couplers for railroad cars and wheels for trucks and trailers, power-control equipment for nuclear generating plants and other facilities, and equipment for tension-stringing and construction.

The ASTARSA/Ellicott licensing agreement illustrates conditions under which successful technology transfers may take place.

B. Unstable Technology: Carbon Black

Founded in 1882, the Cabot Corporation had become by 1947 the largest producer of carbon black in the United States and by 1950 the largest in the world.[51] Like most large transnational firms, it has diversified and now derives its income from three main sources: performance chemicals (including carbon black), energy, and engineered products. These pages concentrate exclusively on carbon-black operations, wherein technology is subject to frequent and rapid changes. Of particular interest is the insistence of company officials on the dominant role played by technological leadership in maintaining a competitive edge.

Carbon black is obtained from a heavy, aromatic, residual fuel oil, with natural gas serving as a secondary source (or, as it is termed in the industry, "feedstock"). More than 90% of carbon black used goes to rubber applications. A tire for a passenger car contains six to seven pounds of black; an average truck tire, twenty pounds. Other uses include pigment in inks, paints, plastics, and paper. In addition to six manufacturing plants in the United States, Cabot has production units in Argentina, Colombia, England, Canada, France, Ger-

many, Italy, and Spain. Company output of carbon black accounts for almost 25% of total world production, excluding socialist countries.

Technology faces several challenges in the carbon-black industry; one is to produce new, quality carbon black from what is called the "furnace" process, which allows manufacturers to phase out the "channel" process that is now becoming obsolete thanks to rising prices of natural gas. What appear to be minor technological improvements often lead to new products, specifically, varieties of carbon black with novel or improved applications. Cost competition is a third domain in which technological breakthroughs produce tangible competitive gains. Process technology (used to prepare the black) merges with product technology (the resultant black has different properties for reinforcing rubber or serving adhesive functions in nonrubber mixes). Cabot's research concentrates on extracting larger quantities of black per ton of feedstock, on finding additional uses for nonconventional feedstocks, and on synthesizing black from nontraditional processes. Pertinent to this study is the effect such volatile technology has on the mode of transfer operations to less-developed countries.

Company officials interviewed endorsed, unanimously, the view that wholly-owned subsidiaries are the preferred channel of technology transfer. Under this arrangement, "technology transfer becomes almost automatic, and questions of licenses and royalties become purely academic." Government pressure in several countries, however, has led to accommodations. Cabot, accordingly, now accepts joint ventures, holding 50% equity in Malaysia and Iran, 49% in Australia, 40% in The Netherlands, and 10% in Japan. Its Argentine and Colombian plants are wholly-owned, and the company contemplates building a new facility in São Paulo, Brazil. Cabot fears, however, that legislation imposing remittance ceilings in these countries will "eventually cramp the company's style." The new Brazilian venture will include less than a 50% equity for Cabot; the company insisted on this clause "in order to be able to charge a technical service fee to the Brazilian affiliate."

When asked their opinion regarding the aspiration of many Latin American countries to acquire their own research and development capacity, officials replied that it does not make economic sense for subsidiaries, or for poor countries, to build their own R&D installations; these are too expensive and scale does not justify investment. More importantly, Cabot wishes to maintain control over its own R&D. Having one's own laboratories allows one to plan ahead, to be the first to reap the benefits of technological breakthroughs (crucial in a "volatile technology" industry such as carbon black), and to assure access to technological innovation. In the absence of one's own R&D, competitors might choose not to sell the company and the new technology. Concessions had to be made in negotiations with Japan

because of that country's huge market. Cabot licenses its technology there in two separate contracts: one for existing know-how, another for future know-how. Because carbon black is a "high specialty" product, it is subject to constant shifts in product quality. *But the key to quality is technology,* and therefore, control over technological change is the key to market advantage.

Cabot officials declared that there are three channels whereby less-developed countries may improve their basic bargaining position in technology:

- more demanding negotiation (as in Japan's case)
- tougher commercial terms for raw materials (in imitation of the OPEC countries)
- probes into new areas of technology development (for example, solar energy)

They claim that many undiscovered technological "points of leverage" exist which poorer countries could readily exploit. Although the company refuses to grant licenses to Eastern European countries because they insist on the right to sell in Western European markets, Cabot remains confident in its ability to adjust to changing demands from all types of governments. And notwithstanding its desire to retain technological control, it praises efforts by Brazil's National Institute for Industrial Property (INPI) to set up a computer data bank on technology.[52]

The Cabot Corporation exemplifies the competitive, albeit urbane, sophisticated, and "socially responsible," international company. Opinions of its officers here recorded, although personal and not necessarily reflective of company policy, are nonetheless confirmed by my observation of company practice. They suggest some correlation between the degree of stability in a technology and the ease with which licensing arrangements can be reached with host countries. They also imply that new ground rules for negotiation are possible whenever weaker partners utilize cost gains realized by scale production to invest in new technologies. Although volatile or unstable technologies may be more highly competitive than stable ones, minor gains realized therein can be more quickly capitalized in a broader market. This explains why the company searches for greater flexibility in exploiting such gains. To facilitate the task, the company grants its two R&D laboratories, located in the United States and Great Britain, relative freedom to concentrate on problem-solving of their own choosing.

We are left with no doubt as to the intimate link between R&D and marketing strategy. And control over technological change is more vital, in the long run, than short-term profits generated by diffused technological licensing.

C. Building Up R&D Capacity: The Case of USM

Third World governments seek not only to control technology transfers from the rich world but also to identify how competitive research facilities are set up. One US corporation, USM,[53] illustrates how a large R&D installation can be created thanks to the convergence of several factors: the vision and perseverance of company officials, unusual circumstances (in this case created by World War II), and a period of "learning by doing," which holds interesting lessons as to the alleged difficulty of new technology.

Long before R&D became a corporate byword, USM had achieved leadership in private industrial research.[54] One farsighted official in the company had built up, by the late 1930s, a team of 400 people engaged in research related to the company's sole product line, shoe machinery. This official, nevertheless, was convinced that a one-product company could not long survive, and he began preparing for future diversification.

When World War II erupted, United Shoe Machinery's research director, so as to avoid losing those he called "his bright young men" to the military draft, turned over to the US government his entire research installations and team. The armed services, along with other government agencies, accepted the offer. The research team, then numbering 500 people, later peaked at 720. Working under contract, the team studied everything from gun mounts for B-29s to anti-aircraft computers, solid-fuel rockets, control systems for torpedoes, gyroscopes, and wind tunnels. In the words of one engineer: "Our ignorance proved to be a great asset. We were forced to take apart computers and other pieces of equipment which we knew nothing about; to learn what made them tick; reconstruct them; and design improvements to solve the problems laid at our doorstep. Our team of eager-beaver kids started from scratch, played around with complex problems like light spectrums and radiation. Although this kind of research was over their heads, they quickly learned that solid basic research conducted by the Massachusetts Institute of Technology would help them. They learned when they had to."

The speed with which this team mastered intricate technologies outside its specialized fields under the pressure of direct problem-solving in a climate of incentives based on "helping the nation" is noteworthy. No less instructive is the decision taken by the R&D unit, after the war, to refuse further government contracts and concentrate on special problems faced by the parent corporation. USM researchers noted that they had not done any work for several years on their own industry, shoe machinery. On the other hand—and despite this lapse in development—the company's retention of a virtual monopoly in leasing shoe-manufacturing equipment made it increasingly vulnerable to a protraction of its long history of being "taken to court" on

antitrust suits. The priority task was obvious: to diversify the company. By 1955 top managers had become sympathetic to this idea because they had had to sell off much of their centralized operation. And so, as part of its diversification strategy, necessary in order to survive and remain profitable, management decentralized control and acquisition in accord with technological R&D breakthrough capacity.

The process, although finally successful, proved difficult: even after research operations were organizationally separated from development, it took years to move away from prototype development to general-market production. The "long and difficult road" to viability included a decision, reached after much debate, to decentralize corporate research itself and to create separate laboratories for each of the company's major product divisions: machinery, adhesives, and fasteners.[55] Yet, today, a single senior research officer coordinates all efforts, "cross-fertilizes" the laboratories, and links separate group priorities to overall corporate decision-makers. The firm's 1973 annual report speaks of

> a degree of synergy in the group's operations wherein a machine may be developed in one location, the technology shared with the rest of the organization, manufacturing takes place wherever optimum quantities can be produced most efficiently, and the end product marketed wherever in the world the demand and the opportunity exist.[56]

The company sees the "emergence of Latin America as an economic entity" and the "stirring of China and the opening of its economic borders" as promising signs that its decentralized R&D policy, allied to a "global approach" of coordinated marketing, will be amply vindicated.

Company officers leave no doubt that technology is the source of their competitive edge. The greatest edge belongs to multitechnology companies able to eliminate obsolete technology lines and create new ones quickly. In their view, used technologies are highly appropriate in many less-developed countries, but their introduction is resisted by politicians for extrinsic reasons. Technology exchange with competitors and clients is like a chess game: "One must be in touch with opponents, but not too closely. 'Keep them guessing' is the watchword." Their advice to policy-makers in less-developed countries reads: "There is no way of stopping technology transfer. Perhaps you can control these transfers. But if you cannot, don't try to stop them. Instead, concentrate your efforts on finding ways of benefiting from them."

USM experience is interesting on three counts:

- It illustrates the multidimensional potentialities of having a basic research infrastructure, particularly its capacity to acquire mastery of unknown problem areas by trial and error.

- It points to the value, within the firm, of the "Sabato triangle" strategy—linking policy-makers dynamically with producers and researchers.
- It confirms the dominant role played by shifting technologies in the marketing strategies of a large, transnational corporation.

The company is more articulate than most as to its own role in a transnational world economy. We are told that productivity improvement is the major instrument for achieving economic growth, in these words:

> USM is convinced that productivity is the path by which the U.S. can best make itself competitive with low-labor-cost countries. . . . Better productivity creates more jobs through real economic expansion, holds down inflation and enables high-labor-cost countries to compete with low-labor-cost nations.[57]

D. "Appropriate" Technology for Poor Peasants

In the Alto Valle (Upper Valley) region of central Bolivia, several Quechua peasant communities are experimenting with new modes of economic activity. Small villages clustered around Tiataco and Huayculi have adopted forms of producer cooperatives which depart in several important respects from conventional models.[58] Their approach to technology illustrates several important values germane to this study.

The economy of this dry plateau, located in the province of Cochabamba and the site of much armed violence in the Bolivian land reform of 1952, is based largely on subsistence agriculture around a protein-rich native crop known as *quinoa*. A few years ago, an indigenous movement, still of modest proportions, arose with the goal of diversifying sources of economic income in a manner which would help revitalize Quechua culture and self-identity. In the words of one of the movement's leaders:

> Cultural development of the people has two elements: the dynamization of the human potentialities and the cultural values of the community, and the assimilation of technology and science at the service of the cultural development of the people.[59]

The two villages just mentioned have launched two cooperatives: one to produce ceramics for sale, the other to make rugs, ponchos, and other marketable woolen artifacts. One broad objective is to improve the economic condition of the entire community, not merely that of members of the cooperative. This commitment to communal improvement helps explain certain decisions reached after arduous debate.

The first decision is that new technology will be judged "appropriate" only to the degree that the community at large is able to understand and control it. Specifically, the ceramics cooperative

decided in December 1974 *not* to introduce small electrically powered kilns into the village. The background against which this decision was made is this: Traditional ovens use twigs and wood gathered locally for fuel, but such sources are now becoming scarce.[60] Moreover, this fuel produced uneven temperatures on the inner surface of the kiln, a failing incompatible with good-quality ceramic surfaces. An outside adviser to the cooperative had, through simple experimentation, discovered a simple and workable electric oven. Nevertheless, this specific technology was rejected because it necessitated bringing to the village a portable electric generator which only the cooperative could afford and which only a very few people could fully understand, maintain, and repair. The principle invoked to justify the decision was that only those technologies are "appropriate" which are in harmony with ancient Quechua rural values of mutual help and sharing the benefits in all improvements. After lengthy deliberations, it was decided to adopt a kerosene-fueled oven and to experiment with ways of improving the refractory (or heat-insulating) properties of local clay. The reason behind the choice is that all villagers already possessed prior experience with kerosene, and even the poorest among them could afford the kerosene oven.

The second principle which departed from conventional norms practiced in cooperatives affects the distribution of net surplus earnings. Here again, so as not to create social and economic distance between the producing cooperative and the larger village community, it was decided to assign a share of the surplus to all members of the village, whether they belonged to the cooperative or not.

Both principles have been applied in the wool cooperative as well as that dedicated to ceramics. Interestingly enough, the peasant associations receive partial outside funding.[61] Moreover, the local cooperatives are fully aware of their need to receive limited "technology transfers" from the outside. Nevertheless, for reasons pertaining to the revitalization of their cultural values, they have established a practical criterion for exercising control over the entry of outside technology into their community in ways which harness it to their self-perceived broader value goals. The operation is admittedly small in scale and has not yet proven its viability over long periods of time. Thus far, nonetheless, it clearly illustrates an important principle expounded in a theoretical vein elsewhere in this book: namely, the existence of a vital nexus among value options, development strategies, and concrete policies for the acquisition and assimilation of technology. These Quechua communities in Bolivia have deliberately and explicitly chosen to subordinate technological efficiency to their wider and more basic cultural needs. They have translated ancient Quechua ideals of solidarity and mutual benefit into a working instrument to guide decisions of a financial and technological nature. *Mutatis mutandis*, it is precisely this kind of approach which is

required even of policy-makers in macrodecisional arenas. However modest in scope, the Tiataco-Huayculi experiment is qualitatively important and has value to others as a paradigm.

E. An Experiment in Transferring Technology within a "Developed" Country

Several approaches tried within the United States to transfer technology from one sector of activity to another shed light on constraints met in less-developed countries. Especially interesting is the technology transfer program conducted by the city government of Tacoma, Washington, and known as Totem One. This project, funded by the National Science Foundation, the Bureau of Standards, and private business, aims at enabling a municipal government to institutionalize the transfer of technological innovations made in the aerospace industry to such municipal operations as firefighting, court-scheduling, personnel management, development-planning, information systems, and law enforcement. Dual emphasis is placed on adapting hardware and developing new operating procedures.

The project is described in publications issued by the office of Tacoma's technology coordinator.[62] A few of the principles which guide the Totem One program are worthy of attention. According to joint evaluators, the best technique for achieving technology transfer from the Boeing company to the City of Tacoma is the "process approach." City personnel and aerospace technologists work together to develop mutual confidence. Out of such daily contact come projects and applications which are simultaneously important to the city and lie within the company's technological capabilities. The city has learned that it is futile to have technology salesmen look at its needs; what is required is daily proximity and collaboration between technologists from the transferor company and officials from the transferee city government. Most important, the private company must share the financial risk of shaping technological adaptations which can be used by the city. The city will not purchase new technology unless the supplier has successfully harnessed the pre-existing technology to some city operation, with clear indications that money will be saved or efficiently increased.

A wide consensus now exists that technology developed by private industry in the United States is not being optimally used outside industry. Hence, financial support from the federal government or private foundations is needed, in most cases, to subsidize technology transfer to cities. The number of cities which are receiving such support and attempting to replicate, at least in part, the Tacoma experiment, is growing rapidly. Thus the city itself comes to be viewed as an urban laboratory. The lesson is that, even within the United States, technology transfers do not function simply on commercial

market lines; government subsidies and deliberate policy intervention are required. All the more reason why promoters of transfer in less-developed countries should recognize the role of deliberate science- and technology-planning allied to subsidies operating outside pure market mechanisms.

* * *

Technology policies are discussed in later chapters. Before they are, however, some attempt must be made to assess the price paid in social dislocation and human suffering by "receiving nations" for their technology transfers. This assessment, however tentative, must take into account the constraints at work in the mechanisms and channels for technology transfer from industrial to Third World countries. These mechanisms have now been examined, as have the criteria employed by transnational corporations as suppliers of technology. And the case studies concretely illustrate the workings of these mechanisms and criteria. The high price paid by Third World societies for technology transfers is the topic of the next chapter.