discount all outside dissatisfaction with the SVCP by attacking the motives of their critics. Certainly the academic community harbors no natural liking for the contract mechanism and planned research of the type represented by the SVCP. But instead of trying to counter the antipathy by exposing the program to outside advice, the higher echelons of the SVCP hierarchy seem instead to have retreated to a closed world of charts and systems analyses, where cancer vaccines can be developed in five phases and three subphases. The charts, which are regarded as a harmless absurdity by the active scientists in the program, are symptomatic of the NCI administrators' divorce from reality, of their failure to provide scientific direction for the SVCP, and to straighten out its organizational confusion. But to let outside air into the SVCP, to switch some of the research-type contracts over to a grant mechanism, to start a sensible training program, and to switch more resources to basic cell biology, are approaches that seem politically foreclosed. Says a virologist close to the SVCP, "The NIH heads have tried so hard to persuade Congress that everything was ready, they are not now in a position to take the long-term view." The moonshot design of the SVCP was from the start a gamble that cancer would prove to have a short-term solution, in the form of a viral cause and a vaccine cure. But many biologists believe a longer-term view is necessary.—NICHOLAS WADE

Chile: Trying to Cultivate Small Base of Technical Excellence

Santiago, Chile. A successful candidate for the Chilean presidency in the 1930's stood on the simple platform, "Bread, a Roof, and Shelter." President Allende's manifesto in last September's election was a good deal more complex than that, but the issues for the majority of people in Chile remain simple. To the casual visitor, Chile is a country blessed with all the advantages—good climate, fertile soil, and at least some of the comforts of modern technology. In the pleasant suburbs of Santiago, it is not too difficult to forget the submerged mass of the people, those who voted for bread and shelter in the 1930's and for Salvador Allende in 1970.

Chile's needs in science and technology reflect the political realities more closely than is the case in many developed countries. One can produce a science policy simply from the balance sheet of foreign trade. For years Chile has had to import food. Despite the fertile central region, large numbers of her 9.5 million people are, by any standards, underfed. The need to increase Chile's domestic production of food is now urgent, since foreign exchange is short, the external debt needs refinancing, and wage increases have sent many of the poor clamoring for a better diet. On the other side of the ledger, it is important to increase copper exports, which make up more than 80 percent of Chile's foreign exchange earnings and which are now for the first time entirely in the control of Chileans. There is also a need to increase the efficiency of manufacturing industry, but in a way that does not reduce employment opportunities. Socialist Chile, with 150,000 people out of work, has little need of technology that increases production only at the cost of jobs.

These aims are easily jotted down, but putting them into practice is another matter. Chile's universities tend to concentrate on pure science, little of which is likely to be relevant to the needs of an underdeveloped country. Chile is an important center for research in optical astronomy because of the exceptional viewing conditions in the coastal mountains of the north. There are four major international observatories in the Chilean Andes, and three big telescopes are under construction. But as basic science, astronomy does not contribute significantly to the country's technological development or to employment. The United States is participating minimally in Chile's technological development; it has no formal, bilateral scientific agreement with Chile such as the one recently concluded with Brazil and the one soon to be signed with Argentina. The National Academy of Sciences has been conducting workshop discussions between U.S. and Chilean scientists on how to coordinate scientific work with government planning, but these are not seen as a prelude to any new cooperative programs.

There is almost no domestically inspired technology—industry does no research at all—and for years Chile has depended on the international community, through U.N. agencies or bilateral agreements, to provide funds for technological development. The result has been to provide Chile with a small core of technical institutes that can, in principle at least, carry out their own development programs. All too often, however, these institutes have failed to make the transition from United Nations development programs (UNDP) to full-fledged national laboratories once the technical assistants have pulled out. The confusions of politics, the difficulties of supplying manpower, the simple failure of will—all have something to do with this. Furthermore, it is by no means certain yet that Chileans recognize the importance of supporting the few centers of technical competence the country possesses.

Chile's major technical institute, the Instituto Technologica (INTECH) was set up by CORFO, the country's development corporation, in 1968. The original concept for the institute, which has laboratories in a beautiful setting in the foothills near Santiago, was to carry out research for industry under contract. But industries that do no research themselves are usually unwilling to pay anyone else for doing it for them, and more than 90 percent of INTECH's funds (now $1.1 million a year) have come directly from CORFO. INTECH now employs 120 people, 70 of them professionals, and is expanding rapidly, with laboratories, pilot plants, and new buildings going up next year.

Like other branches of the Chilean government since the Allende victory last year, INTECH still seems to be seeking an identity. In true Chilean fashion, almost all of the senior officials were replaced after the election last year, and the result has been confusion. Astonishing as it may seem, the

Renovating Rocky Flats

Recent developments, including the resignation of its manager and the announcement of a $150 million modernization program, spell major changes for the Rocky Flats plutonium weapons plant near Denver. This plant has been a long-time target of local criticism (see *Science*, 5 November 1971).

At the same Denver press conference on 6 December where AEC Chairman James R. Schlesinger made the now-famous remark that the AEC had a "moral responsibility" to Grand Junction, Colorado, homeowners whose houses were built on uranium tailings, he also announced AEC plans to modernize many of the buildings at Rocky Flats. Production of plutonium bomb triggers at Rocky Flats—which is operated by the Dow Chemical Company for AEC—has increased with the establishment of the multiple independent reentry vehicle (MIRV) program. Nevertheless, the 20-year-old plant has often been criticized as being unsafe for both Denver area residents and plant workers.

The primary purpose of the modernization will be to reduce risk of workers' exposure to plutonium—a bona fide carcinogen in dogs and a potential carcinogen in man. Refurbishments will include: "hot cells," or shielded areas where remote control handling techniques are used; additional floor space to reduce crowding of men, equipment, and radioactive materials; and inert gassing of glove boxes to replace oxygen, thus minimizing possible spread of fires. Worker safety has been an issue at Rocky Flats ever since the plant suffered a $45 million fire on 11 May 1969 which AEC officials have admitted was a near catastrophe.

In a related development, the general manager of Rocky Flats, Lloyd Joshel, has announced his retirement. He is 57. He will be replaced by a man from the Dow home office in Midland, Michigan, James H. Hanes. Joshel held the top job at Rocky Flats at the time of several troublesome incidents, including the discovery of leaks of plutonium particles to nearby soils, the 1969 fire, worker strikes, and a continuous hailstorm of adverse publicity. Dow is at present negotiating the renewal of their fixed-fee contract to operate the plant for the AEC, and there has been some speculation that Joshel's retirement is related to AEC pressure for better management at Rocky Flats. Asked at his press conference whether the change of command reflected AEC dissatisfaction with safety precautions at Rocky Flats, Chairman Schlesinger declined to comment directly. He simply said that Dow contract negotiations were under way, and that discussions with contractors involve "getting the best possible management."

Finally, using Rocky Flats as an example, the Environmental Protection Agency in Washington last week called on the AEC to submit guidelines for siting and design criteria for all plutonium handling facilities.

In a commentary released last week on the AEC's draft environmental impact statement for its new plutonium recovery facility at Rocky Flats, the EPA called for much more detailed information. On the basis of the AEC statement, EPA said, "it is not possible . . . to arrive at definitive conclusions regarding the environmental impact of the proposed facility."

EPA noted that the AEC had referred to "guidelines for plutonium processing facilities," but tersely added, "We would appreciate an opportunity to review those guidelines." Rocky Flats is now one of a very few installations that handle plutonium, but the AEC plans a large increase in the number of plutonium handling plants when the fast breeder reactor program becomes a main source of national energy in the 1990's.

EPA also criticized the AEC for inaccurate statements and statistics on plant wastes and other features. For example, it noted that the AEC claimed that the distance from Rocky Flats to downtown Denver was 23 miles. EPA noted that this was the driving distance on local highways, not the 15.8 mile air route which—presumably—radioactive particles escaping from the plant might actually take.—D.S.

government appointed as director of its premier technological institute a man who had previously been a primary school carpentry teacher, Uldaricio Acoste. By all accounts, he is still somewhat confused by his new job, and visitors are tactfully passed on to his deputy, sub-director José Valenzuela.

Valenzuela, a cheerful, bearded man, does his best to explain what INTECH is all about. He sees it as an interface between the productive system, represented by CORFO, and the science and technology system, represented by CONICYT, the state planning agency for science and technology. "Chile's productive needs are determined by the basic needs of the community," says Valenzuela, "and technology, in turn, has to reflect those basic needs. We're not interested in technology for its own sake." He divides INTECH's functions into three areas: education, by which he means the training of research workers; "technological implementation," which means introducing new technology into Chile, usually from abroad; and information. In addition, INTECH is responsible for part of the national information system CONICYT is putting together.

Valenzuela believes that it is important for Chile to be selective about the technologies it adopts, because in the long run they may determine social values and the shape of society—as the automobile has in the United States, for example. At INTECH there are groups working on food technology, plastics and polymers, mechanical and industrial design, the metallurgy of copper, dehydration of vegetables, and the refrigeration of mollusks. Patents have been taken out for a method of leaching copper from ores, as well as for the dehydration and refrigeration projects.

Laboratories at INTECH are well designed and equipped, although things may be more difficult from this year on, now that the annual dollar budget (previously worth $200,000) has been stopped. Dollars are in such short supply that nobody is being allowed any this year, which may make it difficult to buy new equipment.

Chile has a number of other institutes, some of which derive directly from aid received from the U.N. agencies. Although INTECH itself is small ("Either we grow quickly to 200 people or we continue to be inefficient," Valenzuela admits cheerfully), most of the others are smaller. The only one that is bigger is the well-equipped agricul-

tural institute, with an annual budget (1968 figures) of $2 million.

The most successful of the institutes receiving international aid seems to be the Fisheries Development Institute (IFOP), which originated as an FAO (U.N. Food and Agricultural Organization) project. Chile has one of the longest coastlines in the world, 4200 kilometers from the semitropical desert regions in the north to the Antarctic in the south. Along most of the coast, the fishing is good but not exceptional; Peru, to the north, gets most of the benefit of the Humboldt Current and has the world's largest fishing industry.

There are plenty of ways in which the IFOP can help improve Chile's fishing industry. At present, large quantities of high-quality fish are turned into cheap fish meal instead of being sold as prime protein. (Part of the explanation for this may be that 10 years ago the Chileans were persuaded by an American "adviser" to invest in $50 million worth of fish meal equipment in which, it later turned out, he had a financial interest. Most of the machinery has lain idle ever since.) Chile's mussel fisheries are in danger of being fished out, unless a technique for growing mussels artificially on rafts can be perfected in the next 10 years. Attempts are being made to revive the oyster beds, destroyed by an earthquake in 1960. The anchovy catch, most of which goes to fish meal plants and is fed to chickens, could instead be exported to the United States or to Europe. Attempts are being made to introduce salmon to new areas and to culture crabs.

But IFOP's major achievement has been the development of a new method for extracting protein from fish. It produces a soluble protein concentrate that can be added to soft drinks or pasta to provide extra protein in Chileans' diets. At the moment, Chile is importing powdered milk so that each Chilean child can have half a liter of free milk every day—the soluble fish protein could help to reduce this import bill.

If a plan before the Chilean Congress goes ahead, IFOP will become part of a totally new ministry, the Ministry of the Sea. The idea is to combine the activities of fishing, maritime transport, and the ports under a single roof, and the moving spirit is a Social Democratic member of the coalition, Humberto Martonez, regarded in Santiago as something of a hustler. If he gets his way, he will be the new minister, in charge of a substantial part of Chile's economy—26 ports, the world's seventh largest fishing industry, and a substantial if obsolete merchant marine.

Enthusiasm for the idea is not universal. The Chilean Ministry of Public Works and Transport, indeed, has prepared a confidential memorandum denouncing it. The only thing that fishing and maritime transport have in common, it declares, is the basic medium in which they operate, the sea. In all other respects, they differ diametrically. By separating maritime transport from other forms of transport, it will make it difficult to produce an effective transportation policy for Chile as a whole.

Whether Martonez or the Ministry of Transport has its way remains to be seen. Indications are that the Communist Party, the most disciplined and hardheaded in the coalition, is against Martonez—it is said to have seen and approved the Ministry of Transport memorandum. If this is so, the Ministry of the Sea may yet turn out to be a nonstarter.

Copper Industry Is Largest

Copper is easily Chile's largest industry, but it is the one Chileans know least about. Until recently, the big copper mines were run by American companies (Anaconda, Kennecott), but with Christian Democratic support, Allende put through Congress a bill nationalizing them. Now the Americans have left, and the Chileans have to run the copper mines themselves.

It is vital to Chile that both the price and production of her copper be maintained at the highest possible level. But copper production has suffered seriously since Allende took the reins. Virtually all of the top technical and managerial personnel left the two largest mines, Chuquicamata and El Teniente, when the government lowered ceilings on salaries and started paying in escudos instead of dollars. Most of these personnel have found jobs in other countries, leaving a shortage of skilled manpower at the mines. The total output this year was the same as last, largely because two new mines came on stream and made up for shortfalls at the two traditional mines. There is not much Chile can do about the price of copper, which is settled daily on the London Metal Exchange. At the moment, it is down so low that Chile's mines are operating on a small margin of profit. Years of American ownership have ensured that the copper miners are the best paid workers in Chile, accustomed to having their wage demands met. So this year, Socialist government or no, they put in for a 50 percent increase—which would add another 6 cents to the price of every pound of Chilean copper and just about push the Chilean mines into the red.

Chile's first attempt to set up a technological institute to deal exclusively with the problems of copper is now in progress under an international aid contract from UNDP and with financial assistance from the government of Belgium. The Mining and Metallurgical Research Center will be built, rather incongruously, in a suburb of Santiago, Las Condes, and should be complete by the beginning of 1972. By 1975, there should be 180 to 200 people working there, 40 to 50 of them with engineering or doctoral qualifications. Four million dollars will be spent equipping the center, and the director will be Carlos Landolt, a Chilean Ph.D. from Pennsylvania State University.

The center will carry out technological studies aimed at helping Chile's copper industry in the most direct way possible. "The situation is not going to move ahead by sophisticated programs in basic research," says the U.N. adviser on the project, W. Charles Cooper, a Canadian. Previously, he says, the Chileans have done little work in extractive metallurgy; now, for the first time, it will be possible to offer Chilean engineers a career in applied research, helping their own copper industry. Getting the right people is a problem that concerns administrators, and as one of them said: "No amount of international aid can do much good if the people are not good enough."

So far, the center has had a good start. It has run into no political problems—always a risk in Chile—and the first few staff appointments have been made. Work has already begun on a study of the stability of slopes in open-pit mines (at Chuquicamata), on electrochemistry, on the maximum recovery of metal from the ores at the Exotica mine, and on smelting metallurgy.

Perhaps all such projects start in hope and end in disappointment. This time, hopefully, now that the Chileans are on their own, they will take care to see that the center flourishes. Chile has few enough centers of technical excellence and cannot afford to neglect the ones it does have. Without them, it will never manage to escape from the politics of dependency that Allende's government rightly despises.

—NIGEL HAWKES