ber. The plan would have the cotton belt divided up into nine zones, with the eradication effort to begin in West Texas. A total of 377 persons, mostly local people to be hired especially for the campaign, would be fighting the boll weevil just in this one region. Some 750,000 acres of cotton would be treated there, and, before the belt-wide campaign ended, it would have reached to more than 10 million acres.

The campaign would advance eastward from West Texas, and, after 2 years, a "second front" would be opened in Virginia and the Carolinas, with this front to advance southward. If all went well, the boll weevil fighters on the two fronts would eventually meet in the mid-South, like the meeting of the Russians and the Americans on the Elbe.

Newsom of LSU, possibly the cotton belt's most outspoken critic of the proposed boll weevil eradication, is convinced that, once begun, the campaign would fail but that it would not die, at least not for a long time. He compares it to some other insect eradication efforts that have failed. "I know we have spent at least $150 million on the fire ant," he says. "The infestation continues to spread, yet we continue to spend money on this ill-advised program."

In a boll weevil eradication campaign, he adds, "there will be failures, as in the fire ant program. They will be explained away. 'Just give us more funds.' This thing will last for decades. We are a long suffering people." Among those to suffer most, Newsom suggests, are those agricultural scientists who would find adequate funding denied for many promising research endeavors because of the high priority given to boll weevil eradication research.

As for what he thinks desirable for control of the boll weevil, Newsom favors some of the same methods that would be used in the eradication effort, but he would avoid heavy application of insecticides for diapause control. "The heavier the pressure put on a species, the more likely you are to bring out inherent resistance," he observes. In his view, the USDA and the cotton industry should be giving greater emphasis to the development of varieties of cotton that are resistant to the boll weevil.

Top officials of the USDA speak cautiously about the proposed eradication campaign. "The eradication program is down the road a few years," T. W. Edminister, administrator of the Agricultural Research Service, told *Science*. Edminister even suggested that "eradication" might not be the right word and that some more modest goal could be in order. Secretary Butz also is reported to have received the eradication proposal with reserve. Ultimately, the question whether the government is to launch a massive attack on the boll weevil may have to be decided in Congress.—LUTHER J. CARTER

Computer Sales to U.S.S.R.: Critics Look for Quid Pro Quos

A large scientific computer sold to the Soviet Union by a British subsidiary of Control Data Corporation has been used by Soviet weapons designers to reduce by 2 years the development of their first MIRVed missile. So at least a Georgia Republican, Representative Ben B. Blackburn, announced last December on the advice of a source which his staff declines to reveal.

In as far as Blackburn's story can be independently checked, it seems to be erroneous in detail and probably unreliable in origin. But as beneath other fantasies, there lurks a serious issue. The Nixon-Kissinger policy of détente with the Soviet Union involves the construction of an elaborate web of relationships, a vital strand in which is the regularization of trade. Following the 1972 agreements on science and technology and on trade, the Soviet government has been seeking, and in many cases obtaining, the items of advanced technology which characterize one of the American economy's major strengths over the Russian.

Whatever the overall advantages of détente, the trade in high technology seems to many to be too much of a one way street in the Soviets' favor. The Pentagon is concerned that items such as computers may be diverted directly to military applications or, by bolstering the civilian side of the economy, may free resources for military use. Company officials fear that the Russians will follow their traditional practice of buying only prototypes or production technology and then going into manufacture themselves. "If the businesses of the United States engage in a series of one-shot technology know-how sales, our economy will very quickly have traded all it has to trade in the way of high technology," Texas Instruments vice president J. Fred Bucy told a House committee in December. Economists note the difficulty of meshing Soviet business habits into the Western economic system; the wheat deal, for example, quite apart from the fact that the U.S. Department of Agriculture allowed the nation to be stolen blind by astute Russian trading, showed how great a disturbance the Soviets could cause on Western markets. There is widespread feeling that the Russians are now placed to get more than they give. "Though our restrictions of the cold war period did not serve U.S. interests well, it does not follow that the simple removal of such restrictions will serve our interests much better. The distribution of the economic benefits from détente may be so unbalanced as to threaten the process of détente itself," says Raymond Vernon, director of the Harvard School of International Affairs, in the current *Foreign Affairs*.

Just what is U.S. policy on the sale of high technology goods? Computers afford a convenient test case, since they have a military as well as general economic significance, and are a field in which the United States has a clear lead over the Soviet Union—reckoned as 2 to 3 years by Soviet sources, and 5 to 10 years by most American analysts. Since the beginning of the cold war exports to Iron Curtain countries have been regulated by an elaborate system operated by the Office of Export Controls (now renamed the Office of Export Administration) in the Commerce Department. A company wishing to export a computer to the Soviet Union first consults a document known as the Commodity Control List which lists the benchmark parameters above which an export license must be applied for. Applications are considered at the weekly

meeting of an interagency committee on which are represented the departments of State, Commerce, and Defense, the Atomic Energy Commission, the Central Intelligence Agency, and the National Aeronautics and Space Administration. The committee takes into account the power of the computer, and its end user, trying in particular to assess the user's *bona fide* need for the machine requested, the likelihood of diversion to military use, and the safeguards, if any, which the company should write into its contract.

If approved by the interagency committee, the application is then considered by the Coordinating Committee on East-West Trade (COCOM), an organization consisting of NATO member countries minus Iceland plus Japan. COCOM holds weekly meetings in Paris under the auspices of the Organisation for Economic Cooperation and Development (OECD). The U.S. list of forbidden exports is generally more restrictive than the COCOM list, although less so since the passage of the Export Administration Act of 1969 and the Equal Export Opportunity Act of 1972. Although the U.S.S.R. presumably knows what it can and cannot buy from the West, the COCOM list is a classified document.

Just how well the system has achieved its purpose is hard to say. Vernon describes it as an "Orwellian mesh of bureaucratic controls" whereby the Soviet bureaucracy "was treated to a dress rehearsal of what would happen if an embargo were applied by force of arms, and one can be sure that it profited from the rehearsal." The two acts passed during Nixon's first administration had reversed the emphasis of the controls from a policy of "you can't export unless there is good reason otherwise" to "you can export unless there is reason not to." Officials in the departments of State and Commerce stress that the controls are not intended to be an instrument of economic warfare. The Pentagon sees it from a somewhat different angle. According to Maurice J. Mountain, director of strategic trade and disclosure in the Department of Defense, "Our implicit assumption is that the Soviets are chronically hostile. The West's advantage is qualitative, not quantitative. The idea of export controls is to maintain that advantage by retarding the rate at which other countries catch up."

Decisions on which computers to let the Soviets buy seem to be marked by a certain degree of latitude, which insiders call judgment and outsiders call ad-hoccery. "There are no rigid standards. Getting a license to export depends on how much weight you can throw or whether your timing is right, like if Nixon has just made a visit to Moscow," says Wade B. Holland, editor of the Rand Corporation's *Soviet Cybernetics Review*.

A landmark decision in which weight played its part was the permission given in 1970 to the British International Computers Limited (ICL) to supply two ICL 1906A's to the Soviet particle accelerator at Serpukhov. The decision, which wound its way up through the Washington bureaucracy and was eventually resolved by the President, has been described in some detail by Howard Margolis, a former member of the Institute for Defense Analyses and now at MIT.* The Russians first asked for a Control Data Corporation CDC 6600 computer, the machine used at most Western high energy physics laboratories. The inclination in the interagency committee was to reject the request but the issue was foreclosed when the AEC bowed to congressional pressure and promised the Joint Committee on Atomic Energy that the computer would not be released.

Dispute over British Sale

The Russians then applied to the British for two ICL 1906A's, the equivalent of a CDC 6600, but the interagency committee, which works out American positions for COCOM, vetoed the British application. Prime Minister Heath, apparently after having been advised that the American position was taken by relatively low-level officials and was quite irrational, took the issue up with President Nixon, and the case was reopened.

The decision came back to the President in the form of a "split paper," with a number of agencies, lead by the Defense Department, opposing the sale and others, lead by State, supporting it. Defense's position was that the computers, if clandestinely used for military purposes, might possibly give a strategic advantage to the Soviet Union and that the available safeguards against diversion were probably not foolproof. State, however, won the argument largely because of an analysis performed by the Office of Science and Technology (OST). The crucial question, in OST's view, was not the imponderable risks being thrown up by Defense, but: Assuming the Russians were to cheat at Serpukhov, how much could this add to their capacity for doing military calculations? The two ICL 1960A's were equivalent to about four of the best computers the Soviets were known to be producing, the BESM-6. It would hardly be possible to divert more than a quarter of the machines' time without it being obvious that something was going on, since Serpukhov was to be an essentially open installation. Hence the advantage to the Soviets of cheating would be comparable to what they could gain from building one extra BESM-6. Once OST had posed the question in this way, Defense's objections became irrelevant, Margolis says.

The British were allowed to make the sale, but safeguards were nevertheless written into the contract. The Russians agreed to a request that ICL technicians should have access to the computer at all times and be able to take "core dumps" (transcriptions on tape of the machines' memory content) at random intervals. (The State Department was intrigued that the Russians accepted this stipulation without demur—it was the first time they had agreed to the principle of on-site inspection.) The core dumps and presumably other kinds of data, such as the computers' work log, are passed by ICL to the British Board of Trade for analysis.

Since then, similar safeguards have been attached to other computers sold to the Soviet Union. Officials in the departments of State, Commerce, and Defense are reluctant to say how or where the feedback from these safeguards is analyzed or whether any indications of diversion have been turned up. What seems to be the case is that in several instances there has been ground for reasonable suspicion of illicit use: in some of these instances the suspicions have been cleared up, in others they still remain. Officials in State, Commerce, Defense, and the White House, all of them in a position to know, said they were aware of nothing to support Representative Blackburn's charge that Serpukhov machines had been used for military computations.

Export controls have probably prevented the Russians from making any significant illicit use of computers obtained through normal commercial channels. Computers, however, can be bootlegged just like anything else, and the Soviets seem to have acquired several items long before they were removed from the COCOM list, including computer peripherals and even an IBM 360/40. Judging from the number of convictions, there is a fairly brisk trade

* H. Margolis, *Notes on Technical Advice on Political Issues* (National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22151, April 1972).

in smuggling embargoed items to the Soviet Union.†

How much assistance bootlegged equipment may have given the U.S.S.R. in developing its own computer industry is far from clear. The most advanced known Soviet computers, the Ryad series, are apparently modeled on the IBM 360 series to the extent of being compatible with it. Hugh Donaghue, an assistant to the president of CDC and maybe not the most impartial of sources in this respect, has been quoted as saying that copying the IBM 360, rather than pursuing their own logic and designs, was what has hurt Russian computer development most.

To copy the IBM 360 series would have required only a general knowledge of the system's philosophy, not necessarily possession of an IBM machine, says Wade Holland of Rand. In his view, the Russians are quite capable of matching anyone else in computer design; where they lag is in the technology of mass production. The Ryad series is seriously behind schedule, and there is no evidence so far that even the early members of the series are being produced in large quantities. The Ryad 10-60, largest of the five-member series, is still in the design stage.

If the Russians succeed in getting the Ryads into mass production, they will have taken a giant leap forward to where the United States stood in the mid-1960's, when third-generation computers first came onto the market. What little is known about the Ryad series computers suggests that they are badly designed for ease of production. The wiring is so complicated that photographs of the back panels look like spaghetti. "It appears there is a gross lack of sophistication," says Holland.

Soviet negotiators often try to make exchange of production know-how a condition of deals with American companies. Recently, CDC signed a 10-year agreement with the U.S.S.R. Council of Ministers for Science and Technology leading to "possible development" of an advanced computer. CDC board chairman William C. Norris defended the deal in a letter to the *New York Times* last 10 November, arguing that most of the technology U.S. firms can provide is already available from other Western countries. But deals such as this have created alarm in several quarters. Malcolm R. Currie, director of Defense Research and Engineering, has launched a campaign to prevent American companies from selling unique production technology to the Russians. "We need a clarification of our national policy," Currie said in a recent speech to military contractors.

Currie's fears derive from the proposition that the Soviet Union has always been dependent on imports of manufacturing know-how from the West and that it is now in one of its periodic phases of buying massive quantities of production technology. This hard-line thesis has been made academically respectable in a series of books by Anthony C. Sutton of the Hoover Institution.‡ Documenting Soviet imports of Western technology in 17 basic industries, Sutton argues that "virtually all widely applied (i.e. innovative) technology in the Soviet Union may have originated in the outside world." But for the past 50 years, whenever the Soviet economy has reached a crisis, Western governments have come to its assistance. In the early 1930's, the Russians used firms like Ford, DuPont, and General Electric to catch up on the technology for producing trucks and tractors, heavy chemicals, and radios. In the 1950's, there was a great surge to import the Western technologies of producing fertilizers and synthetic fibers. The U.S.S.R. is now making wholesale purchase of the technologies for automobile production and branches of electronics, particularly computers.

The departments of Commerce and of State, which institutionally are proponents of trade normalization and détente, deny that a technology handout is in process. "The problems of establishing effective control over technology are formidable. . . . Fortunately, there is industry self-interest in restricting the flow of proprietary know-how on a free or unreimbursed basis that complements the government's national security interest in controlling exports of data," a House committee was told in December by Steven Lazarus, deputy assistant secretary of Commerce for East-West Trade. The same committee heard from the State Department the interesting argument that the Soviet Union would be prevented by "cultural barriers" from challenging the United States' market lead in high technology. According to John V. N. Granger, deputy director of the Bureau of International Scientific and Technological Affairs:

> The "cultural barriers" to Soviet exploitation of U.S. technology are particularly significant. . . . We Americans often fail to appreciate the extent to which our technology and its myriad applications reflects the very nature of our society, with our characteristic freedom of movement of both persons and goods, the universality of our individual familiarity with technical gadgets, and the incentives for personal enterprise which are the driving force of our economy. . . . We do not believe . . . that the Soviet Union, even when strengthened by greater access to U.S. technology, will in the foreseeable future threaten the U.S. position in the world market for the products of advanced technology.

Whatever the merits of this argument, export controls of computers and other items of advanced technology have been steadily relaxing and will do so further. The relaxation seems to date back at least 5 years and was not especially influenced by the rather vague 1972 agreements with the Soviet Union on technology and trade, although the volume of trade has increased sharply since then. (In total trade with the Russians, East Europeans, and Chinese in 1973, the United States achieved an estimated trade surplus of some $2 billion.) Overall policy decisions are made by the East-West Trade Policy Committee, established last March and, in effect, codirected by Secretary of the Treasury George P. Shultz and Secretary of State Henry Kissinger. At a less lofty level, the White House Council on International Economic Policy has nearly completed a specific review of the controls on computer exports. According to a member of the review group, the recommendations will lead to a further easing of controls. For the present, however, officials charged with the day-to-day decisions of which computers to let the Soviets have and which to embargo seem to be guided not so much by any clear-cut policy as by precedent, judgment, and intelligence evaluations (which seem to be scanty) of what the Russians can produce for themselves.

This may constitute a policy, but it is one with a blurred and moving outline that is not too easy to represent to critics. Granted that high technology trade is a necessary part of détente, the present procedure seems reasonable on national security grounds and of probably limited risk on commercial grounds. But should détente prove a temporary phase, the Soviet Union will have bought in a lot of high technology without having given anything very much in return.—NICHOLAS WADE

† For example, a Viennese entrepreneur, Walter Basta, was discovered last year to have obtained a strategic neutron generator of U.S. origin by stating it was to be used by a technical university in Ankara, Turkey. Once the generator had arrived in Ankara, Basta reshipped it to Vienna and thence straight to Moscow. Penalties for infringing U.S. export control regulations are truly Draconian. Basta was denied all U.S. export privileges for a whole 60 days.

‡ *Western Technology and Soviet Economic Growth*, vol. 1, *1917–1930*; vol. 2, *1930–1945*; vol. 3, *1945–1965* (Hoover Institution Press, Stanford University, Stanford, Calif.). The most recent volume was published last year at $15.